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CONTENTS

Foreword	7
1. Benedict Valentine ARULANANDAM, Beata GLINKOWSKA-KRAUZE, Pei Yu TAN – The impact of working capital management on manufacturing firms’ profitability – an emerging market perspective	9
2. Inna BALAHUROVSKA – The use of technologies in different forms management ..	33
3. Robert BALCERZYK, Karolina GABOREK – Talent management in sport	43
4. Honorata BALICKA – Digital technologies in the accounting information system supporting decision-making processes	57
5. Jolanta BARAN, Iwona ŻABIŃSKA – Analysis of the environmental impact of the vertical parking solution using life cycle assessment	91
6. Agnieszka BARCIK – Selected aspects of crisis management in the workplace with regard to pandemic challenges	105
7. Maciej BIELECKI – Reverse logistics at home appliance manufacturers in Europe and Poland – challenges faced by the industry	125
8. Justyna BOGOŁĘBSKA – Capital structure of Polish joint stock companies in the process of internationalization	145
9. Magdalena BSOUL-KOPOWSKA – Determinants shaping the sense of work satisfaction in uniformed services	157
10. Agnieszka BUKOWSKA-PIESTRZYŃSKA – Circular economy implications for e-commerce – an example of individual returnable packing	173
11. Tomasz CZAKON, Danuta ŚLĘCZEK-CZAKON – The presence of ethics in management textbooks	185
12. Wojciech DOMAGAŁA, Olga BUCKIŪNIENĖ – Alternative transport routes from Europe to Asia after the outbreak of war	201
13. Agnieszka DZIUBIŃSKA – Interaction of schemata and routines – the missing link between theory and practice of organizational dynamics	215
14. Piotr DZIWIŃSKI – Leadership and managing stress in the organization	233
15. Bożena GAJDZIK – Industry 5.0 as a new concept of development within high volatility environment: about the Industry 5.0 based on political and scientific studies ..	255
16. Bożena GAJDZIK – Kaizen in smart manufacturing (SM) projects: framework and examples of improvement areas	281
17. Magdalena GOSTKOWSKA-DRZEWICKA, Ewa MAJEROWSKA – Capital structure vs financing rules – the Visegrad Group countries	301
18. Fabio GUALANDRI – Self-emergent supply chain resilience? A case of industrial strategy in critical times	319
19. Piotr HETMAŃCZYK – Barriers and determinants of restructuring employment in the mining industry under the just transformation mechanism. Interviews results ...	333

20. Bartłomiej JABŁOŃSKI, Dorota KIKA – Impact of the Covid-19 pandemic on the rates of return of selected WSE listed companies	351
21. Marlena JAWORSKA – The classification of the capabilities of the firm	371
22. Dorota JENDZA – Individualist and collectivist behaviour in public and business organisations	383
23. Monika JURGA, Anna ZABŁOCKA-KLUCZKA – Technical education and experience of a leader as a determinants of team work effectiveness in IT projects	401
24. Agata KLAUS-ROSIŃSKA, Małgorzata KARPOWICZ – Risk management in social projects	421
25. Agnieszka KRAWCZYK-SOLTYS – The influence of personal competencies on organizational competences of Emergency Medical Units	439
26. Dorota KUCHTA, Oksana YAKIVETS – Situational student research projects management	451
27. Anna LAMEK – Dropshipping in the age of the Internet – does it really work in crisis?	467
28. Aleksander LOTKO – Scores and opinions about car maintenance and repair shops as an example of word-of-mouth marketing in digital social networks	479
29. Rafał MATWIEJCZUK – An attempt to the classification of firm competences	497
30. Katarzyna MAZUR-WŁODARCZYK – Ecological civilization with Chinese characteristics – a bibliographic analysis	507
31. Jerzy MIKULIK, Mariusz NIEKURZAK – Impact of a photovoltaic installation on economic efficiency on the example of a company with high energy consumption ...	521
32. Aldona MUSIAŁ-KIDAWA – The idea of human rights according to Leszek Kolakowski. Prolegomena	541
33. Janet Awino OKELLO, John Ayieko AKOKO – Smart City trends and innovations shaping the future of cities	553
34. Maciej PAWŁOWSKI – Development of the public infrastructure of EV charging stations in Poland	563
35. Roman PIETROŃ – Management system structure vs. behavior – a supply chain simulation analysis	575
36. Wioletta POMARANIK, Agnieszka SULKOWSKA, Magdalena KLUDACZ-ALESSANDRI – Talent management practices – empirical evidence from Polish healthcare entities	599
37. Jerzy RÓŻAŃSKI – The policy (strategy) of financing Polish joint stock companies, in the context of their internationalization	623
38. Agata RUDNICKA, Dominika KACZOROWSKA-SPYCHALSKA, Janusz REICHEL, Monika KULIK – Current concerns in digital economy era. Lessons learnt form Polish advanced internet users	637
39. Rafał SAWICKI, Anna ZABŁOCKA-KLUCZKA – The Covid-19 pandemic as a moderator of relationship between applied project management methodologies and employer brand attractiveness	655

40. Bartosz SZCZEŚNIAK – Online forms and spreadsheet as means to support the ABCD method	679
41. Łukasz WAWRZYNEK – Network of trust relationships in the remote work model ..	691
42. Antoni WILINSKI, Ravindra SHARMA , M.K. ARTI – Covid-19: pandemic management in different parts of India	707
43. Radosław WOLNIAK – Innovations in Industry 4.0 conditions	725
44. Radosław WOLNIAK – Team innovations	743
45. Monika WOŹNIAK, Piotr SLIŹ – The impact of project excellence on the level of project maturity of an organization	759

FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Contemporary management. Presented papers contain result of researches conducted by authors from Poland, Ukraine and Malaysia. The number consists of 45 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: production management, talent management, information management, crisis management, Industry 4.0, Smart Cities, logistic, finances, human resource management, circular economy, ethic in management, leadership, project management, quality management, supply chain management, impact of COVID-19 pandemic on management, environmental management, talent management and innovativeness.

Radosław Wolniak

THE IMPACT OF WORKING CAPITAL MANAGEMENT ON MANUFACTURING FIRMS' PROFITABILITY – AN EMERGING MARKET PERSPECTIVE

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Purpose: This study aims to investigate the effects of working capital management on firm profitability of listed manufacturing companies in Malaysia.

Design/methodology/approach: This study uses account payables, inventory turnover, account receivables, cash conversion cycle, firm size, growth, leverage and current ratio as accounting information variables. Secondary data was collected for all variables over a ten-year period, i.e. 2009 to 2018 and was obtained from the annual report published via Bursa Malaysia (Malaysian Stock Exchange) official website. Data was analyzed by using IBM SPSS Statistics Subscription software. Descriptive statistics, correlation analysis and multiple regression analysis were utilized in this study.

Findings: The results revealed that inventory turnover in days, account receivables and firm size have a positive significant relationship with manufacturing firms' profitability, while account payables and cash conversion cycle have a positive insignificant relationship.

Research limitations/implications: The sample size is too small for any generalization. A mixed method approach in the future could contribute to a holistic finding.

Practical implications: Since these variables contained significant influence on firm profitability, it is recommended that listed manufacturing companies should prepare a complete and timely manner of accounting information based on the regulation context in Malaysia.

Social implications: It provides an empirical evidence on the importance of working capital management amongst the manufacturing concerns in Malaysia and its impact on its business sustainability.

Originality/value: This study contributes to the limited research on working capital management involving manufacturing companies in Malaysia.

Paper Type: Research Paper.

Keywords: working capital, profitability, manufacturing companies.

JEL Classification: M00; M20; M41.

1. Introduction

Working capital management has always been a challenge for corporations. Liquidity is crucial and reflects on the performance of the company as noted by Naser, Nuseibeh and Hadeya (2013) and Kandpal (2015). As Masocha and Dzomonda (2016) stressed that working capital is concerned with the day-to-day operations and not long-term commitments, managing investment decisions and the firm's short-term financing are primary functions of managing working capital as noted in corporate finance theories. The study of financial decisions in long-term, including investments, structure of capital or decisions of company valuation have been extensively focused on from past literatures.

The development of strategies to maximize profitability is being seen as necessary by increasing competition among firms. Therefore, the ability of managing working capital is regarded as a special existence to emphasize on. The firm profitability is grasped by good managing of working capital and is essential towards paying of dividends to shareholders (Oladipupo and Okafor, 2013). In addition, a study by Samiloglu and Demirgunes (2008) argued that one of the reasons for bankruptcy among firms is the poor management of working capital.

Problem Statement

Planning and controlling non-fixed assets are included in managing of working capital efficiently. It is associated with the elimination of the risk of the inability to meet with current liabilities (Eljelly, 2004). Managers spend much time in juggling the liquidity on a daily basis in some industries (Rao, 1989). As Joshi (1995) stressed that management of working capital influences firm's profitability.

The cycle of cash conversion is a democratic scale of managing in working capital. The time lag between the expenditure of purchasing the raw materials and the collection of finished goods sold are the main components explained in the cycle of cash conversion. The bigger such lags, increases liquidity risk (Deloof, 2003). Previous studies by Raheman and Nasr (2007), noted that there was a negative correlation of firm's profitability with managing working capital from data collected from 94 Pakistani companies between 1999 and 2004. Likewise, studies by Akoto, Awunyo-Votor and Angmor (2013) also highlighted a similar finding involving 13 companies. In a study of (Falope, Ajilore, 2009), using a sample of 50 listed Nigerian companies on the Nigerian Stock Exchange was examined and found that the correlation of net firm operating profitability associated with the inventory turnover in days, average collection period, cycle of cash conversion and average payment period was shown to have a significant negative relationship.

Nobanee, Abdullatif and AlHajjar (2011), went further and found that between the data collection period of 1990 to 2004, there was a negative correlation of firm profitability associated with cycle of cash conversion. Similarly, Singhanian and Sharma (2014) highlighted that there was a negative relationship between cash conversion cycle and profitability from a study of 82 Indian manufacturing firms from which data was collected between 2005 to 2012. Furthermore Ray (2014), studied that the share of non-fixed assets to total assets of Hindalco company, a key player in Indian aluminum industry varied between 40% to 83%, indicating that the liquidity position of the company over profitability position was due to investments in inventories and receivables.

This study involving manufacturing sector of Bursa Malaysia is limited, owing to the non-attractiveness nature of this topic researchers. Hence, this study scrutinizes the management of working capital by manufacturing companies listed in Bursa Malaysia between the period of 2009 and 2018, which is a period after the global financial crisis.

2. Literature Review

Financial performance measurement

Hofer (1983) stressed that a measurement in financial performance is represented by the sales growth. However, business economic performance can be justified by the importance of return on investment associated with net income growth as well as expected sales growth (Venkatraman, Ramanujana, 1987). Huselid (1995) argued that that a company's financial performance is examined by the essential variables such as concentration in industry, growth of sales, net sales, and intensity of capital in his study. In addition, McGuire et al (1988) noted that there is a positive relationship amongst return on assets, sales growth, and assets growth. The financial performance of a firm can be justified by sales growth which it is deemed as the most essential parameter to examine for (Paquette, 2005).

Financial Performance measurement tools

The financial firm performance is measured by using variety of tools such as, multiple regression analysis (Samiloglu, Demirgunes, 2008), Panel data analysis (Garcia-Teruel, Martinez-Solano, 2007), and pooled OLS regression analysis (Zariyawati, Annuar, Taufiq, Rahim, 2009), etc. in the past. Observation that the financial ratio analysis is one of the important advantages in measuring the correlation between two numbers in the financial statement (Lawder, 1989). The purposes of predicting the unknown in the future that the appropriate measurement will be ratios according to a study by Beaver (1966). A by-product of combined ratios is regarded as a single overall performance measurement by (Coyne, 1986) and

(Cleverley, 1990). The corporate success and failure is predictable by utilizing the measurement tool of ratios (Houghton, Woodliff, 1987). The company's shortage in cash is forecasted with utilizing the financial ratios recommended by Mramor and Valentincic (2003). The firm profitability is increasing due to shortening the inventory conversion period and account receivables cycle analyzed over listed manufacturing firms of Istanbul during the period of 1998 to 2007 with utilizing multiple regression analysis (Samiloglo, Dermirgunes, 2008). The firm profitability is significantly impacted by ratios of receivables turnover, current ratio, ratio of working capital to total assets and liquid ratio in the study of Hindalco Industries Ltd. during the study period of 1990-2007 (Singh, Pandey, 2008).

A correlation of firm profitability associated with managing in working capital proxy and was analyzed in negative but concluded that increasing in profitability with reducing the length of period in cash conversion by using pooled OLS regression (Zariyawati, Annuar, Taufiq, Rahim, 2009). A firm performance associated with market value is increased by efficiency in managing of working capital depends on managers' skill in a sample of 172 Malaysian listed firms with applying multiple and correlation regression analysis (Azhar, Noriza, 2010). There were association of variables in working capital with firm performance was conducted as being negative significantly. The same theoretical framework and observations included in the study of 2,123 listed Japanese corporations for the period 1990-2004 (Nobanee, Abdullatif, AlHajjar, 2011) and 20 automobile industries during the study period of 1996-2009 (Vijayakumar, 2011). The firm profitability is promoted more by reducing ratio of debt and net trade cycle with utilizing ordinary least square regression technique and Pearson correlation technique from 12 manufacturing firms from 2002 to 2006 (Oladipupo and Okafor, 2013).

Firm Profitableness and Cycle of Cash Conversion

Positive

The firm profitability and its value are determined by managing of working capital essentially. A correlation of firm profitability associated with the cycle of cash conversion is found to be significant, statistically (Smith, 1980). A correlation of firm profitability with cycle of cash conversion in smaller size is investigated as being of significant relationship strongly in the study by Hutchinson, Farris and Anders (2007). There was a correlation of firm profitability associated with the cycle of cash conversion studied inversely in retailing firms concluded in his study (Kamath, 1989). The length of the cycle of cash conversion depends on firm size in a study involving retail firms (Moss and Stine, 1993). Shorter of cash conversion will be in the larger firms conducted in the study.

The activity of business must have supported by certain level of necessary liquidity reflecting in the suitability of liquidity position mentioned by Schilling (1996). The return of investing in capital is always more than return of investment, hence managing resources between investing in capital and operation capital wisely is vital in financing investment mentioned in his writings. As a result of maintaining optimum liquidity is important same goes

to managing resources on working capital wisely. Then the association between cycle of cash conversion with liquidity required in minimum existed such that the minimum liquidity required will be increased in the longer time of cycle of cash conversion and vice versa.

The association was found to be positive significantly between cycle of cash conversion and current ratios in the same research. A firm profitability tends to increase due to the decrease in investing in working capital, as revealed by Wang (2002). An association of firm profitability with cycle of cash conversion is found positively significant for sample of 82 listed Greek firms observed in the study by Lazaridis and Lyroudi (2000). Likewise, Gill, Bigger and Mathur (2010) concurred that firm profitability with cycle of cash conversion is positively correlated.

Negative

The firm profitability is found to have impacted significantly by a well-managed working capital as per the analysis of 1,009 Belgian firms between 1992 to 1996 (Deloof, 2003). An association between operating income and the number of account payables in days, inventory and the number of account receivables in days were found to be negatively significantly in Deloof's research. The correlation of firm liquidity and profitability was analyzed as negative in the Saudi Arabian companies from a study of Eljelly (2004). A correlation of firm profitability associated with the cycle of cash conversion is found strongly negative for listed American firms for the period between 1975-1994 by Shin and Soenen (1998). However, firm profitability is affected negatively by holding extensive current assets (Horne, Wachowicz, 2000). Effectively in managing payables, inventory and receivables will lead to business success in the study involving 32 non-financial institutions (Filbeck, Krueger, 2005). The firm performance (as represented by ROA) was examined as negative with the cycle of cash conversion for sample of small-scale manufacturing enterprises in the period of 1998-2003 (Padachi, 2006). The author stressed that, negative impact of firm profitability is due to the high level of account receivables and inventory.

The correlation of firm profitability associated with the cycle of cash conversion with its independent variables for example account payables, inventory and account receivables are observed as significant in the study of 131 listed firms in the period of 2001-2004 (Lazaridis, Tryfonidis, 2006). A relationship between variables of managing in working capital such as cash conversion cycle, average conversion period, profitability and inventory turnover in days are analyzed as negative in the research involving 94 Pakistani listed companies during the period of 1999-2004 (Raheman, Nasr, 2007). The correlation of cycle of cash conversion cycle associated with returning assets was conducted as negative during the study of Spanish firms in the study period of 1996-2002 with two of the fix effect and random effect models (Garcia-Teruel, Martinez-Solano, 2007).

Reducing of cycle of cash conversion helps in increasing firm profitability for both medium and small-sized firms. Besides that, a correlation of the firm profitability associated with degree of assertiveness of investing in working capital was examined to be negative using regression analysis in the study by Afza and Nazir (2009). Studies by Zariyawati, et al., (2009), posited

that improvement in firm profitability was due to the decrease in cash conversion cycle conducted in Southeast Asia firms. The correlation of firm profitability with the cycle of cash conversion was found to be significantly negative in Vietnamese listed firms for the period 2006-2008 (Dong, Su, 2010). The firm profitability can be increased by decreasing inventories and number of accounts receivables yet remain outstanding in the study. Likewise, Naompech (2012) concluded that firm profitability can be increased with the proper management of cash conversion for Thai listed firms.

Working capital management and Firm Performance

The association of firm profitability associated with account receivables turnover in-days were found to be significantly negative in a sample size of 30 companies during the study period of 1993-2008 (Mathuva, 2009; Sen, Oruc, 2009). This was similar to the study of listed Turkish firms by Uyar (2009). The managing of working capital with firm profitability in 49 Istanbul listed corporations for the period 1993-2007 were investigated. The firm profitability increased due to aggressive working capital management for example reduced current ratio and shortening of cycle of cash conversion. In the sample of 204 manufacturing firms in the period of 1998-2007 was used to analyze the effect on firm performance with working capital management practices (Raheman, Afza, Qayyum, Bodla, 2010), in which it was found that, firm performance affected significantly by cycle of cash conversion, inventory turnover, and net trade cycle in the study.

The firm profitability could be improved by managing of working capital with aggressive policies. However, the findings are conflicting with the current literature on Indian companies. A correlation of managing in working capital with firm profitability was analyzed with number of account payables in days was conducted found to be negative whereas the correlation of firm profitability and the number of account receivables in days investigated as being positive in a sample of 263 Indian firms during the study period of 2000–2008 (Sharma, Kumar, 2011). Firm performance was found to increase by increasing both net trade cycle and the cycle of cash conversion in examination of the effect of managing in working capital on the profitability of Turkish firms (Karadagli, 2012).

Decreasing in net trade cycle and cash conversion cycle is associated with improved profitability for larger companies. Results suggested that the firm growth, number of account payables in days, and firm size was conducted in positive association with firm profitability whereas number of inventory in days, numbers of account receivables in days, cycle of cash conversion and debt ratio investigated in relation with firm profitability inversely in the study of small medium enterprises in Pakistan (Gul et al., 2013). A firm profitability was impacted positively with the managing of working capital as measured by net operating profits from Ghanaian companies (Akoto, Awunyo-Vitor, Angmor, 2013).

A correlation of firm performance associated with managing of working capital was conducted as positive from Nigeria (Imeokparia, 2015). Decreasing accounts receivable and net trade cycle with maintaining inventory to reasonable level to create firm value by managers

(Jahfer, 2015). The firm profitability was investigated as significantly impacted with working capital management (Khalid et al., 2018).

Firm Profitability and Managing of Working Capital

There is a correlation of firm profitability associated with variables of working capital are found in reverse (Ahmadi et al., 2012). A correlation of firm profitability with number of account receivables in days and cycle of cash conversion were investigated in negative, but a correlation of firm profitability associated with number of inventory in days and number of account payables in day investigated in positive in Kenya in the period of 2003 to 2012 (Makori, Jagongo , 2013). Asaduzzaman and Chowdhury (2014) highlighted that the number of inventory in days, period of cash conversion and the number of day in account receivables is positively associated with the firm profitableness, contrary to yet the numbers of days accounts. While the firm profitability is negatively impacted with the days of payables outstanding, the other variables indicated a correlation with firms profitability as positive (Asaduzzaman, Chowdhury , 2014).

The correlation of firm profitability associated with managing in working capital was investigated as negative by using four measures of managing in working capital (Asaduzzaman, Chowdhury , 2014) and (Javid, Zita , 2014). The firm profitability is investigated as negative along with the variables of account receivable period, cycle of cash conversion and period of inventory turnover from a study in Sri Lanka's listed companies from 2008 to 2012 (Jayarathne, 2014). The firm profitability is reduced from improving of leverage. The firm profitability can be improved in managing of working capital wisely in manufacturing companies. An empirical research provided evidence showing there is a linear association of the firm profitability with the variables of working capital and managing of return on assets (Yasithamal, 2015). The firm profitability was impacted by debt ratio inversely significant in a sample size of 164 listed manufacturing firms from 2007 to 2011 (Jakpar et al., 2017).

Methodology

Theoretical Framework

The firm profitability is indicated in negative correlation with variables of cycle of cash conversion in a sample of 148 Malaysia listed companies in the research time period of 1996-2006 in the study of (Ashhari et al., 2009). The firm profitability is exposed in insignificant correlation with current ratio in this study although it is investigated in relevant positively. There are correlation of firm profitability associated with the cycle of cash conversion and its components investigated negatively in all sectors in the study exclude the sector of industrial product.

The association of the cycle of cash conversion and its variables of returned on invested capital, firm's return on assets and market value are shown in negative significantly. Beyond that, they discovered that the relation between current ratio, returns on invested capital and

return on assets is investigated in negative significantly in the study of sample with 172 listed companies of Malaysia from 2003 to 2007 (Mohamad, Saad, 2010).

The firm value is increased and the efficiency of working capital is improved with decrease in investing operation capital indicated in the study of 192 listed firms from 1999 to 2008 (Wasiuzzaman, 2015). The firm's financial constraints bring certain effect to the relation. The firm value is significantly improved by managing of operation capital efficiently to the constrained firms and vice versa.

The central target in this research is to investigate the association of firm profitability with managing of operation capital of listed manufacturing companies in Malaysia. Those previous studies in Malaysia context are used as a reference with similar results to this study (Ashhari et al., 2009; Mohamad, Saad, 2010) in which the comprehensive measurement of efficiency in working capital they found.

Independent Variables Dependent Variables

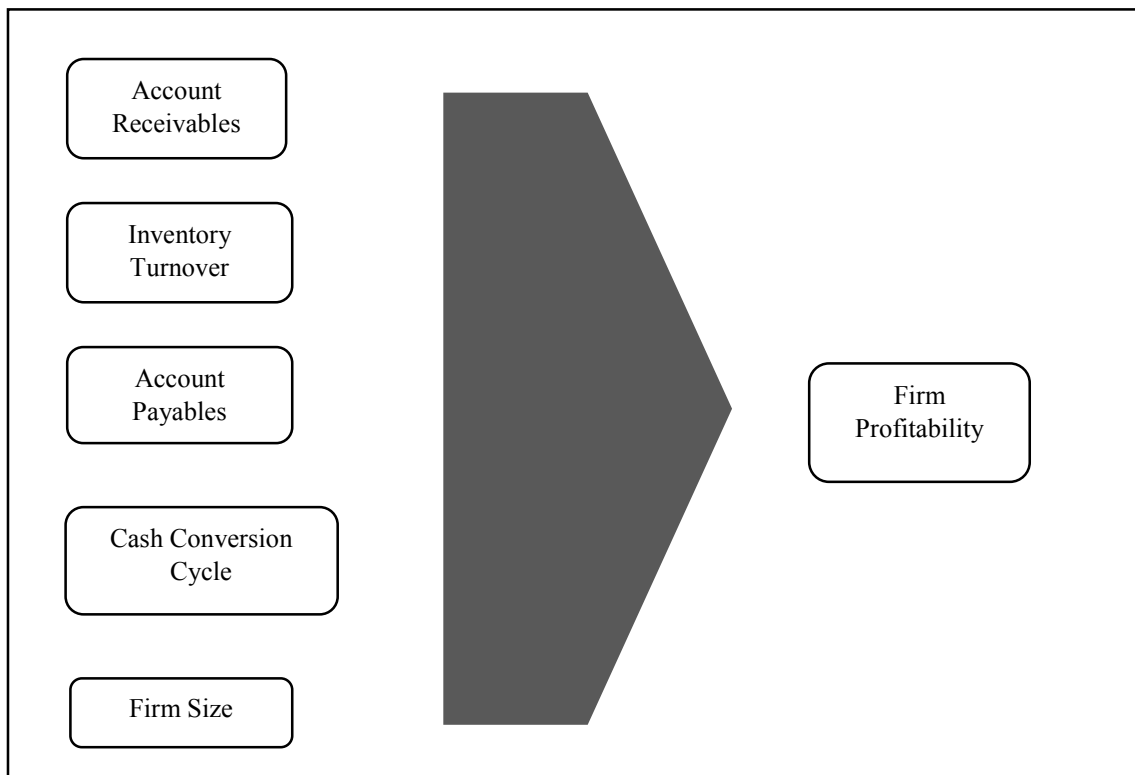


Figure 1. Conceptual Framework.

Data and Variables

There are 26 of listed manufacturing companies from Bursa Stock Exchange (CSE) in Malaysia in this study. The companies selected in this study are fulfilled in the condition of period from 2008 to 2018. There are 26 listed companies to be investigated in the sample size of 260 observations on balanced panel set in total. The dependent variable is return on assets to replace with the firm profitability. A return on assets is suitable in measurement because the role it plays relevant to asset base of firm profitability (Padachi, 2006). Profit before

depreciation tax accounts divided by total assets is the official calculation of return on asset. The notations, variables in independent and its calculation methods utilized in the analysis are disclosed in the appendix.

Specification of Regression Models

The correlation of firm profitability associated with managing in working capital in Malaysian companies is the central objective in this research to be investigated for. These objectives are able to have capability in accomplishing with utilizing a developed methodology and there are some empirical framework are using included (Garcia-Teruel, Martinez-Solano, 2007; Zariyawati, Annuar, Taufiq, Rahim, 2009; Nazir, Afza, 2009; Samiloglu, Demirgunes, 2008). The estimation obtained with utilizing the equations of OLS regression is exposed in the following:

$$ROA_{it} = \beta_0 + \beta_1 GROWTH_{it} + \beta_2 LEV_{it} + \beta_3 CR_{it} + \beta_4 SIZE_{it} + \beta_5 INV_{it} + e_{it} \quad (1)$$

$$ROA_{it} = \beta_0 + \beta_1 GROWTH_{it} + \beta_2 LEV_{it} + \beta_3 CR_{it} + \beta_4 SIZE_{it} + \beta_5 AR_{it} + e_{it} \quad (2)$$

$$ROA_{it} = \beta_0 + \beta_1 GROWTH_{it} + \beta_2 LEV_{it} + \beta_3 CR_{it} + \beta_4 SIZE_{it} + \beta_5 AP_{it} + e_{it} \quad (3)$$

$$ROA_{it} = \beta_0 + \beta_1 GROWTH_{it} + \beta_2 LEV_{it} + \beta_3 CR_{it} + \beta_4 SIZE_{it} + \beta_5 CCC_{it} + e_{it} \quad (4)$$

$$ROA_{it} = \beta_0 + \beta_1 GROWTH_{it} + \beta_2 LEV_{it} + \beta_3 CR_{it} + \beta_4 SIZE_{it} + e_{it} \quad (5)$$

Notes: Where ROA stands for the return on assets, SIZE is size of company as tested by logarithm of sales in nature, GROWTH means sales growth, CR stands for current ratio, INV represents number of days inventories, LEV represents leverage, AR means the number of account receivables in days, AP means the number of account payables in days, and CCC measures the cycle of cash conversion. All the companies (cross section dimensions) is expressed by the subscript of *i* started from 1–26 and years is indicated in *t* (time-series dimension) during the period of 2009-2018. The research hypothesis is tested by utilizing SPSS software. The significance value (or *p*-value) will be calculated automatically by SPSS. Thus an appropriate level is always taken in the level of profitability of less than 5% or equivalent for most general research involving this study.

3. Results and Discussions

3.1. Descriptive Statistic

Table 1.
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ROA	26	-0.73	16.21	3.4618	3.58
AR	26	2.34	395.86	117.3934	99.36
INV	26	22.65	389.54	253.8020	184.97
AP	26	2.43	293.21	112.3049	100.83
CCC	26	-172.10	364.05	196.0244	192.03
SIZE	26	4.12	9.71	7.0393	1.32
GROWTH	26	-0.52	6.52	0.7294	1.04
LEV	26	-7.91	1.03	0.4547	1.27
CR	26	0.16	7.49	1.7337	1.32
VALID N	26				

Table 1: The variables of descriptive statistics used are exposed in the study. Around 4 per cent is the mean value to return on assets (ROA) with a standard deviation of 3%; 117 days is the number of account receivables meanwhile 112 days is belonged to the number of account payables. 196 days is the cash conversion cycle's average value with taking all the firms at once is disclosed in the table above. Beyond that, the general sales growth of the firms is near to 73% annually, when 1.73 is the general value of current ratio in the period of study (2009-2018).

There is a relation of return on assets associated with number of inventory in days and the cycle of cash conversion, firm growth and current ratio in positive shown as an evidence in the table 3. At the same time, the number of account receivables in days, leverage and number of account payables in days are shown in correlation in negative with firm profitability.

According to correlations between the control or independent variables, the values of associations in maximum between independent variables can be found are only between the account receivables and account payables at the point of 0.967 and the other maximum value is between the number of leverage in days and the number of account receivables in days showed in 0.298 point. The chance of occurring multicollinearity problem is high potential due to existence of value in correlation coefficient is high in the middle of variables utilized in this research, and the values of variance inflation factor (VIF) will be analyzed furthermore.

Correlation Matrix

Table 2.

Correlation matrix

	<i>ROA</i>	<i>AR</i>	<i>INV</i>	<i>AP</i>	<i>CCC</i>	<i>SIZE</i>	<i>GROWTH</i>
ROA	1						
AR	0.269	1					
INV	-0.120	0.089	1				
AP	0.211	0.967	0.067	1			
CCC	0.204	0.958	0.078	-0.999	1		
SIZE	0.060	-0.081	-0.010	-0.064	0.061	1	
GROWTH	0.100	0.037	0.166	0.048	0.057	-0.002	1
LEV	-0.344	-0.298	0.233	-0.274	-0.273	0.082	-0.128
CR	-0.272	-0.129	0.266	-0.107	0.108	-0.260	0.302

Regression Models 1: Number of Inventory in Days and Return on Assets

Table 3.

Model Summary

Regression Statistics	
Multiple R	0.889
R Square	0.596
Adjusted R Square	0.453
Standard Error	2.088
Observations	260

a. Predictors: (Constant), CR, LEV, GROWTH, INV.

b. Variable in Dependent: ROA.

59.6% is the value of the R-square in adjusted from the table 3, which means that variation of the dependent variable (ROA) is shown at 59.6% obviously according to the variables in independent, as an explanatory power in regression is dedicated strongly.

Table 4.
ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	298.592	69.528	9.052	0.000
Residual	255	95.095	7.681		
Total	260	393.687			

a. Predictors: (Constant), GROWTH, LEV, CR, INV.

b. Variable in Dependent: ROA.

9.052 is the significance of F-stat from the table 4 as the level of significance is less than 5% so it is regarded as significant. Thus, return on assets is found to be impacted by leverage, firm size, firm growth and inventory turnover in days of those Malaysia companies.

Table 5.
Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	2.833	3.489	0.865	0.683
INV	0.004	0.003	0.618	0.537
GROWTH	-0.175	0.285	-0.772	0.416
LEV	-1.592	0.246	-0.375	0.000
CR	-0.495	0.284	-2.274	0.036
SIZE	0.361	0.371	0.532	0.476

a. Variable in Dependent: ROA.

Thus, 59.6% of explanatory power predicts the ROA in the model below:

$$\text{ROA} = 2.833 - 1.592 \text{ LEV} - 0.175 \text{ GROWTH} - 0.495 \text{ CR} + 0.361 \text{ SIZE} + 0.004 \text{ INV} + e.$$

ROA is found to be affected by current ratio and leverage only from the results to assess the significance on the dependent variable ROA by each independent variable as their p-value are less than 5%. However, ROA is insignificantly affected by firm size, firm growth and inventory as the p-value is more than 5%. There is a connection between returns on assets, dependent variable and inventory and firm size is analyzed in positive from the results in regression. But leverage, current ratio and firm growth are related with return on asset in negative. Hence, the firm profitability is becoming more due to higher the inventory same to the company's size is greater so as the profitability of a concern is greater will be.

There is correlation of current ratio associated with return on assets analyzed in negative. Increasing in numbers of inventory in days by one day is attached with an increasing in firm profitability analyzed in 0.437 from the results of coefficient of number of inventories in days in the regression by positive (as measured with return on assets) at 0.004%. According to the theory in corporate finance, the number of holding inventory in day the lesser, the higher the firm profitability will be. This implies when the number of inventories in day hold is increasing in the firm will help in increasing the firm profitability.

Those results from conducted studies are close to the results in this study included (Deloof, 2003; Padachi, 2006; Garcia-Teruel, Martinez-Solano, 2007; Raheman, Nasr, 2007) of the correlation of firm profitability with number of inventory in days in their respective analysis.

Decreasing in the inventory and number of accounts receivables in day so will the decreasing in firm profitability is concluded in this study. In the table 5 observed the other essential result is that the measurement in liquidity classically, such as the return on assets is related in negative with current ratio, which situation is in negative for Malaysia firms, and the results in this study is similar to the studies previously of (Shin, Soenen, 1998).

The null hypothesis has to be rejected as there is correlation of firm profitability with number of inventories in days significant statistically.

Regression Models 2: Number of Account Receivables in Days and Return on Assets

Table 6.

Model Summary

Regression Statistics	
Multiple R	0.892
R Square	0.695
Adjusted R Square	0.691
Standard Error	2.659
Observations	260

a. Predictors: (Constant), CR, LEV, AR, Growth,

b. Variable in Dependent: ROA

69.1% is the number and value of R-square in adjusted in the model, which variation of the dependent variable (ROA) is shown in 69.1% obviously due to the independent variables, and treated as a strong explanatory power in regression.

Table 7.

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	0.423	0.085	11.453	0.000
Residual	255	1.876	0.007		
Total	260	2.299			

a. Predictors: (Constant), LEV, AR, CR, GROWTH

b. Variable in Dependent: ROA

11.453 is found to be the value of F-stat from the table 7 and because the significant level is less than 5% so it is significant. Hence the return on assets of Malaysia industries is analyzed and impacted by firm size, current ratio, firm growth, leverage and account receivables.

Table 8.

Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	2.284	3.943	0.579	0.563
AR	0.004	0.008	1.253	0.295
GROWTH	-0.218	0.279	-0.530	0.306
LEV	-0.123	0.491	-2.902	0.004
CR	-0.622	0.287	-2.326	0.021
SIZE	0.408	0.463	0.757	0.218

a. Variable in Dependent: ROA

About 69.1% of explanatory power predicts the ROA in the model below:

$$ROA = 2.284 - 0.218 \text{ GROWTH} - 0.123 \text{ LEV} - 0.622 \text{ CR} + 0.408 \text{ SIZE} + 0.004\text{AR} + e$$

ROA is only affected by independent variables of current ratio and leverage as their p-value are less than 5% from the results to evaluate the consequence of dependent ROA by every variable in independent. However, ROA does not affect by account receivables in days, firm size and firm growth significantly as the p-value is more than 5%. The relationship of account receivables in days associated with firm profitability is investigated in positive.

Depicted from the theory of corporate finance, the company's profitability is increasing due to the reducing of numbers of days of account receivables. Beyond that, increasing in return on assets will bring influence to increase the number of account receivables in days shown by 0.4% from the results of coefficient value of number of account receivables in days in Malaysian companies. The theory of managing efficiently working capital is denied with this.

There are some difference of the results significantly in previously literature comparing to this study by (Deloof, 2003; Lazaridis, Tryfonidis, 2006; Raheman, Nasr, 2007; Garcia-Teruel, Martinez-Solano, 2007). Their studies imply that an increase in the number of accounts receivables in day by 1 day is associated with a reducing in gross operating income which is opposite to the outcome of our study. Improving the granted credit period to the customers to increase the firm profitability indicated in Malaysia companies. The company's profitability will be affected ill when increasing of company's leverage as a result from relationship between ROA and leverage show in negative significantly, the firm growth and firm size is related in negative is treated as denying the theoretical framework of ROA. Further, the correlation of firm profitability associated with current ratio is exposed in negative from the table 8. The firm profitability is gained from lower the firm's current ratio. Same to the theory of describing firm profitability increasing with current assets in lesser money blocked.

The null hypothesis has to be rejected as there is correlation of firm profitability with number of account receivables in days significant statistically.

Regression Models 3: Number of Days Accounts Payables and Return on Assets

Table 9.

Model Summary

Regression Statistics	
Multiple R	0.849
R Square	0.740
Adjusted R Square	0.579
Standard Error	2.616
Observations	260

a. Predictors: (Constant), GROWTH, SIZE, AP, LEV, CR, LEV

b. Variable in Dependent: ROA

74.0 % is the value of R-square in adjusted in the model, which means that 74.0 % variation of the variable in dependent (ROA) is obviously shown due to the independent variables, and it is a strong explanatory power in regression.

Table 10.
ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	0.385	0.077	10.214	0.000
Residual	255	1.914	0.008		
Total	260	2.299			

a. Predictors: (Constant), LEV,CR, SIZE, GROWTH, AP

b. Variable in Dependent: ROA

10.214 is the significance of F-stat in the table 10 above and the level of significance is less than 5% so it seems as significant. Hence it was found that current ratio, leverage, account payables in days, firm growth and firm size have affected on return on assets (ROA) of those Malaysia companies.

Table 11.
Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	2.167	3.992	0.543	0.588
AP	-0.002	0.002	0.231	0.792
GROWTH	-0.189	0.395	-0.436	0.302
LEV	-1.796	0.337	-3.176	0.002
CR	-0.518	0.231	-2.316	0.021
SIZE	0.398	0.418	0.587	0.269

a. Variable in Dependent: ROA

About 74.0% explanatory power predicts the ROA in the model below:

$$\text{ROA} = 2.167 - 0.189 \text{ GROWTH} - 0.518 \text{ CR} - 1.796 \text{ LEV} + 0.398 \text{ SIZE} - 0.002 \text{ AP} + e$$

It has been found that ROA is affected by current ratio and leverage as their p-value are less than 5% from the results. However, ROA is affected insignificant by account payables in days, size and growth as the p-value is more than 5%. Number of account payables in day is replaced from number of account receivables in day and revealed the results of regression equation (3) in table 11.

The firm profitability will be impacted as the less profitable firms do not pay their suppliers early as more profitable ones do. There is a correlation of firm profitability with number of account payables in days showed negatively in the results from regression as measured by return on assets. Malaysia companies use up 112 days in the short-term to make sure their suppliers get payment on average is confirmed in the descriptive statistics presented in the table 1.

The business operations still on counting as delaying payment to suppliers even the profitability of the companies is reducing with less profit (Padachi, 2006). There are more capital to be utilized for other functions to make remarkable profits for business to survive as long as the payment period is longer and it makes economic sense from the result.

The null hypothesis has to be accepted as there is statistically insignificant the relationship of firm profitability associated with number of account payables in days.

*Regression Models 4: Cash Conversion Cycle and Return on Assets***Table 12.**
Model Summary

Regression Statistics	
Multiple R	0.699
R Square	0.656
Adjusted R Square	0.598
Standard Error	2.087
Observations	260

a. Predictors: (Constant), LEV, CCC, GROWTH, SIZE, CR

b. Variable in Dependent: ROA

59.8 % is the value of R-square in adjusted in the model, which means that 59.8 % variation of the variable in dependent (ROA) is shown obviously due to the variables in independence and regarded as weak explanatory power in regression.

Table 13.
ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	0.381	0.076	10.085	0.000
Residual	255	1.918	0.008		
Total	260	2.299			

a. Predictors: (Constant), GROWTH, LEV, CR, SIZE, CCC

b. Variable in Dependent: ROA

The value of F-stat is found in 10.085 from the table 13 and the level of significance is less than 5% is deemed as significant. Hence the return on assets (ROA) is found that impacted by current ratio, firm size, cycle of cash conversion in days, firm growth with leverage of those Malaysia companies.

Table 14.
Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	3.022	2.999	0.941	0.589
CCC	0.002	0.004	0.616	0.530
GROWTH	-0.131	0.231	-0.379	0.300
LEV	-1.804	0.251	-3.208	0.002
CR	-0.730	0.204	-2.309	0.022
SIZE	0.397	0.477	0.680	0.533

a. Dependent Variable: ROA

Thus, about 59.8% is the power of explanatory in prediction of the ROA by the following model:

$$\text{ROA} = 3.022 - 1.804 \text{ LEV} - 0.730 \text{ CR} - 0.131 \text{ GROWTH} + 0.397 \text{ SIZE} + 0.002 \text{ CCC} + e$$

The finding of ROA is affected by independent variables of current ratio and leverage as their p-value are less than 5%. However, ROA is affected insignificantly by size, growth and cash conversion cycle as the p-value is more than 5%. The correlation of firm profitability associated with the cycle of cash conversion is utilized to analyze equations (1), (2) and (3) with all the three variables for the combined effect. It was found positive (0.002) in the

coefficient value of cycle of cash conversion. This implies that the firm will have lesser profits to be generated in decreasing of the cash conversion cycle. The firm profitability will be generated more with lower cycle of cash conversion is stated in theory and it is contrast to this study.

The firm profitability is added with decreasing of cycle of cash conversion in theoretical researches whereas the profitability of the company is affected negatively for longer cash conversion cycle. At the level in significance with shown p-value (0.530) and it is treated as insignificant from the results. These studies prove the negative relationship as they are, (Lazaridis, Tryfonidis, 2006; Raheman, Nasr, 2007; Samiloglu, Demirgunes, 2008), the conclusion that they have made is either increasing or decreasing in the period of cash conversion, the firm profitability will still be affected significantly. The conclusion of positive correlation of firm profitability associated with cycle of cash conversion is conducted by (Padachi, 2006) with 0.165 coefficient value in correlation.

The null hypothesis has to be accepted as there is statistically insignificant relationship of firm profitability with cycle of cash conversion.

Regression Models 5: Firm Profitability and Firm Size

Table 15.
Model Summary

<i>Regression Statistics</i>	
Multiple R	0.721
R Square	0.703
Adjusted R Square	0.635
Standard Error	1.982
Observations	260

a. Predictors: (Constant), SIZE, CR, GROWTH, LEV

b. Variable in Dependent: ROA

In the model, the significance of R-square in adjusted is 70.3 %, which 70.3 % diversification of the variable in dependent (ROA) is shown obviously due to the variables in independent and the power from regression.

Table 16.
ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	4	0.345	0.086	11.247	0.000
Residual	255	1.954	0.008		
Total	259	2.299			

a. Predictors: (Constant), CR, LEV, GROWTH, SIZE

b. Variable in Dependent: ROA

A significance of F-stat is found to be 11.247 in table 16 and as the level of significance is less than 5% so it is significant. Thus, it was found that return on assets (ROA) is impacted by size, growth, current ratio and leverage of the firm in those Malaysian companies.

Table 17.
Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.011	0.040	0.281	0.779
SIZE	0.004	0.002	2.082	0.038
LEV	-0.095	0.024	-3.879	0.000
CR	-0.010	0.004	-2.223	0.027
GROWTH	0.009	0.009	1.024	0.307

a. Variable in Dependent: ROA

According to table 17, showing the results of regression model mathematically as following:

$$\text{ROA} = 0.011 - 0.095 \text{ LEV} - 0.010 \text{ CR} + 0.009 \text{ GROWTH} + 0.004 \text{ SIZE} + e$$

ROA is affected by independent variables of size, leverage and current ratio are found to investigate the significance on the variable of dependent ROA from each independent variable in the analysis as less than 5% are shown at their p-value. However, the p-value of growth is more than 5% and it is regarded as insignificant affects in ROA.

The correlation of firm profitability associated with firm size is used to analyze the combined impact of all the three variables used in equations 1, 2, 3 with 4. The coefficient value of size was found in positive (0.004). This implies that a company will have lesser profits in the decreasing firm size. At the significance level with shown p-value (0.038) implies there is significant on the results. There is an association of firm profitability with firm size analyzed in positive and is written by (ALghusin, 2015) with the value of correlation coefficient in 0.021 same as this study.

The null hypothesis has to be rejected as there is correlation of firm profitability associated with firm size statistic significantly.

Summary

Research Objective 1

There is a relationship between returns on assets, dependent variable and inventory and firm size is analyzed is positive from the results in regression. Hence, the firm profitability is increased due to higher the inventory, likewise the firm size. According to the theory in corporate finance, when the number of inventories in day-hold is increasing, profitability is enhanced.

Those results from previous studies are similar with the results of this study including Deloof (2003); Padachi, (2006); Garcia-Teruel, Martinez-Solano, (2007); Raheman, Nasr, (2007) which stressed the correlation of firm's profitability with number of inventories in days in their respective analysis.

Research Objective 2

There is a positive correlation between firm profitability associated with the number of account receivables. The number of inventories in-day and number of account payables in-day was found to be positive. The cash conversion period was used to measure the number of account payables in-day, inventory in-days and account receivables in-day with regard to integrated analysis. There are different results conveyed in this study compared with many past studies produced in various countries as per Mathuva, (2009) and Sen, Oruc, (2009).

Research Objective 3

The result of correlation of firm profitability associated with number of account payables in-days and numbers of inventory in-days are divided in this study which concurs with previous studies, which are; Jose, Lancaster, and Stevens, (1996); Deloof, (2003); Lazaridis, Tryfonidis, (2006); Raheman, Nasr, (2007) and Samiloglo, Dermirgunes, (2008).

Research Objective 4

The positive correlation as measured by cycle of cash conversion and the measurement of integrated operation capital is shown of firm's profitability associated with managing the working capital. A firm's profitability will be affected negatively by reducing the cycle of cash conversion which has been discovered in this study. This study also revealed that reducing the time of cash conversion cycle would benefit the firm, which concurs with studies by Garcia-Teruel, Martinez-Solano, (2007) in Spain; Raheman, Nasr, (2007) in Pakistan, Kaddumi, Ramadan, (2012) in Jordan.

However, the analysis of correlation of firm profitability and cycle of cash conversion has departed significantly compared to previous studies of Shin, Soenen, (1998); Deloof, (2003); Padachi (2006); Samiloglo, Dermirgunes, (2008); Nazir, Afza, (2009); Singh, Kumar, Colombage, (2017) and Nwude, Agbo, Ibe-Lamberts, (2018).

Research Objective 5

A company will have lesser profits with the decrease in firm size, as per the significance test of a p-value of 0.038. The outcome of this study is compatible to the study of (ALghusin, 2015).

Limitations and Future Research

This study has its own limitations. The sample size is too small for any generalization. A mixed method approach could contribute is a holistic finding. This paves the way for future research in this area. Working capital management is crucial to be often than not looked into to ascertain, the fluctuating needs of firms today.

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THE USE OF TECHNOLOGIES IN DIFFERENT FORMS MANAGEMENT

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Purpose: This article aims to investigate the necessity and importance of using technology – artificial intelligence in modern management forms, such as information management, innovation management, project management, knowledge management, quality management, and HR management.

Design/methodology/approach: The research method used in the article is an analysis scientific works, which describe the features of various forms of management in organizations. The research procedure included a review of world scientific literature, methodological analysis, identification of consistent connections between the two main structural parts of the researched question, and deductive reasoning.

Findings: The article examines the issue of the need to use artificial intelligence in management to increase the organization's effectiveness. The analysis of the characteristics of six modern forms of management in organizations showed how exactly artificial intelligence could improve the activity of the organizational system. The work describes the positive aspects and benefits of using key components of artificial intelligence in the manager's management activities.

Research limitations/implications: Our proposals for future research are to conduct research in organizations with different degrees of technological development to identify the dependence on the efficiency of activities and the level of technology provision of organizations.

Practical implications: Modern technological development requires every manager to implement technologies in the managed organization. Analysis of the need to use artificial intelligence in various management forms to improve the organization's efficiency is important for managers striving for high financial results in their activities.

Social implications: Implementation and use of technologies in organizations ensure their stable development. Developed organizations form a strong economy that provides people with a high standard of living.

Originality/value: The study results indicate the importance of studying issues related to implementing and developing technological processes in the organization. The analysis of the characteristics of the forms of management and their connection with the key components of artificial intelligence prove the necessity of its use in management to achieve the organization's financial stability.

Keywords: management, technology, artificial intelligence.

Category of the paper: Research paper.

1. Introduction

Effective management of the organization is a key factor in achieving high economic results and forming the competitiveness of the organizational system. This type of management is only possible with a manager who strives for the development of the enterprise. The role of a manager in an organization is specific and critical. An effective leader influences the organization, which generally consists of a social and technological component, in such a way that the implementation of the mission of the managed system is fully fulfilled.

Today, technology in management is necessary to perform many management functions. This necessity is connected with the development of the modern world, which can only do by using various technologies, including artificial intelligence.

2. Results

The use of technology by people is an integral part of everyday activities in any sphere of social life. The large amount of information surrounding each of us requires rapid processing and systematization for high productivity in regular and professional life. The technological orientation of organizations is necessary for the formation of high economic results and competitiveness of the organizational system.

There is a science of information technologies for collecting, storing, processing, and transmitting information, and information is the lifeblood of complex industrial societies, and its importance is increasing (Forester, 1985). Information is a necessary tool that ensures the development of society in various ways, it is a source of the latest knowledge for people and creates conditions for the formation of education in the community. It is information-savvy people who can become the basis of successful organizations for developing the economy in any country.

The effective managerial activity of managers in organizations is a key process that ensures the effectiveness of the business entity (Kuzior et al., 2021). One of the manager's main tasks is to manage the organization's technological development. On the other hand, some scientists equate the management process with technology (Bloom et al., 2017), a rational, innovative, and effective strategy.

Artificial intelligence and cognitive technologies have already entered the lexicon of the world of science, business, and technology (Kuzior et al., 2022). Thanks to artificial intelligence, various opportunities facilitate employees' work in many areas of activity. A specific task of artificial intelligence is to make certain decisions in managerial activities

(Kuzior et al., 2019, 2020) since the level of success of the organization depends on the effectiveness of the work of managers.

There are a large number of directions and forms of management. In the proposed work, we will consider six management forms where artificial intelligence as technology plays a significant and productive role - information management, innovation management, project management, knowledge management, quality management, and HR management.

Table 1 shows the characteristics of each proposed management form for a more accurate understanding of the need to use artificial intelligence and cognitive technologies in these management areas.

Table 1.

Characteristics of information management, innovation management, project management, knowledge management, quality management, and HR management

№	Management	Characteristic
1.	Information management (Reitz, 2004)	The skillful exercise of control over the acquisition, organization, storage, security, retrieval, and dissemination of the information resources essential to the successful operation of a business, agency, organization, or institution, including documentation, records management, and technical infrastructure.
2.	Innovation management (Birkinshaw et al., 2005)	Management innovation involves the introduction of novelty in an established organization, and as such it represents a particular form of organizational change.
3.	Project management (Munns et al., 1996)	The function of project management includes defining the requirement of work, establishing the extent of work, allocating the resources required, planning the execution of the work, monitoring the progress of the work and adjusting deviations from the plan.
4.	Knowledge management (Quintas et al., 1997)	Knowledge management is the process of continually managing knowledge of all kinds to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities.
5.	Quality management (Dean et al., 1994)	A philosophy or an approach to management that can be characterized by its principles, practices, and techniques. Its three principles are customer focus, continuous improvement, and teamwork.
6.	HR management (Opatha, 2021)	HRM is the adoption of certain functions and activities for utilizing employees efficiently and effectively in an organization to achieve its goals which include satisfying the key stakeholders to the possible extent and contributing positively to the natural environment. It involves formulation, implementation, and on-going maintenance of strategies, policies, procedures, rules, practices and systems of managing employees strategically, participatorily, and sustainably.

Source: constructed by authors.

As seen from Table 1, management in the described areas of activity, such as information, innovation, knowledge, quality, and human resources, ensures organizations' development and high economic performance.

Let's consider the effectiveness of using artificial intelligence in the proposed forms of management of organizations to solve certain tactical and strategic tasks facing the manager.

1. A large amount of information surrounding modern people requires the ability to use and process it. The sources from which data comes are diverse, and there is a need for their systematization and some filtering for reasonable consumption.

Artificial intelligence in information management ensures the performance of decision-making exploration and intelligent information support by mediating data with knowledge and base resources (Wiederhold, 1992).

Information management in organizations has the following features:

- information should be considered a resource that needs proper management, like money, human resources, and materials,
 - at the most superficial level, information management involves the planning and coordination (if not direct control or use) of the following: information skills, information technology, information sources, and services,
 - information management requires careful "observation" of new developments that can contribute to better management of information resources,
 - information management requires understanding the patterns of information flow within the organization and then requires systematic means of displaying and monitoring such flows (Rao, 1999) it can be stated that the use of artificial intelligence in this form of management ensures the effectiveness of the implementation of such management tasks.
2. The second example is artificial intelligence's effective use in innovative management. Potential areas of application of AI in the innovation process:
- development of ideas by overcoming the limitations of information processing. An AI system can identify and evaluate more information, which can then be used to develop insights,
 - generating ideas by overcoming the limitations of information processing. An artificial intelligence system can recognize more problems, opportunities, and threats that can be used to create new ideas,
 - development of ideas by overcoming the local search routine. An AI system can identify and evaluate more creative/exploratory ideas,
 - generating ideas by overcoming local search routines. An artificial intelligence system can recognize and create more creative/research problems, opportunities, and threats to generate new ideas (Haefner et al., 2021).

Since ideas are a key component of the innovative field of activity, simplifying and improving management tasks related to their generation and processing with the help of artificial intelligence indicate the need to use technologies in this management direction. However, the ethical context of innovation management should always be kept in mind (Kuzior et al., 2019) and how they serve the Sustainable Development Goals (Kuzior et al., 2022).

3. The third example is using artificial intelligence in project management. AI is useful for decision-making, speech and language recognition, learning new project ideas, planning, and problem-solving (Dacre et al., 2022). Project activity and its management require a detailed information study of the scope of implementation, the target audience, the project's expected results, effective organization, planning, and control over the

performance of the project program. The use of artificial intelligence tools ensures the effectiveness of these management tasks.

4. In looking at ways for sharing knowledge, transforming individual knowledge into collective, organizational knowledge, and reincarnating organizations into “knowledge organizations”, the field of artificial intelligence (AI) can help push these basic tenets of knowledge management (Liebowitz, 2001).

Knowledge management in the organization is necessary for achieving high results in the organization's activities and requires the manager's attention to form effective communication with the staff and team members among themselves. Such a tendency is connected with people being the bearers of knowledge.

The use of artificial intelligence in knowledge management occupies a special place because key element of knowledge management is knowledge sharing within a given environment or community (Kaniki et al., 2013). That is, the manager must consider that human resource - knowledge and its use can be used more effectively with the help of specific technological processing.

5. A high level of development of quality management in the organization is the manager's task, which ensures the enterprise's competitiveness and financial stability (Wolniak, 2019). The manager's focus on developing quality management indicates his high level of professionalism and the effectiveness of management activities.

Artificial intelligence in quality management concerns the following components of the organization (Carvalho et al., 2021):

- management commitment, i.e., the use of artificial intelligence ensures improvement of the manager's performance of obligations,
 - employee involvement, increasing the level of this indicator in the organization depends on the use of technologies to optimize the working conditions of employees,
 - information and analysis, information processing, and its analysis are necessary components of improving the quality of services or goods produced in organizations. Artificial intelligence always aims to increase the efficiency of working with these components.
6. The sixth proposed example is using artificial intelligence in personnel management. The role of artificial intelligence in human resources management: personnel selection, verification and interview process, reduction of administrative burden, selection, reduction of discrimination, improvement of efficiency, and enrichment of training at the workplace (Yawalkar, 2019).

It is this understanding of the need to use artificial intelligence that identifies the presence of a team in organizations that is constantly developing and is aimed at fulfilling the tasks set by the manager for the realization of the organization's mission.

Key Components of AI: Machine learning, Deep learning, Neural network, Cognitive computing, Natural language processing, Computer vision (Kanade, 2022). Let's consider how these key components relate to the six forms of management proposed for analysis in work. Table 2 shows the results of this study.

Table 2.

The relationship between key components of artificial intelligence and forms of management

Forms of management	Key Components of AI					
	Machine learning	Deep learning	Neural network	Cognitive computing	Natural language processing	Computer vision
Information management	+	+	+	+	+	+
Innovation management	+	+	+	+	+	+
Project management	+	+	+	+	+	+
Knowledge management	+	+	+	+	+	+
Quality management	+	+	+	+	+	+
HR management	+	+	+	+	+	+

Source: constructed by authors.

As can be seen from Table 2, the key components of artificial intelligence can be applied in Information Management, Innovation Management, Project Management, Knowledge Management, Quality Management, HR Management to increase efficiency in management processes.

So, despite different opinions (Baker-Brunnbauer, 2020; Bawack et al., 2021; Zhang et al., 2021; Kuzior et al., 2022) regarding the use of artificial intelligence, the effectiveness of technology in management activities has a positive effect on the results of organizations. Improving processes through the use of artificial intelligence in the management of information, innovation, projects, knowledge, quality, and personnel positively affects the development of organizations and their financial results.

3. Conclusions

Modern technological development of people's various life processes ensures positive societal transformations. As the main function in organizational systems, management requires the manager to provide technology to enterprises. Having considered six forms of management that ensure the development of organizations - information management, innovation management, project management, knowledge management, quality management, and HR management, we can conclude that their common and main feature is the availability of a large amount of information. This information is an important resource for development in the organizational system and requires processing, systematization, and specific filtering to achieve certain positive results in management activities.

Artificial intelligence, as a technology, performs these tasks and improves the organization's work. Six key components of artificial intelligence able to positively influence the effective implementation of the forms of management proposed in work.

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TALENT MANAGEMENT IN SPORT

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Purpose: The main objective of the research presented in this article was to diagnose talent management in the Wrocław Taekwon-do Sports Club. In order to achieve this goal, the first part of the article explains the meaning of the term „talent management” in the scientific literature on management, and then, on the basis of the research carried out, an attempt was made to answer the question: which factors are the key determinants of the talent management process.

Design/methodology/approach: For the research presented in this paper, a literature analysis in the area of talent management. The studies in literature also included secondary sources, which were communications from research of similar scope.

The combination of different research methods allowed to obtain a broader context of the studied phenomenon and ensured a higher quality of the conducted research. The diversity of methods was aimed at achieving a consistency of the empirical basis for the inference. A diagnostic survey was adopted as the leading method. The remaining methods applied in the paper were auxiliary (complementary).

Findings: „Talent management” and having talented employees in a global economy is a strategically important resource affecting the market value of the organisation itself and providing a competitive advantage. Building a significant intellectual capital of the organisation requires the use of appropriate methods and tools to support the management, systematic measurement, constant comparison with competitors, elimination of barriers and use of opportunities for development (and such becomes the current crisis).

Research limitations/implications: In the future, research will be continued on a larger research sample.

Practical implications: The article presents the results of research carried out in one of Wrocław's sports clubs. The research results are very interesting and encourage more research. They are a valuable source of information for managers and coaches responsible for schools and the development of sports players. In turn, for those responsible for recruiting athletes, the results may be useful in terms of designing individual career paths of players.

Originality/value Based on empirical research, the article proposes an original set of systemic solutions for talent management to improve organisational performance.

Keywords: talent management, talent.

Category of the paper: Research paper.

1. Introduction

We live in an era where companies are constantly outdoing themselves with new ideas to help them gain a competitive advantage. The growing importance of the human resources management process shows the direction in which these changes are taking place. Talent management, On the other hand, talent management is considered to be one of the main challenges of strategic human resources management. It turns out that it is the implementation and effective use of the talent management process in its strategy that helps to achieve high results and create a leading position of the organisation on the labour market. Therefore, in order to increase the competitiveness of companies on the market, they rely not only on their offerings, but also on proper search and then skillful use and retention of people who, thanks to their knowledge, above-average skills or natural leadership abilities, will contribute to the development of the whole company.

The concept of talent management emerged some thirty years ago, based on a concept initiated in the USA back in the 1980s. Already then, human resources started to be treated as assets and intellectual capital of a company. It was noticed that investing in the development of employees, the formation of a specific structure of employment and a constellation of personnel characteristics allows to create a competitive advantage in relation to other business entities. Despite the growing interest in this subject, a large part of companies is not aware of the existence or omits talent management when creating development strategies, not believing in the benefits resulting from their application. Thoughtful implementation of talent management processes may bring measurable effects not only in terms of income but also in terms of building a positive company image, increasing employee involvement and satisfaction which will directly contribute to obtaining a competitive advantage.

2. The essence of talent management

Talent management is considered to be one of the most important global trends which influence the human resources development policy (Knap-Stefaniuk, Karna, 2017). This trend is also visible in Poland, which results in emphasising the need to create special development programmes for employees with the highest potential (Tabor, 2013). Talent management, next to performance management and supporting the work-life balance, is also recognised as one of the three main challenges of strategic human resources management (HRM) (Brzeziński, 2015).

Talent is a complex set of expectations from both managers and their talented subordinates. Many of these expectations are undefined and most of the difficulties in managing talented people arise from that problem. There are three main streams in talent management:

- talent management equated with human resource management,
- talent management focusing on the flow of employees and their adequate deployment in the unit,
- talent management consisting in employing the most talented individuals and treating them as a superior asset (resource) for the organisation (Tabor, 2013).

In order to properly understand the concept of talent management, it is necessary to define it first. There are several definitions of talent.

In psychological terms, talent is defined as a person who has a better appearance and understanding of his or her unique interests and aptitudes than others, perceives the relationship of these attributes to educational and professional opportunities, thinks reflectively and knows how nurturing these individual characteristics can affect their future development (Achter, Lubinski, 2005).

In their publications, A. Miś and A. Poczowski define a talent as a person who „brings something to the organisation which is a kind of excess in this organisation, often not visible in its plans and strategy, due to the fact that the organisation is not aware of it until a certain moment. The features of the competence profile of a talented person are consistent with the needs of the organisation at an accepted level, but there is something that makes them special, which cannot be measured (Miś, Poczowski, 2008).

On the other hand, J. Kopeć defines the concept of talent as „innate abilities transforming, as a result of actions taken, into appropriate skills and passion thanks to which a given individual can make products or provide services that are socially useful and subject to high quality assessment, beautiful or pleasing to the senses of the receiver at a level higher than average and difficult to meet by the majority of other producers or reproducers of a given product or service (Kopeć, 2012).

Slightly different aspects in her definition of talent are pointed out by J.A. Tabor who notes in her publications that talent "is a person who combines innate skills, intelligence and a desire for self-fulfilment with the ability and willingness to continue learning and development. They may have experience, which we will judge by their high results already achieved at work, or they may be just starting their career, demonstrating competences which particularly distinguish them among candidates. Talent consists of qualifications, potential and capabilities as well as hard work to develop one's personality and professional competencies (Tabor, 2013).

It follows from the above definitions that that talents display above-average skills and a set of personal qualities such as individual effectiveness, leadership skills, entrepreneurship, passion in action and commitment to their work tasks, which allow them to achieve excellent results at work - Figure 1 (Miś, 2020). However, it is important to remember that talent should be interpreted not only as a person outstanding in above-average skills, but as an employee who through his or her involvement and own development contributes to the success of the organisation. Talent understood in this way becomes the subject of talent management, often expressed in the literature as TM.

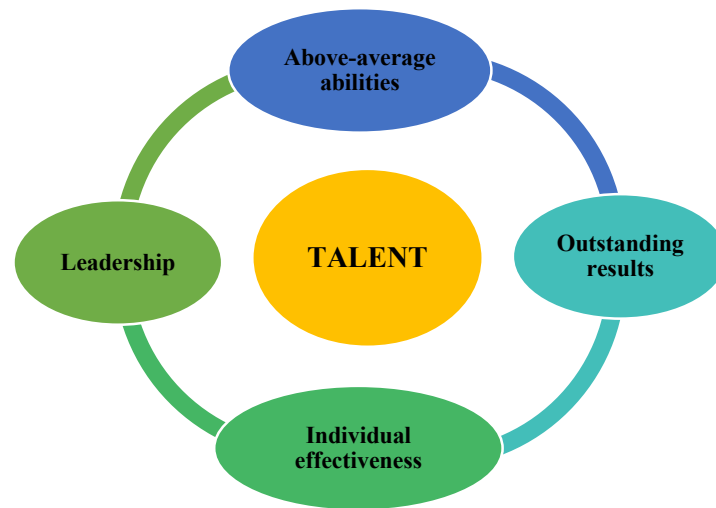


Figure 1. Set of personal characteristics defining talent.

Source: Own elaboration based on: Miś, 2020.

Considering the diversity of characteristics and individual abilities allowing for high performance at work the problem of defining the concept of talent management appears. Another issue is the lack of unanimity among management science experts. This is why, despite many attempts, it has not been possible to formulate a single definition of talent management.

M. Armstrong defines talent management as "the process of identifying, developing, recruiting, retaining and deploying talented individuals (Armstrong, 2011).

R.S. Wellins, A.B. Smith and L. McGee prefer to define talent management as "the recruitment, development, promotion and retention of talent, planned and executed in accordance with the current and future goals of the organisation (Wellins, Smith, 2006).

E.E. Lawler points out „attracting real talents and helping them understand what is expected of their work for the company. (...) It is also about providing employees with developmental experiences that create organisational strength and core competencies to retain real talent” (Lawler, 2008).

On the other hand, T. Davis states in his publications that "talent management is about recruiting and properly training and developing employees as well as retaining excellent performing employees on a continuous and consistently. A talent management strategy is a deliberate, structured approach by a company to the recruitment, retention, and training and development of talent in its organisation. and development of talented individuals in the organisation (Davis, Cutt, Flynn, Mowl, Orme, 2010).

J. Kopeć defines talent management as a process of strategic importance for the company consisting in identifying employees with above-average abilities and achieving the best results at work or their identification, attracting them to the unit and creating an appropriate organisational culture conducive to the development of this group, so that they bring maximum value to the company's stakeholders and ensuring that these staff do not leave their current place of employment (Kopeć, 2012).

Strategic talent management is also understood as activities and processes involving the systematic identification of key positions affecting organisational competitiveness, the development of a pool of high-potential and highly effective talent to fill these roles, and the development of a differentiated human resource architecture to support the filling of these positions with competent people, ensuring their commitment to the organisation. These processes and actions lead to a measurable difference in organisational effectiveness now and in the future (Miś, 2020).

The effectiveness of talent management in an organisation depends on many factors. The management literature identifies, among other things, elements such as:

- attracting outstanding individuals to the organisation,
- keeping talents in the organisation,
- effective talent management,
- talent identification (Mikuła, 2001).

The variety of interpretations of the concept makes it difficult to establish a single definition as the most appropriate one. Therefore, it seems more reasonable to distinguish several main perspectives from which talent management can be considered. J. Blass describes it as:

- process perspective - the process perspective believes that the future success of the company depends on having the right talents, so talent management and nurturing should be a part of the daily processes of organisational life. Talent management and nurturing are an integral part of the organisation's processes;
- cultural perspective - the cultural perspective considers talent management as a kind of mindset, a belief that talent is essential to the success of a company. It is a belief that talent is a key factor in achieving business success, each individual talent is important to the organisation and talent development becomes part of the work routine;
- competitive perspective - from a competitive perspective, talent management is about identifying talent and offering them what they need to prevent them from being acquired by competitors;
- development perspective - according to the development perspective, talent management is about fast-tracking high-potential employees; talent management is about creating development paths for the most outstanding;
- HR planning perspective - following the HR planning perspective ZT is about connecting the right people with the right jobs at the right time and performing the right tasks;
- change management perspective - in the change management perspective talent management is used as a driving force for change in the organisation. ZT is treated as a part of a broader strategy, initiating changes in the company (Mróz, 2015).

It is assumed that similar or sometimes the same processes are used in talent management as in human resources management (Gottwald-Białdyga, 2018). In both processes people are the subject used to achieve the organisation's competitive advantage in the market. The key

aspect in talent management is the awareness of employees' self-realization with simultaneous continuous development. This will make their work much more efficient, satisfying potential employers. Talented employees use their abilities and natural aptitudes

Important concepts in relation to talent management are recruitment and selection, which enable the talent acquisition and identification process to operate efficiently. Recruitment of employees is aimed at selecting individuals who meet the requirements set for them by the company. After selection the organisation gives them the opportunity to further their education through training adapted to the needs of the company. Outstanding individuals who contribute to the organisation's profits and goals are recognised, if only through remuneration appropriate to their work. An employee appreciated by his employer has no intention of leaving for a competing company. Currently, many companies invest in human resources focusing on their quality rather than quantity. An important aspect is the choice and selection of individuals who thanks to their high competence will help achieve the company's strategic objectives.

The leader plays an important role in talent management. The role of a leader begins with getting to know the potential of the players and discovering their talents (Balcerzyk, 2021).

Summarising the above, the main premise of the talent management concept is to find ways in which the competencies and potential of employees can be revealed and then exploited.

3. Methods and characteristics of the research sample

The questionnaire concerning talent management in the Wrocław Sport Taekwon-do Club, conducted from the beginning of February to the middle of March 2022, was addressed to people actively training in the Wrocław Taekwon-do Sports Club (WTSC) who are not their competitors as well as to licensed competitors of the Club. It was divided into two sections - the first one applied to both tested groups while the second part referred only to licensed competitors of the described club. The research group consisted of 30 people (16 women and 14 men). The most numerous age group were 19-25 year olds (37%) and 15-18 year olds (33%). A less numerous group were people aged between 25 and 31 (20%). The least numerous group were people aged over 32 (only 10%).

The age of the competitors is closely related to the age category in which they compete. The Junior category is made up of players aged between 13 and 15. In this group of people, 13% of all respondents took part in the research. Juniors are 16 to 18 year olds and account for 23% of respondents to the survey. Seniors constitute the largest group of respondents - 57%. Competitors between 19 and 35 years of age take part in it. The last age category, and at the same time the least numerous group of respondents (7%) are Veterans aged over 35 years.

Among the respondents people with high (at least 10 years) training experience dominate and they constitute 53% of all the respondents. This draws attention to the fact that many people with long-term experience train at the club which can be used in shaping young players. The second largest group (37%) is represented by people with 5-10 years of training experience. Less numerous, 7% and 3%, are respectively the groups of respondents with 2 to 5 and less than 2 years of training experience.

The aim of the conducted research was to diagnose talent management in the Wrocław Taekwon-do Sports Club.

4. Managing the talented competitors

According to research, 80% of those training at the WTSC are its licensed players, while the remaining 20% only train there. This draws attention to several aspects. The first is an extremely innovative approach to players from rival clubs, which is cooperation. The club does not close itself off to competitors; on the contrary, it makes its resources available to them. In return, it receives certain benefits, including talented players from other clubs raising the level of training - sharing their knowledge and skills. It also gives an opportunity to learn about the strengths and weaknesses of rivals, as well as the training methods of other clubs, so that appropriate tactics can be developed.

Another important issue in the context of talent management is the fact that there is an opportunity to get talented, already formed players, who may decide to leave their previous club. At this point it will be important to present the opportunities that the club offers its players. The most important factors that can determine this are availability, financial considerations, development prospects and the atmosphere at the club.

Research shows that as many as 47% of those surveyed admit to having participated in at least one training camp of the Polish National Taekwon-do Team. This means that these are (or were) well-formed athletes who maintain a very high level of performance, have extensive experience competing in national and international championships, and are constantly developing. They achieve high results and are often versatile - winning medals in various categories, both individual and team. The fact of being in the national team requires them to devote a great deal of time to preparing for sports events. Almost half (47%) of the respondents are very experienced competitors and are ready to pass on their skills and knowledge. As many as 90% of the respondents indicated that they were medallists at international tournaments and 86% said that they had won a medal at national tournaments.

Considering the above factors, this group of people should be defined as talents. It should be remembered that some of them are not players of Wrocław Taekwon-do Sports Club, but they train there every day. Thanks to that the level of training is raised and licensed players have the opportunity to draw knowledge, skills and experience from them.

The study attempted to identify factors motivating athletes to train and develop. The factors were divided into two types. The first one was self-motivation which includes factors coming from inside a person, i.e. opportunities for physical and psychological self-development (participation in trainings, courses or competitions), own satisfaction, a desire to improve motor abilities and maintain an athletic body. This type of motivation is the most important for talent development, because the definition of talent presupposes a high level of self-motivation. However, it is also important to provide other factors, which are referred to as extrinsic motivation. This group includes other influences such as pressure from coaches, parents or peers, financial benefits such as the desire for scholarships and prizes, the desire to win medals and the opportunity to meet friends at training or competitions.

Research has shown that 90% of people training at the Club train primarily for their own satisfaction and have a high level of self-motivation. They value activities that enable self-development in the form of participation in competitions and improvement of motor skills such as agility, speed or strength. Most respondents are also positively motivated by the possibility to stay in athletic shape. A small percentage of people train because of external pressures, financial gain or winning medals. However, many people treat participation in training or competitions as a great opportunity to meet with friends.

It is also important to mention the club's process of acquiring talented athletes. About 20% of the players are persons acquired by the Wrocław club from other sports clubs. Due to this, the respondents were asked about the above issues.

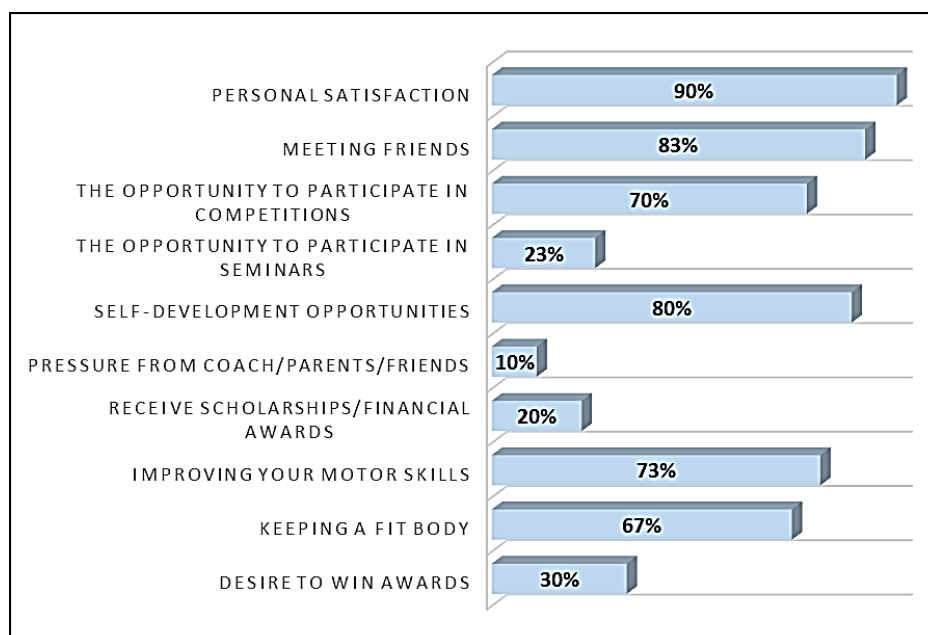


Figure 2. Diagram showing factors influencing players' motivation.

Source: Author's own analysis.

It turns out that the factor that most encourages the respondents to choose the Wrocław Club is the wide range of talented players who are successful in the national and international arena. Their achievements motivate and the talents themselves are living examples to follow. Thanks to this new icons appear and they promote the club all over Poland.

Interesting trainings and a wide and trained coaching staff are also very important factors indicated by the respondents. The first of them prevents routine which kills creativity and accelerates professional burnout, which unfortunately often affects above-average talented people. Related to this is the fact that 79% of respondents believe that the Club's coaching staff is professionally prepared to work with young people. Their participation in coaching courses or seminars develops their competences, and they themselves propose modern training solutions. This leads to a conclusion - the two above factors function inseparably with each other. Another related advantage noted by 63% of the respondents is a wide range of coaching staff, thanks to which trainings are varied, and an additional advantage of the described element is a multidimensional view obtained thanks to trainings under the supervision of several coaches. It should be noted that as many as 21% of the respondents rather did not pay attention to this issue when choosing a club.

The respondents also identified who has the greatest influence from their environment on their sporting career. All players highlighted the coach as the person who clearly contributes to shaping the path of their sporting career. About 46% of the respondents at the same time mentioned that it is the coach, through his decisions, who influences his athletes to the greatest extent. This means that according to the respondents, the coach's concepts, training selection, his or her help and support is the key to their success. More than 38% of the athletes stated that they themselves decide on the trajectory of their sports career. This demonstrates the high self-awareness of the respondents who are thoughtfully attempting to take the most important decisions concerning their careers. They are aware of their capabilities and are able to use their knowledge and skills for self-improvement. Another frequent answer was the statement that the respondents' career is strongly influenced by their friends training in the Wrocław Club. Therefore, it should be noted that joint trainings, trips to competitions or training camps with friends can motivate for self-development, introduce healthy rivalry and elements of entertainment. The influence of people outside the sports environment (parents, siblings and friends) was considered insignificant by the competitors.

The research shows that the players of Wrocław Club most value the opportunity to practice with titled players training in the club. This opportunity would positively influence as many as 91% of respondents. A great prospect for development for 88% of people would also be the opportunity to compete in various competitions. Over 80% of the respondents also indicated that participation in inter-club sparring, seminars and training would have a positive impact on improving and expanding their skills.

As part of talent management, the Club provides opportunities for players to develop by running their own sections. More than 38% of all respondents, are individuals who already have their own training sections or individuals who the coaches can support when necessary. The club makes proper use of the competences of talented players by managing them properly. By assigning them to their own training groups, the club makes it clear that it has great trust in them, while the talents can show their creativity by introducing innovative solutions.

The surveyed organisation promotes its talented players through financial support. As many as 92% of the respondents perceive that without the Club's financial support they would not be able to secure participation in competitions. The club trains a small number of people who receive awards and scholarships from various sources such as the Marshal's Office or the Municipal Office in Wrocław.

It is remarkable that more than half of the respondents do not attach importance to activity in social media. Most of the respondents also do not pay attention to the club's involvement in various promotional activities of their players. This also makes it difficult to attract potential sponsors. Slightly more than 1/3 of the respondents believe that this aspect is important for them. It should be remembered that through proper conducting of individual profiles or websites the club can effectively communicate with the surroundings. The benefit can also be the shaping a positive image of the club.

The research shows that the Wrocław club cares about monitoring the departure of talented players. Usually the reasons for such decisions are injuries or relocation. The club is positively perceived by its players and 96% of the respondents said that they would definitely recommend the club to their friends. Only 4% are unable to say whether they would recommend the club to their friends or colleagues. This shows that often, despite the decision to leave the club for various reasons, the players will remember the club very pleasantly and as a result shape a positive image of the organisation in the sports environment.

5. Conclusions

At the Wrocław Club, a group of talented players can be identified and singled out based on an analysis of their achievements. These are individuals who have a great wealth of knowledge and experience and are constantly expanding their skills and qualifications. Talented people can also include some people who are not players at the Club but train there on a daily basis. Therefore, it seems reasonable to pay attention to attracting such players. In addition to the mentioned groups of people, young, developing players should also be mentioned. Such people can also supply the existing pool of talents, so it is important to bet on their development as well.

The Management Science literature emphasises the importance of conducting a reliable, starting from strategy planning to conducting an in-depth analysis and evaluation of talent management in an organisation. The conducted research shows that talent management processes in the studied organisation are carried out automatically and consciously. Thanks to the developed system, which nevertheless requires a few improvements, the players achieve excellent results. The atmosphere in the Club is also worth mentioning. Consequently, the following conclusions emerge after the analysis:

- the Club trains talented people who have great knowledge and skills, who regularly win medals in the national and international arena and are appointed to the National Team identified as talents;
- they are highly motivated and train primarily for their own satisfaction;
- the researched organisation has adopted an extremely innovative approach to athletes from rival clubs - cooperation. The club makes its resources available to them and in return receives certain benefits: a high level of training, as well as the opportunity to learn knowledge and skills from them;
- research shows that a club takes advantage of the opportunities offered by allowing talented players from rival clubs to train with them, later acquiring them on a permanent contract;
- the factor which most encourages players to choose Wrocław Club is the wide range of talented successful players. Their achievements become a motivating factor and the talents themselves are examples to follow;
- very important elements are also interesting trainings and a wide and well-trained coaching staff indicated by the respondents. Coaching courses or seminars help widen horizons and offer modern training solutions;
- the club makes proper use of the competences of talented players by managing them properly. The club uses the skills of talented players in the right way by managing them properly, assigning them to their own training groups which shows that it has great confidence in them. The talents can show their creativity by introducing new solutions;
- the players claim that if they received a competitive offer, they would not accept it. None of the interviewees are inclined to leave the Club which shows high loyalty towards the Club and proves that the players feel comfortable and the Club meets their requirements;
- almost all players, despite having to decide to leave the club for various reasons (injuries, change of residence), stated that they would recommend the club to their friends which contributes to the formation of a positive image of the organization in the sports environment.

The analysis of the collected results allows us to formulate a conclusion that proper talent management in the researched organisation brings results in the form of successes of talented players on the national and international arena. However, the talent management process needs to be improved:

- the club should focus on the planning process and in particular the long-term planning of the players' career paths. This should include elements such as discussing previous seasons, learning from mistakes made and targeting specific goals to be achieved in future seasons;
- another element for improvement is the funding of talented players. Although it is the club that provides the most financial support to its players, it very often turns out that the burden of financing participation in sporting events falls on the athletes themselves and their families;
- it would be advisable to intensify the club's efforts to raise funds by submitting scholarship and award applications.

To sum up the research on the issue of "talent management", it should be stated that talents require appropriate conditions to reveal themselves and develop. It is necessary to know the area of activity of the employee, in which the information for talent development will be obtained. The implementation of "talent management" programmes is mainly conducive to increasing the company's competitiveness in the market, supporting organisational culture, retaining talented employees in the company, ensuring the inflow of new talented employees, creating a positive image on the external labour market.

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DIGITAL TECHNOLOGIES IN THE ACCOUNTING INFORMATION SYSTEM SUPPORTING DECISION-MAKING PROCESSES

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Purpose: The aim of the article is to characterize the possibilities of improving the accounting information system supporting decision-making processes in the enterprise with the use of selected digital technologies with particular emphasis on artificial intelligence.

Design/methodology/approach: Basic research methods include critical analysis of literature. Simulation models of the stock market game using deep learning were also used. In addition, intensive computational experiments were carried out to analyze the quality of the solutions, which were determined by the proposed deep learning methods using artificial neural networks based on short-term memory (LSTM). The research presented in this article was verified by simulating the possibility of using deep learning.

Findings: The results exceeded the estimates described in the literature. The average error is estimated to be less than 3% when using the LSTM network. It should therefore be assumed that other deep learning paradigms will also be an effective tool in financial systems. The results of theoretical research and numerical experiments confirmed that the impact of selected digital technologies on the improvement of the accounting information system supporting decision-making processes is significant.

Practical implications: The results are the basis for formulating recommendations regarding the possibility of using the analyzed digital technologies in the accounting information system, supporting decision-making processes in the enterprise. They can also serve as an example of the digital transformation of the enterprise accounting information system.

Social implications: The obtained results indicate significant opportunities to improve the accounting information system supporting decision-making processes. This situation suggests the need to implement the latest achievements of digital technologies in the accounting information system for the effective collection and processing of a growing amount of data. A clear presentation, ongoing monitoring and precise prediction of future results are the basis for making effective decisions based on precise data analysis, and not based on intuition or experience of the decision maker.

Originality/value: The authenticity of the study results stems from the clear ideas for the effective use of digital technologies, in particular, deep learning with the use of artificial neural networks in the cloud to improve the accounting information system, especially in the field of estimating forecasted values.

Keywords: Accounting, Artificial Intelligence, Digital Technologies.

Category of the paper: research article.

1. Introduction

The main challenges in the post-pandemic realities of economic development are the digital revolution, energy transformation and climate change. As a consequence, the key factors influencing the changes in the approach to the accounting information system are sustainable social, ecological and technological development. Digital technologies play an increasingly important role in improving the accounting information system in terms of effective data processing and extracting business-useful information from them. This article is a synthetic analysis of the possibility of using selected digital technologies to improve the accounting information system in the conditions of growing information requirements and to adapt reporting to the needs of managers and individual stakeholder groups.

Digital transformation of business is a process that uses digital technologies in virtually every area of the company's operation, including accounting. Progressive digitization and growing information requirements increase the demand for an effective information and accounting system, enabling the acquisition of understandable economic and financial information in a relatively short time, on the basis of which the knowledge necessary to make effective decisions enabling the increase of the company's competitiveness is obtained. An effective information and accounting system that supports the decision-making processes of managers requires support from modern ICT systems for the collection and intelligent processing of a rapidly growing amount of data.

The factors affecting the extension of the scope of information required in corporate accounting is the global trend towards sustainable development of innovative circular economies based on knowledge and modern technologies. The circular economy means the use of innovative solutions in companies that reduce the consumption of natural resources and ensure environmental protection. On the other hand, the pursuit of sustainable development means integrated activities in the economic, social and environmental spheres. Sustainable development means that stakeholders expect not only accurate information about the type of company's operations and its financial results, but also about the research and development activities it undertakes, which are innovative, and at the same time take into account care for the natural environment and are characterized by social responsibility.

In the era of sustainable development of economies based on knowledge, innovation and modern technologies, it is necessary to prepare increasingly complex reports for internal recipients and to disclose more and more information in financial reporting to external recipients. In this context, it is of key importance to streamline the processes of collecting and intelligently processing the required data, as well as adapting reporting to the information needs of individual stakeholder groups. The effective use of modern digital technologies is a prospective direction for improving the accounting and reporting information system, in particular in the micro and small enterprises (MSE) sector in the countries of Central and

Eastern Europe, in the light of the ongoing system and economic changes. These technologies not only improve the process of data collection and storage, but above all create a huge space of various processing, analysis, reporting and transparent presentation of data in order to extract knowledge, which is a key resource in today's competitive conditions.

The aim of the article is to characterize the possibilities of improving the accounting information system using such breakthrough technologies as: Blockchain, Internet of Things, Big Data, Cloud Computing and Artificial Intelligence. According to the Author, the effective use of the latest solutions based, in particular, on deep learning in the accounting information system, has great potential to improve decision-making processes in the company. Comprehensive and properly structured information is the basis for success, because up-to-date information allows you to achieve a competitive advantage and reduce economic and investment risk. There is a gap in the literature in this regard, because there are no clear ideas for the effective use of deep learning using artificial neural networks in the cloud to improve the accounting information system supporting decision-making processes in the enterprise.

The article discusses the possibilities of effective use of digital technologies to improve the accounting information system that supports decision-making processes in the enterprise. In particular, the issue of deep learning for forecasting in financial systems was described. Considerations on a specific case of a deep learning architecture based on artificial neural networks are also presented. Neural networks based on long-term memory were considered for estimating predicted values in relation to stock market investments. Finally, conclusions and planned future work are presented.

In the context of the above considerations, we should ask the following questions. How to effectively improve the accounting information system? How to use modern technologies, including artificial intelligence and cloud computing? How important is the use of deep learning and cloud computing to obtain business-useful information that facilitates making the right decisions? We may be able to answer some of the above questions at the end of this article.

The rest of this article is organized as follows. Part I presents an overview of the literature on the subject. Section II defines the role of the accounting information system in the decision-making process in the enterprise. Part III describes the importance of disruptive digital technologies to the accounting information system. Section IV presents the possibilities of improving the accounting information system using artificial intelligence and cloud computing. Section V describes deep learning for forecasting in financial systems. Considerations on a special case of deep learning architecture based on artificial neural networks (ANN) are also presented. The LSTM class recursive ANN has been validated for financial investments in the stock market in Section IV, which also considers long-term memory based neural networks for estimating predicted values. Finally, conclusions and planned future work are presented.

2. Related work

Accounting plays a very important information function both in the Shared Service Center (SSC) and in Business Process Outsourcing (BPO) of financial and accounting services (Martyniuk T., 2016). The essence of accounting is defined as an institutionalized information and control system adapted to the purposes of the broadly understood financial management of an economic entity, reflecting economic events and processes occurring in the enterprise, as well as in its relationship with the environment, included in the monetary measure for the purposes of supervision, control, planning and publishing (Kloock, 1997). The essence of accounting as an information system in the era of digitization of enterprises is interpreted as a system of continuous and systematic collection, measurement, processing and presentation of data (Gierusz, 2018). The increase in the functionality of the accounting system as an information system was influenced by the division into financial accounting, generating information in the form of financial statements for the environment, and management accounting, providing financial and non-financial information for internal recipients in the form of reports. Reliable interpretation and transparent presentation of data play a key role in the accounting information system, allowing for obtaining practical economic and financial information. An important qualitative feature of the accounting system as an international language of business and finance, increasing the usefulness of the generated information, is ensuring its comparability in the reporting of various entities (Gierusz, Martyniuk, 2017). An important premise for improving the accounting information system is the global trend towards the development of circular economies (European Commission Communication, 2.12.2015). The aforementioned trend increases the information requirements in the field of innovative solutions used in the company that reduce the consumption of natural resources and ensure environmental protection.

Sustainable development poses additional challenges to the accounting and reporting system, especially of the SME sector in the countries of Central and Eastern Europe (Martyniuk, 2021). They are related to growing information requirements regarding both financial and non-financial data. With regard to financial data, the most important is information on resource consumption, which allows for more accurate measurement and settlement of costs (Kotecha et al., 2022). Effective cost accounting principles should be applied in many areas, including in healthcare settings (Martyniuk et al., 2021). On the other hand, with regard to non-financial data, the extended scope of data expected by stakeholders mainly concerns the social and environmental responsibility of the conducted business activity (Martyniuk, Majerowska, 2017).

Digital technologies meet the challenges arising from the need to improve the accounting information system and adapt it to the information needs of individual stakeholder groups. In the era of digitization of the economy, it is particularly important to identify the opportunities

created in the discussed area by digital technologies (Śledziwska, Włoch, 2020). In the literature on the subject, attempts are made to define the opportunities that modern digital technologies create for business (Gregor, Kaczorowska-Spychalska, 2020). Their impact on the increase in the competitiveness of enterprises no longer raises any doubts (Bartnik, 2016). The question is how to effectively use the potential of key technologies that intensify digital transformation to obtain clear information on the basis of which practical business knowledge necessary to make optimal management decisions (Olszak, 2007). This is because employees, especially managers, are expected to solve problems quickly and efficiently (Nazmiye, Mehmet, 2022).

Many solutions have already been developed in the field of creating and using electronic systems for processing company data and communicating information to recipients. These include domain-specific financial and accounting systems used in financial accounting to record events and prepare financial statements according to strictly defined rules. On the other hand, in the area of management accounting, spreadsheets and integrated ERP-class computer systems, based on a common database, mainly for consolidation and budget preparation, played a significant role in improving the information system. However, they were intended only for the collection and processing of historical data.

Computer programs for solving decision problems had much greater utility values, from the point of view of the possibility of generating forecasting information, used mainly for planning and reducing economic risk. Such programs additionally used methods from other fields and theories, such as game theory or operations research.

Another class of computer programs, based on ERP class systems, has already enabled the generation of information needed to improve process management and rationalize operational data. An exemplification of the improvement of process management in accounting is the automatic generation and sending of tax returns. Extending such systems with artificial intelligence modules would additionally enable automatic drawing of conclusions based on data and the creation of specialized business analysis. Programs to improve process management and rationalize operational data were developed under the name of Business Intelligence (BI) and were increasingly used in business at the turn of the 20th and 21st centuries (Olszak, 2012b).

In the following years, applications began to be created, which were to improve the management of achievements by viewing scorecards, generating reports and preparing specialized analyzes (CIMA, 2008). New solutions in the field of self-service systems also had an impact on the use of information collected as a result of the use of management accounting methods in the company. The new solutions had an impact on the use of information collected as a result of the use of management accounting methods in the company (Łada, Burnet-Wyrwa, 2015).

The ongoing digitization increases the demand for advanced, cognitive accounting information systems, including those using the most modern quantitative methods (Soszyńska-Budny, 2021) facilitating data analysis, as well as specialized software facilitating work in this area (Balicki, Balicka, Dryja, 2021). Advanced accounting information systems supporting decision-making processes in the enterprise should enable not only a clear presentation of the achieved results, but also the monitoring of current operations, updated on the basis of data flowing in real time, and, very importantly, the prediction of future outcomes.

How, then, against the background of the solutions used so far, can you improve the accounting information system and support the process of making optimal decisions, using the potential of breakthrough digital technologies, in particular the latest achievements of artificial intelligence? The author tries to answer this question in the following parts of the article, trying to at least partially fill the existing gap in the literature on the subject.

3. The role of the accounting information system in the decision-making process

An effective accounting information system is an increasingly popular term in the context of digitization of enterprises, as well as increasing their competitiveness and market value (Pioch, 2011). In short, this term can be defined as a type of systems that transform raw data into clear information, on the basis of which knowledge is built necessary to make the right decisions and consciously analyze activities in the enterprise. Initially this term was identified only with data analysis tools (Anandarajan, Srinivasan, 2004). Currently, effective information system is understood much more broadly, namely as an element connecting various components that make up the infrastructure supporting decision-making (Baaras, Kemper, 2008), providing decision-makers with comprehensive information, precise analyzes and reports (Negash, 2004). An effective information system is a kind of combination of tools, software and expert knowledge. The expected result of the effectiveness of such a system is the improvement of the company's results and the elimination of potential threats (Benbouzid, 2019).

The key technology for building an effective information system is a data warehouse (Inmon, Strauss, Neushloss, 2008; Sauter, 2008), that integrates data from various information systems for analytical purposes. Data warehouses store all possible information about the company, including transactions, settlements, processes and relationships. The more data the warehouse contains, the better results are obtained from data processing. The data warehouse is the basis for the effective use of various analytical tools, such as: data exploration and process exploration (Olszak, 2012a), but also more advanced, such as expert systems, neural networks (Balicka, 2020; Balicki, 2013) or genetic algorithms (Balicki et al., 2020). Advanced analytical tools are used to perform specialized analyzes using detailed "cross-sections" of data, allowing to verify hypotheses made on the basis of previously generated, standard reports and indicators.

Basic techniques for visualizing reports include scorecards and interactive dashboards. Presentation techniques are selected according to the individual needs of the user. The scorecard shows the company's progress based on current metrics and values against predefined goals. Scorecards are most often used to monitor the financial condition of a company (Figure 1).



Figure 1. Finance KPIs Using Scorecards.

Source: Saranya K. (2019). *Scorecards vs. Dashboards: Which Should Your Organization Use?*, <https://www.boldbi.com/blog/scorecards-vs-dashboards-which-should-your-organization-use>, 15.06.2022.

In turn, an interactive dashboard allows you to visualize a wide range of indicators in a clear picture form. The advantage of this presentation technique is the ability to monitor financial results in real time, which increases the effectiveness of decisions made. The interactive dashboard allows you to update reports on an ongoing basis based on real-time data. Continuously updated reports allow you to effectively monitor corporate finances, historical revenue data, company's critical financial metrics, and other important metrics (Figure 2). Interactive dashboard scenarios can be modified according to the user's information needs (Saranya, 2019). With the help of dashboards, you can acquire the knowledge necessary to optimize organizational processes in the company, financial optimization, increase sales and find the cause of poor sales of some products, as well as reduce costs and reduce business risk related to late payments by customers.



Figure 2. Monitoring of Financial Performance Using the Dashboard.

Source: Saranya K. (2019). *Scorecards vs. Dashboards: Which Should Your Organization Use?*, <https://www.boldbi.com/blog/scorecards-vs-dashboards-which-should-your-organization-use>, 15.06.2022.

The role of the accounting information system in the decision-making process in the enterprise is evidenced by the variety of solutions that enable the effective use of the potential of corporate data. There are many systems for data analysis and processing. Their classification is made mainly due to the purpose and purpose of the information obtained. Popular systems for data analysis include: OLAP, DSS and EIS. OLAP (Online Analytical Processing) enables data processing based on multidimensional analysis and multidimensional data structures. DSS (Decision Support Systems) is a system dedicated to supporting informed decisions based on precise data analyzes and reports. A specialized form of the DSS system is EIS (Executive Information Systems), which represents the systems of early informing of senior management, supporting the making of strategic decisions.

Depending on the purpose for which business information is sought, an appropriate division is made into analysis: predictive, prescriptive, diagnostic, descriptive and cognitive. Predictive analytics is about forecasting and modeling the future. Prescriptive analytics establish both possible scenarios and the consequences of potential decisions. Diagnostic analytics provides answers to questions about the causes of given events, based on historical data. Descriptive analytics processes historical data to describe specific past facts. On the other hand, the increasingly important cognitive analytics uses advanced technologies of artificial intelligence and machine learning to process large amounts of data in order to support managerial decisions, but also to enable autonomous decision-making by a dedicated accounting information system.

Making the right decisions leads the organization to success, and the use of appropriate analytical tools enables making decisions based on evidence (Szymczak, 2012). No unequivocal answers or indications of the only right solution were expected from the hitherto used accounting information systems. These systems only supported problem solving in key areas of finance, such as assessing the impact of the structure and cost of capital on the level of profitability of enterprises (Majerowska, Gostkowska-Drzewicka, 2021), however, they did not make decisions for the manager. On the basis of the economy transformation from analog, through digital to autonomous, cognitive information systems that use primarily artificial intelligence are becoming more and more popular (Czajkowski, Kuzior, 2019).

An effective accounting information system should be tailored to the needs of a given enterprise, constituting a dedicated solution that enables the use of the potential of company data. Therefore, the same schemes and algorithms are not used in individual enterprises (Lech, 2021). For this reason, the key role in creating dedicated solutions that enable the transformation of raw data into practical business knowledge is played by proper identification of both the type of data collected and processed, as well as the specification of information expected by decision makers. The expectations relate primarily to knowledge allowing to achieve a competitive advantage, as well as enabling the reduction of economic and investment risks. In order to support the decision-making process, new forms of management information with an extended

range of data expected by business users, based on precise analyzes and appropriately visualized and interactive reports of advanced accounting information systems, are necessary.

4. The importance of breakthrough digital technologies

The most disruptive technologies (Figure 3), shaping the future of the digital economy and business, include: Artificial Intelligence (AI), Cloud Computing, as well as the Internet of Things (IoT), Big Data, Blockchain and Robotic Process Automation (RPA). The identification of the most breakthrough technologies, also referred to as technologies intensifying the digital transformation towards Industry 4.0 and Enterprises 4.0, was made on the basis of an assessment of global technology trends, carried out by major research centers and consulting and advisory companies, such as DELab UW (Śledziwska, Włoch, 2020), Gartner (Gartner, 2022), McKinsey (Manyika et al., 2013), Deloitte (Henke, Wilmott, 2018), and the Council on New Technologies of the World Economic Forum (World Economic Forum, 2018). An interesting approach not only identifying the most important new technologies, but also determining the phases of their maturation, was presented by the consulting company Gartner (Panetta, 2018).

Many companies try to apply modern technologies as soon as they are available on the market. It results from the belief that digital technologies are among the factors ensuring the achievement of a competitive advantage. Meanwhile, technologies by themselves do not guarantee anything, they only create certain opportunities. Effective ways of implementing and using them are important. The key to the survival and development of enterprises is to treat digital technologies as an integral part of the strategy and orientation in the new digital economy (Brzóska, Knop, Olko, 2017). It can be said that digital technologies constitute a kind of backbone, while the larger, up-to-date, reliable and precise knowledge obtained with them and its use in the process of reasoning and making optimal decisions is the basis of the digital economy based on knowledge, in which information and the ability to use it are becoming an increasingly important factor of production.

Technological solutions integrating cloud computing, mobile technologies and the Internet of Things contribute to the generation of large sets of various data (Big Data). Therefore, there arises the problem of skilful selection, evaluation and use of the collected information by managers operating in a large amount of data. It can be concluded that on the one hand, technologies improve the operation of enterprises, increasing efficiency, productivity, reliability, quality of manufactured goods, work safety and allowing to reduce operating costs. On the other hand, they generate an enormous amount of data (Figure 4).

Taking into account the fact that data is a strategic factor of production in the digital economy, it should be emphasized that the key issue is not the mere generation and collection of data, but their effective processing. In the smart business of the digital economy, the basis of success is skillful inference based on knowledge extracted in a relatively short time in the process of processing and analyzing many different sources and categories of data (Nguen et al., 2018). Intelligent reasoning, supported by technology, consists in comparing the acquired knowledge with the existing situation, which enables making optimal decisions and modeling future events related to the enterprise.

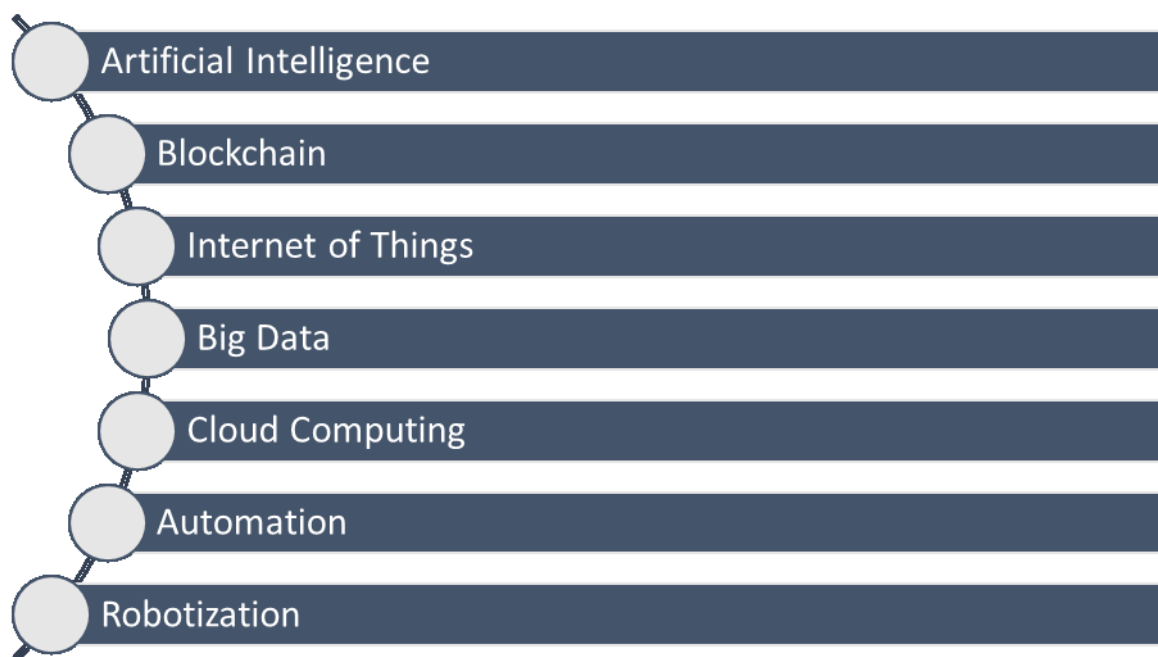


Figure 3. New efficient technologies for business.

Source: Own study based on: Rahman A. A., Hamid U.Z.A., Chin T.A. (2017), Emerging with Disruptive Effects, A Review, *PERINTIS eJournal*, Vol. 7, No. 2, p. 112.

Appropriate management of a rapidly growing amount of data requires skilful use of the knowledge and ideas of employees, supported by modern ICT technologies. Skilful acquisition and use of data increasingly determines the position and competitive advantage of enterprises. Collecting data mainly about the preferences of recipients allows you to optimize the offer, but also allows you to predict consumer behavior, using innovative methods of personalized internet marketing. The collected and properly used user data allowed companies such as Microsoft, Apple, Amazon and Alphabet to place in the top five corporations with the highest market value in 2021, created by the magazine "Fortune 500" and Financial Times Global 500". It is worth noting that the total revenues of the largest global companies from the above-mentioned list, driven by innovations introduced thanks to the effective use of digital technologies, account for over one third of the world's GDP. Thus, innovation creates market value and is the main driving force behind the development of enterprises.

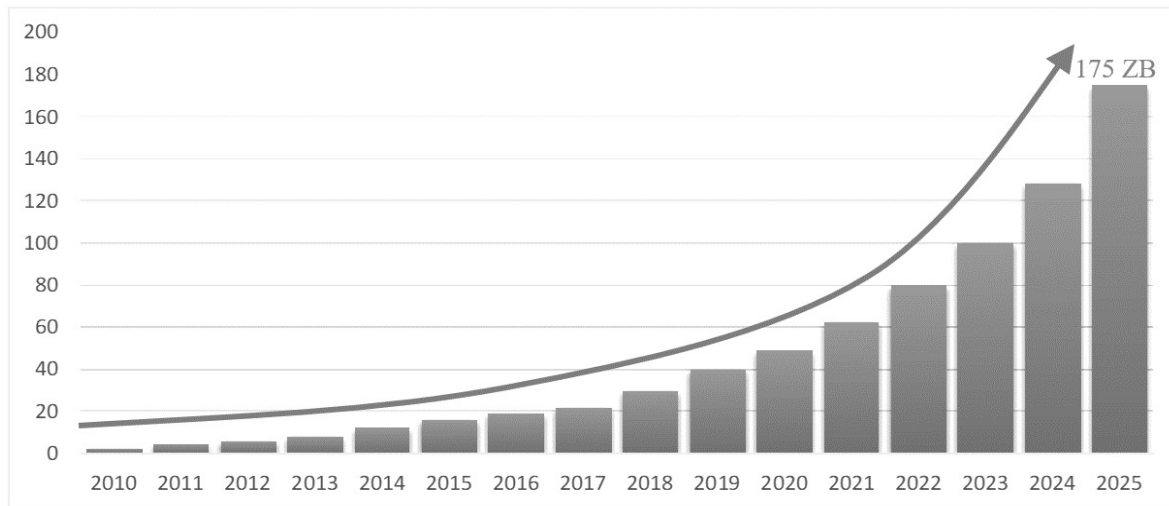


Figure 4. Annual data volume in the world in zettabytes (trillion gigabytes).

Source: Reisel D. (2018). *The Digitization in the World. From Edge to Core*, IDC White Paper, p. 6, <http://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf>, 07.07.2022.

Only enterprises with appropriate technological, organizational and economic potential have a chance to compete on a global scale (Malara, 2006). The basis of the victorious struggle for survival and development in global markets are innovation and knowledge, which are at the same time the most important drivers of digital, economic and social development (Antonowicz et al., 2021). A necessary condition for the development of a company in the post-pandemic global economy is the introduction of innovation, primarily in the IT dimension (Folwarski, 2021). However, these innovations should be perceived not only from the point of view of individual technologies and their infrastructure, but also from the perspective of previously unknown ways of their implications in practice.

Innovative solutions, enabling effective use of digital technologies and competitive advantage, are created on the basis of two types of technological innovations, namely: hardware innovations and software innovations. Hardware innovations mainly concern IT tools such as quantum computers and information transfer tools. A key criterion for the development of hardware innovations is the speed of data processing and transfer. Competition in the field of hardware innovation is referred to as the "arms race" in today's knowledge-based and modern technology economies.

Software innovations concern all kinds of information delivery and processing tools, such as big data analysis algorithms, classified as machine learning and deep learning tools within the wider area of artificial intelligence. Software innovations also include data processing implementation tools based on the joint use of IT services, such as cloud computing. In addition, software innovations include tools for reporting financial phenomena according to the concept of a distributed database, i.e. blockchain technology.

Generating and collecting data is mostly a technical problem. On the other hand, data processing and extracting knowledge from it, in addition to the necessary technical layer, is primarily an algorithmic, computational and intellectual problem (Tabesh, Mousavidin, Hasani, 2019). Making effective decisions based on the extracted knowledge in the realities of the digital economy depends mainly on the results of precise data analysis, and not on the intuition or experience of the decision maker (Provost, Fawcett, 2013).

Modern digital technologies used in business activities allow for obtaining and maintaining a competitive advantage on the market. If the competitive advantage obtained through the implementation of information technologies seems to be short-term, due to the benchmarking effect, attention should be paid to the resulting possibilities of converting information flowing from these systems into current, reliable and precise knowledge necessary for the proper management of the enterprise. It is the use of this knowledge gained with the use of appropriate IT systems, tailored to the individual needs of the company, that makes the obtained competitive advantage may be long-lasting.

The ongoing digitization processes in the developing economies based on knowledge and innovation mean that the possibilities of using digital technologies in enterprises of particular industries arouse more and more interest in global research. They are carried out mainly by significant research centers, as well as consulting and advisory companies. According to research carried out by experts from the Gartner group, as many as 87% of senior managers admit that digitization is a priority, and 79% of corporate strategists even say that digitization redefines their activities in a completely new way (Gartner, 2022).

Despite the fact that business representatives point out the need for digitization and optimization of processes in the era of dynamically developing digital technologies, Poland, according to the edition of the European Digital Economy and Society Index (DESI) for 2021, is ranked 24th in terms of digitization out of the 27 Member States of the European Union. Thus, the innovativeness of the Polish economy with the result of 41 is below the EU average of 50.7. The level of innovation is correlated with the degree of investment and the use of new technologies in business. Meanwhile, only 12% of Polish enterprises are characterized by a high degree of digitization, while the EU average is 18% (DESI, 2021).

Microsoft's Digital Futures Index (DFI) also indicates that the innovativeness of the Polish economy compared to innovation-driven countries is also 6% lower than the average in Central and Eastern Europe. The level of digitization of enterprises in Poland compared to the region is also lower by almost 10%. The DFI results also show that countries with higher levels of digital skills and more active use of various digital technologies and services score higher on the key quality of life indicators: productivity, earnings and innovation (Microsoft, 2022).

Micro and small enterprises (MSE) play a special role in the economy, both due to their impact on the development of entrepreneurship and their ability to quickly adapt to changing socio-economic conditions. Therefore, one of the key problems of the innovative economic development of the country is the creation of conditions conducive to the functioning of MSE

in the realities of the digital economy based on knowledge and innovation (Jonek-Kowalska, Nawrocki, 2022). An innovative company is distinguished by intelligence, conducts research and development, systematically implements new scientific and technical solutions, represents a large share of new products in production and services, and constantly introduces something new to the market. So what are the main barriers in creating innovations in Poland against this background?

The main barriers to the development of innovation include, first of all, the lack of appropriate financial support in the form of reliefs for automation, including ICT systems and robotization, which would give small and medium-sized enterprises the opportunity to profitably invest in innovation. A 2018 study by the Keralla Research Institute shows that as many as 70% of small and medium-sized enterprises are not supported by any funds to finance their current operations. Therefore, it is emphasized that financial support should go hand in hand with advice on possible options for the development of innovative projects.

The barriers discussed also include overzealous bureaucracy and insufficient digitization of administration. The representation of women in the IT industry in Poland is also insufficient. Meanwhile, countries where women are involved in building a digital economy are leading the race for competitiveness as well as quality of life, according to the DESI economic and social index, included in the DFI (Microsoft, 2022).

The barrier is also not very modern universities and the shortage of specialists with appropriate digital competences (DESI, 2021; Kubik, 2016). Each year, Thomson Reuters publishes a ranking of the 100 most innovative universities in Europe. The list identifies and properly ranks educational institutions that conduct the most advanced scientific research, pride themselves on influencing innovations and patents, create new technologies and contribute to the development of the global economy. For the fourth year in a row, the highest place in the ranking is occupied by the Belgian university KU Leuven (No. 1). The German Erlangen Nuremberg (No. 2) came second, ahead of the British Imperial College London (No. 3) and the University of Cambridge (No. 4) and the Swiss EPFL (No. 5). Only one university from Poland and at the same time the only one from the countries of Eastern Europe to be included in the list of the 100 most innovative European universities is the Jagiellonian University, which took 90th position. According to the results of the ranking prepared in cooperation with Clarivate Analytics, in the top 100 most innovative educational institutions most of them come from Germany (23), followed by Great Britain (21), France (18), the Netherlands (9), Belgium (7), Spain (5) and Switzerland (5), Italy (4), Denmark (3), Norway (2) and 1 universities each from Austria, Ireland and Poland. Universities educate future employees. And it is them who determine how the potential of the available resources, both in the form of innovative tools and funds, will be used and will result in innovative implementations (Thomson Reuters IP Science, 2022).

The shortage of specialists significantly affects the uptake of digital technologies by enterprises, in particular MSE, which means that they cannot fully use the potential of the digital economy (Wolniak et al., 2022). According to the analyzes of the European Commission, up to 90% of professions will require new digital competences (DESI, 2021). The ranking of the most innovative companies in the world, created by the Boston Consulting Group (BCG), confirmed the thesis that "readiness to innovate" and the associated strong competitive position of companies mainly depend on access to intellectual capital with appropriate technological competences (BCG, 2022). Progressing digitization creates a demand for specialists primarily in the development of artificial intelligence, cloud services, software developers, as well as Big Data analytics (Marszycki, 2022) (Table 1).

Table 1.

Trends which in the next 3-5 years will have an impact on the demand for specialists with new competences

No.	Trends	Influence
1	cybersecurity	53%
2	artificial intelligence / machine learning	45%
3	computing clouds / edge computing	41%
4	5G	37%
5	virtual and augmented reality	35%
6	personalization of the end user experience	34%
7	industry 4.0 / economy 4.0	33%
8	big data / data science	30%
9	quantum / bionic computers	29%
10	internet of things and autonomous items	26%
11	user experience design	25%
12	autonomous transport	22%

Source: Own study, based on: BBKL IT 2nd edition, 2022 – employers survey.

It should be emphasized that in order to provide the appropriate infrastructure necessary to intensify the processes of digitization of enterprises in the conditions of sustainable development, green data centers are also necessary (IMARC Group Analysts, 2022). It is estimated that the demand for green centers will triple by 2027. It is estimated that this market will reach the value of USD 200.84 billion in 2027, while at the end of 2021 its value was estimated at USD 59.32 billion. Despite the fact that three-quarters of companies in Poland process data using their own server rooms, and their number is to increase by as much as 226% by 2025 compared to 2019, the progressing digitization of enterprise processes will require support from specialized data center services for several key reasons. These include, first of all, the growing demand for additional disk space, as well as computing power and devices that comprehensively support the proper operation of the ICT infrastructure. The server room security and service continuity aspects are also important. The above-mentioned reasons, combined with the growing prices of computer components and the costs of building company server rooms, translate into a growing demand for specialized data center services. Moreover, due to the energy transformation, which is to protect against rising energy costs and its possible lack, there is a growing interest in ecological solutions provided by green data center services.

They are characterized by high energy efficiency and use renewable energy sources in order not to emit greenhouse gases. The forecasted development of this sector in Poland will additionally result in an increased demand for highly specialized personnel.

The use of key technologies that intensify digital transformation makes it possible to adapt new solutions that increase the effectiveness of activities and improve their quality in every sphere of business activity (Wolniak, Gajdzik, 2022). Therefore, in the further part of the article, the author will present proposals for the use of selected digital technologies, with particular emphasis on artificial intelligence, to improve the accounting information system supporting decision-making processes in the company.

5. Opportunities to improve the accounting information system using cloud computing and artificial intelligence

Modern digital technologies provide many opportunities to improve the accounting information system, eliminating or significantly reducing many barriers to the current collection, processing, analysis, reporting and presentation of data. The impact of new technologies simply changes and improves the data management process. While the logic of the impact of the accounting information system on decision-making processes has not changed, the available tools have changed. In order to support the decision-making process, new forms of management information are necessary with an extended range of data expected by business users, based on precise analyzes and properly visualized and interactive reports of advanced accounting information systems.

5.1. Blockchain

Another technology that improves the functioning of the accounting information system is blockchain. The functionality of this technology is based on cryptographic algorithms with which each transaction is recorded. The main attribute of this technology is openness and transparency, while ensuring the security of transactions. The use of cryptography to save individual transactions significantly increases security against potential failures as well as hacker attacks. Ultimately, it may also significantly reduce the scope of inspections carried out by state authorities and large corporations.

Blockchain allows you to create a public, decentralized and distributed transaction register that can be used for a number of purposes (Klinger, 2017). The most popular applications are transactions made with cryptocurrencies, which are increasingly often acquired by small enterprises, next to large corporations. Despite the growing interest in altcoins, including as alternative sources of capital investment, the lack of appropriate legal regulations means that accounting specialists have a problem not so much of a technical nature as of accounting related

to the use of cryptocurrencies. The problem is the lack of a developed method of correctly posting altcoin transactions in financial statements (Raiborn, Sivitanides, 2015).

This technology is also implemented for efficient project management (Kisielnicki, 2018). Blockchain is also a good solution for such transaction registers as, for example, open book accounting systems. The use of cryptographic algorithms allows you to share data from accounting books that are not disclosed in the company's external reporting due to trade secrets (Sobańska, 2013). The advantages of using blockchain technology in open book accounting systems include, above all, the aforementioned security of data registration and exchange, but also the speed of the system's operation and maintaining data consistency, all of which can be provided at a relatively low cost (Fanning, Centers, 2016).

In order to further improve corporate financial management, in the near term, we can expect to expand the use of blockchain technology to improve the exchange of financial data of the company with such financial service providers as banking institutions and fintech companies. There is a relatively long tradition of using the services provided by banks. On the other hand, the use of financial services provided by Fintech companies specializing in innovative technological solutions has a much shorter history (Hałasik-Kozajda, Olbryś, 2020). The growing demand for services offered by this type of enterprise results from striving to meet the needs of business units for innovative solutions that improve financial processes, especially in the field of banking (Folwarski, 2019).

5.2. Internet of Things (IoT)

The technology that greatly supports BI is Internet of Things (IoT), because it enables the integration of distributed data from various transaction systems, including Cloud Computing. IoT can be defined as a system consisting of objects with built-in sensors whose task is to detect, recognize and record specific signals from the environment. These signals may concern, for example, the occurrence of a specific event or exceeding a certain threshold value. A characteristic feature of the IoT system is that data is transferred between the things that compose it, also known as intelligent objects. Communication of intelligent objects and data exchange with other devices is possible thanks to a variety of network solutions, mainly wireless. It can be said that IoT, on the one hand, generates a large amount of data, thus being a rich source of information for analytical purposes, and on the other hand, it is a consumer of data that it obtains thanks to sensors and sensors embedded in intelligent objects (Kumar, Tiwari, Zymbler, 2019).

IoT can generate a large amount of information in accounting, e.g. on the implementation of specific processes in the company and its environment. The information of interest to the entrepreneur may be, in particular, customer preferences and the specificity of using the services or products offered. This technology provides much more data necessary for recording and reliable cost calculation, as well as identifying the factors that affect them. In addition, IoT enables better collaboration between buyers and suppliers in creating a new or improving

an existing service or product, as well as determining the acceptable cost. Data exchange in IoT also allows for the active participation of the consumer in the prediction of costs and revenues, as well as cash flow. Thanks to a large amount of accurate data, it is also possible to detect new factors, which primarily determine the effectiveness of a given organization, which should contribute to precise planning and cost control, as well as to a fuller use of resources. In-depth control of individual objects of the IoT system also allows for a significant reduction or even elimination of potential failures and for making an accurate diagnosis as to the expected costs, revenues, cash flows and shaping of non-financial indicators.

5.3. Big Data

Big Data represents the specific structure of a large-volume, real-time stream of data, characterized by diversity, complexity and variability. The specificity of data with the Big Data structure does not allow for their management with the use of previously known tools. The characteristic structure of Big Data is the basis for the effective management of the rapidly growing amount of data (Beath et al., 2012). Data management, consisting in proper processing, interpretation and use in order to create valuable business knowledge (Willcocks, Whitley, 2009), it is the basis of action based on facts, not on intuition (Mayer-Schonberger, Cukier, 2013). The feature that distinguishes Big Data from traditional data processing is faster and easier collection of a large number of specific data, especially non-financial and unstructured data, such as video files or charts, characterized by a large number of information nodes. In addition, data can come from a variety of internal and external sources and stream in real time. Therefore, examining the correlation between individual data on the Big Data structure in order to obtain reliable conclusions and new knowledge in a relatively short time requires the use of innovative methods and technologies in Big Data analytics (Han, Kamber, Pei, 2016).

The starting point is to adapt the accounting information system to the use of Big Data structure data. The implementation of this technology in accounting enables a significant expansion of both the number and scope of available data. They can come from internal accounting data and from outside. The source of external data can be, among others, financial and non-financial institutions, state institutions, but also data from the Internet not indexed by most search engines (Deep Web Data), including, inter alia, social media (Balicka, 2018). Data collected in the accounting system can be used, for example, to record and calculate costs, but also to forecast costs, revenues, cash flows and a number of financial indicators. Large data sets in combination with advanced methods of artificial intelligence, such as machine and deep learning, as well as with advanced analytical methods and increased computing power, allow in accounting to precisely identify certain patterns in the formation of costs, revenues and cash flows, and also enable the capture of factors determining specific changes. The application of Big Data is also believed to influence the change of the cost structure, the way information is used and the knowledge creation process (Bhimani, Willcocks, 2014).

The implementation of Big Data in the accounting information system is the basis for generating not only better-quality reports, but also precise forecasts. It enables the discovery of new dependencies. It prompts a better understanding of the existing relationships between financial and non-financial information. It increases the perceptual possibilities in terms of the existing cause-effect relationships between the actions taken and the effects obtained. It also contributes to the improvement of performance measurement tools, including the popular Balanced Scorecard. It is also the basis for the development of new, flexible tools, such as interactive picture-based dashboards, enabling real-time monitoring of financial results, increasing the effectiveness of decisions made. An important support for decision-making processes thanks to the accounting information system is also the possibility of implementing automatic management systems, such as company liquidity management.

It should be noted that the pursuit of obtaining precise knowledge, enabling the optimization of decisions, with the participation of modern information technologies, will lead to further escalation of data. In order to tackle the data overload phenomenon, innovative advanced processing methods such as deep learning are already being used at data sources such as Internet of Things tools or local edge servers, that is, before the data goes to a dedicated database. This process is known as edge processing (Balicka, Balicki, Dryja, 2021). This process is known as edge computing (Balicka et al., 2019).

5.4. Cloud computing

Cloud computing is a technology that significantly supports the accounting information system (Balicka, 2019). Cloud computing is understood as a data processing model that is offered by external entities offering specific computing services, concentrated in one place on the Web (Post-Lee, Pakath, 2014). Access to the services is possible from anywhere using a computer with Internet access. These services are scalable due to the changing needs of the recipients. There are three main service models, which include: Infrastructure as a Service, Platform as a Service, Software as a Service (Kapeliński, 2014). Taking into account the ownership criterion of a specific data processing model and the specific nature of their implementation among recipients, the following types of computing clouds are distinguished: Public Cloud, Private Cloud, Community Cloud, Partner Cloud, Hybrid Cloud and Dedicated Cloud (Dziembek, 2016).

Using this technology in practice most often means transferring the provision of IT services to the servers of cloud service providers. What distinguishes cloud computing from the solutions offered so far related to IT outsourcing is the fact that users using this solution have dynamic and instant access to the resources necessary at a given moment using a remotely connected computer (Balicka, Balicki, Zakidalski, 2022). Storing data in the cloud of a specialized provider allows enterprises to reduce the costs associated with the maintenance of appropriate infrastructure, software and hosting (Balicka et al., 2014). Thus, the reliability and

speed of calculations depends on the power of servers owned by the suppliers and the Internet bandwidth. IT systems operating in the cloud enable virtually immediate use of the necessary data processing services, increase flexibility and efficiency, and ensure effective data management in the future, thanks to the scalability of services in the cloud.

The key determinants of the development of cloud computing include the growing needs for data processing and storage along with the amount of data, as well as numerous technical solutions facilitating access to the Internet. It can be said that cloud computing has become a standard solution used by large corporations. According to Microsoft's strategic plans for the coming years, the most important thing for the company will be the expansion of the cloud. The corporate goal is to have 90% of all infrastructure in the public cloud. This strategy requires the construction of successive technological levels that will enable its effective implementation (Microsoft, 2021). Smaller enterprises are also increasingly interested in simple IT systems used to process information in the cloud. Interest in the cloud is to be expected to continue to increase, especially in EU Member States, as the Commission seeks to remove restrictions on the location of data as well as on their free flow within the EU. The Commission is also developing appropriate contractual clauses for the outsourcing of cloud storage services by financial institutions.

IT systems operating in the cloud allow you to keep accounting and generate analyzes based on documents sent in electronic form. The cloud is also a very good solution for interactive dashboards created with dedicated applications. These types of applications and services are largely cloud-based, thus facilitating the collection, management, processing, analysis and visualization of data from various sources, including IoT tools, in real time (Gartner, 2021). Microsoft's cloud solution is highly rated in this area (Enterium, 2022). There are also other cloud-based solutions of this type available on the market (Cloud solutions, 2022).

6. Machine Learning Models for the analysis of financial data

Forecasting in the accounting information system can be effectively supported by deep learning models, such as Convolutional Neural Networks or Long Short Term Memory Neural Networks (Mylonakis, Diacogiannis, 2010). This kind of financial forecasting requires cloud computing (Balicki, Balicka, Dryja, 2021). For example, some banking sector crises, also affecting corporate finances, can be anticipated by trained deep learning models (Balicka et al., 2013). This task is extremely difficult due to the small amount of data because about hundred banking crises have been observed in the last fifty years, only (Oet et al., 2011). The banking crisis in Poland in 2009 weakened the annual GDP by 14%. Because of EU funds, GDP returned in 2010 to the previous level of EUR 360 billion, and it reached EUR 574 billion in 2021 (Eurostat, 2022). Much more deep crises were in Italy and Spain that returned to the previous

values of GDPs after five years (Eurostat, 2022). In Greece, GDP was reduced to level of 2003 year. The effects of the global banking crisis were very serious and long-lasting in the case of Greece because its value EUR 224 billion in 2010 fell to EUR 183 billion in 2021. In general, two-year period of slow decline of GDP precedes the banking crisis, and then it becomes an actual crisis with a significant decline in GDP (over ten percent) for the next two years. Finally, the next two years will be making up for the effects of the crisis and reaching the level preceding the banking crisis. Thus, effective models for predicting the occurrence of a global banking crisis can significantly contribute to mitigating the effects of related economic crises. For this reason, high hopes and expectations are associated with machine learning models as early warning systems of the banking crisis.

6.1. Deep learning models for prediction and classification

The crisis related to the Covid-19 pandemic can trigger a much more severe economic crisis, including financial and banking crisis. Compared with the same quarter of 2019, seasonally adjusted GDP decreased by 14.1% in the EU in the second quarter of 2020. Within the second quarter of 2020, GDP in the United States decreased by 9.5% compared with the previous quarter. In 2021, GDP of Poland increased by 7.1% due to the reference level in 2019. Spain (-3.2%), Portugal (-1.5%) and Italy (-1.2%) were the most affected by this crisis. On the other hand, Ireland's economy is developing the best, with a growth of 14.1% in 2021. In addition, Norway (11.3%), Lithuania (10.9%), Sweden (9.5%) and Denmark (8.3%) obtained the rapid growth of GDP. To discover the pandemic crisis some deep learning models can be developed, too.

Another area of development some deep learning models is the classification of the credibility of borrowers to shrink an amount of unpaid loans. Too liberal lending and high unemployment may lead to bank bankruptcy or to high social discontent in the case of probate inheritance law and restrictive debt collection. Avoiding innovation in financial systems, in particular, may lead to the uncontrolled development of a new currency system, as was the case with bitcoin, where the financial transaction approval process adds a new entry to the blockchain. Deep learning models can predict the course of Bitcoin, too (Frankel, Rose, 1996).

Bitcoin was applied in El Salvador, where Bitcoin Law granting the currency legal tender status went into effect. In October 2021, there were more Salvadorans (three million, 46% Salvadorans) with the Chivo bitcoin wallets than traditional bank accounts (29%). In January 2022, the International Monetary Fund urged El Salvador to cease using bitcoin as legal tender regarding its risk to the country's financial stability and consumer protection. The switch to bitcoin had made paying remittances more difficult for many Salvadorans, because the fees associated with the bitcoin transactions were several times as expensive as traditional remittances. Prior to the crash, several other countries had announced plans to adopt bitcoin as legal tender, but only the Central African Republic has done so (Roy, 2021).

The US economy is believed to be successful because of the aggressive absorption of high technology. It is worth noting that Asian manufacturers are also supporting their activities with artificial intelligence to develop products. In addition, several problems with climate modeling are solved by deep learning models. In addition, the US defense industry, which develops *dual-use* technologies, was called to make deep learning and IoT available to manufacturers, innovators and entrepreneurs. An interesting example of combining deep learning and parallel computing is the supercomputer IBM Watson that is helpful in making decisions, including medical diagnostics. It is equipped with artificial intelligence enables correct diagnostics in 90% of lung cancer cases (Balicki, Korlub, Tyszka, 2016). Nuance Communications Inc. uses Watson with speech recognition skills and medical knowledge in medical diagnostics. IBM is also exploring the use of Watson as a lawyer assistant (Shouwei, Mingliang, Jianmin, 2013).

French company ARIA Technologies performs calculations to predict flood risk for insurance companies by simulating extreme rainfalls. In addition, the impact of climate change on natural hazards is simulated. It is worth mentioning one more interesting project is IBM Blue Brain that try to simulate the human brain, one should reckon with modeling 100 billion neurons and 1 trillion neural connections (Balicki et al., 2015; Hanschel, Monnin, 2005).

Aldrich et al. show that GPUs estimated 200 times faster computing than CPUs when analyzing business cycles in markets (Aldrich E., 2011). Genetic programming is an alternative to classic stock exchange applications based on technical analysis, such as the CRISMA system, which determines a positive return on investment within 10 years with transaction costs of 2% (Chen, Kuoand, Hoi, 2006; Brabazon, Kampouridis, O'Neill, 2020). Frequently, program performance is compared with business strategies such as a *buy and hold* strategy (Schwaerzel, 2006) and more advanced autoregressive methods (Svangard et al., 2002).

Genetic programming may produce decision-making rules during dynamically changing conditions on the stock market. An investor may buy the company's stock and holds its assets for a relatively long period of time and sells when it makes a profit (Potvin, Soriano, Vall, 2004). In results, an algorithm provides buy and sell rules that can be triggered when certain conditions are met.

6.2. Long Short Term Memory neural networks for estimation of predicted values

Deep learning models are used in computer games based on behavioral models, which inspired similar applications in financial systems. Models are most often used in two areas: to simulate phenomena taking place on capital markets and to support decisions made on stock exchanges (Henley, Hand, 1996). It is assumed that the propensity to take risk depends on the personality of the investor. The capital market is modeled as a set of autonomous entities, each of which has the same goal (Atsalakis, Valavanis, 2013). The ability to model interactions between rival agents facilitates the simulation and analysis of occurring phenomena. The strategies of cooperation and negotiation of agents are also taken into account (Bosse,

Siddiqui, Treur, 2010). On the other hand, simulating the market situation allows to predict trends and make recommendations for transactions (Balicki, 2013).

On the other hand, Long Short Term Memory (LSTM) artificial neural networks are the most efficient approach for stock market investments (Gately, 1999). LSTMs are learned based on historical data of time series that is available through technical analysis (Nazari, Alidadi, 2013). In the case of the anticipation of numerical values, we consider a regression problem, and in the case of symbolic values – the classification one. In the context of stock market prediction, we are dealing with a specific problem of predicting time series (Baesens et al., 2003). A training algorithm allows adjusting the synaptic weights in the model (Davis, Karim, 2008). Analyzing many training sets requires computing cloud.

The LSTM model remembers their states in memory cell. Data is passed through the cell information, and then is accepted or removed. The block of LSTM consists of a block input, three gates (input, forget, and output), a memory cell, and output activation function (Kumar, Haider, 2021). Past information is saved that was learned in previous steps (Figure 5). LSTM has two transfer states c^t (cell state) and h^t (hidden state). Among them, the transmitted c^t changes very slowly, usually, the output c^t is the c^{t-1} passed from the previous state plus some values, while h^t is often very different under different nodes. First, use the current input x^t of LSTM and the h^{t-1} passed from the previous state to concatenate and train to obtain four states (Aslam, Rasool, 2021).

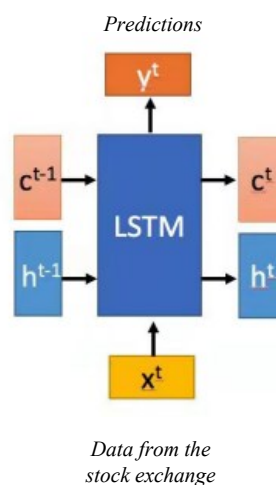


Figure 5. LSTM model to support stock market investments.

Source: Atsalakis G., Valavanis K. (2013). Surveying stock market forecasting techniques - Part I: Conventional methods in Computation Optimization in Economics and Finance Research Compendium, New York: Nova Science Publishers, p. 35.

An example of a prediction for the Warsaw Stock Exchange is based on a table with five columns: opening price, highest price on a given day, lowest price on a given day, closing price and trading volume. More advanced models can use information from social media about a sentiment of the considered organizations. Besides, the other input data can support decision making: average from the last n days or Gini index.

For the selected organization, data of opening price are added to verify the prediction for one day and seven days ahead. Data of opening price before 30 days are added to train the model. 75% of the data is split as train data, and 25% is test data. Figure 6 shows how the dataset is split.



Figure 6. Division of PGE company data for supervised training (blue line) and testing (red line).

Source: Own study.

Figure 7 shows the simulated dependence of the achieved profit by the LSTM. The experiment was carried out in relation to PGE company stocks. Concurrently, two other predictions have been prepared by Support Vector Regression (SVR) (Awad, Khanna, 2015) and Convolutional Neural Networks (CNN) (Balicki, 2009). We can observe that prediction by LSTM (purple line) is very close to the actual values of PGE (blue line).



Figure 7. Prediction of PGE open price between July 2020 and January 2022.

Source: Own study.

Deep neural networks are also used to optimize the stock portfolio (Staniec, 2003). Tasks related to financial activities for which the support based on artificial neural networks was successfully applied include the analysis of the creditworthiness of bank customers (Yobas, Crook, Ross, 2000), risk analysis related to granting a mortgage loan (Zan et al., 2004),

and building bid strategies. Besides, forecasting index values (German Credit Dataset, 2022) and directions of trends on the stock exchange can be determined. Some models predict risk classes of stock exchange financial instruments, detection of regularities in changes in the prices of financial instruments and forecasting of bankruptcies (Brown, 2011). Neural networks do not contain any assumptions about the modeled phenomenon. For this reason, they can identify local market disturbances or dependencies occurring for a short time in financial markets.

An alternative way of stock exchange investments is the implementation of virtual brokers to execute transactions on the market. Automated trading systems are used in high frequency trading (HFT). Currently, we can own shares for mille - or even microseconds. The selected models do not exhaust the enormous potential of using other methods of artificial intelligence in financial systems (Gierusz, Koleśnik, 2021). An important dilemma is how to develop machine learning models for an estimation of the informative value of the financial result in the light of the usefulness of the financial statements (Martyniuk, 2013).

Remarks and conclusions

The results of theoretical research and numerical experiments confirmed that the impact of digital technologies on the accounting information system supporting decision-making processes is significant. Developing ideas for the implementation of solutions for the effective use of digital technologies, and then their implementation in cooperation with the business world is necessary to do not feel only the negative effects of automation and robotization. Then, it is possible to develop the emergence of new, creative jobs and, consequently, a higher position in the rankings regarding the level of digitization, as well as innovation and competitiveness.

The use of cloud computing, the Internet of Things and deep learning models creates a great opportunity to avoid deep crisis in the economy due to the negative effects in the banking systems, a pandemic lockdown or war perturbations. In particular, the models of deep neural networks implemented on cloud computing, predict the exchange rate, symptoms of corporate bankruptcy, and banking crises. Besides, we characterize issues related to deep learning for prediction in financial systems. Finally, a case study is studied for using Long Short Term Memory artificial neural networks for stock market investment.

Answering the questions we asked at the beginning of the article, it is worth emphasizing that the harmonious development of smart information technologies can be effectively supported by carefully investing significant funds in the development of modern technologies such as deep learning, Internet of Things and cloud computing. To support this hypothesis, many examples were presented or cited. It will also ensure the synergy effect resulting from the balanced interaction of key domain systems.

Also in the paper, we tried to answer the question, how to use modern technology, including machine learning, Internet of Things, and cloud computing. Complex deep learning models of the intelligent enterprise require a lot of computing power for training. Summing up, we can emphasize that we observe a very significant influence of deep learning and the Internet of Things on directions of development of integrated financial systems.

An interesting direction for further research is the development of the other deep learning models such as Convolutional Neural Networks for estimating the risk of the banking sector. Moreover, an important problem is the use of deep artificial neural networks for testing the credibility of potential borrowers.

The use of digital technologies accelerates the digital transformation towards Industry 4.0, in which the implementation of all processes, including accounting, is changing. As a consequence, the role of employees is also changing, including accounting specialists, mainly management ones, who are responsible for the quality of material information created for both internal and external financial reports. Business analysts are gaining more and more importance, while certain activities, such as accounting records, will be automated. The right choice, implementation and effective use of modern digital technologies in the accounting information system of Industry 4.0 requires the acquisition of new knowledge, competences and skills.

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ANALYSIS OF THE ENVIRONMENTAL IMPACT OF THE VERTICAL PARKING SOLUTION USING LIFE CYCLE ASSESSMENT

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Purpose: The purpose of this article is to present the results of an analysis of the environmental impact of an innovative vertical parking solution, the so-called smart parking lot.

Design/methodology/approach: The Life Cycle Assessment (LCA) method was used for the analysis. The study was conducted in accordance with the recommendations of ISO 14040/44. Calculations were carried out using SimaPro software and the Ecoinvent database.

Findings: The analysis identified significant issues in the life cycle of a smart parking lot, i.e., parameters indicating the greatest potential environmental impact of the solution, in categories such as climate change, ozone depletion, carcinogenesis, eutrophication, acidification, use of mineral and metal resources, and fossil fuels.

Practical implications: The results presented can be taken into account at the stage of developing eco-innovative technical solutions.

Originality/value: The problem of an insufficient number of parking spaces forces the search for optimal urban, economic and environmental solutions for the construction of parking lots. Research results presented in the article represent the first phase of a broader project on the analysis of the environmental impact of selected parking solutions.

Keywords: Life Cycle Assessment, environmental impacts, parking.

Category of the paper: research paper.

1. Introduction

The literature on the subject (Hu, Wen, 2012; Krivda et al., 2014; Pilepic et al., 2019; Segó et al., 2021; Wang et al., 2016; Yetiskul, Senbil, 2018) and the survey research conducted by the authors of this article (Baran et al., 2021) show that the ever-increasing number of vehicles is affecting the deterioration of road capacity and the difficulty of parking a car. The study in question showed that the problem of insufficient parking spaces mainly affects large cities and people living in multi-apartment buildings, as well as those commuting by car. Based on

a review of the literature (Duda-Wiertel, 2018; Wang et al., 2021; Yaacob et al., 2020), it can also be concluded that the search for a vacant parking space contributes to higher emissions of air pollutants, increases vehicle operating costs, and takes up more and more time for drivers and passengers. The parking space problem forces the search for optimal solutions that take into account the constraints of plot size, the high price of land, construction costs and environmental pollution. Different expectations of different social groups, such as drivers vs. urban residents (Baran et al., 2021) are also worth mentioning. Due to emerging urban, economic and environmental issues, there is growing interest in modern technical solutions for parking structures and parking management (Severino et al., 2021; Biyik et al., 2021; Jog et al., 2015; Polycarpou et al., 2013; Krieg et al., 2018; Thomasa, Kovoorb, 2018; Kotb et al., 2017; Slezok, Luczak, 2015; Issrani, Bhattacharjee, 2018; Block et al., 2020; Mendoza-Silva et al., 2019; Al-Turjman, Malekloo, 2019; Khalid et al., 2021; Kalašová et al., 2021; Lin et al., 2017). Given the above, the implementation of new parking solutions should look at all dimensions of sustainability, the assumptions of a circular economy and the results of the latest research on smart cities and future mobility (Bukowski et al., 2018; Górnjak, 2016). There are studies in the literature on the effects of providing parking spaces on land use and the associated loss of open space and biodiversity (Russo et al., 2019; Ibrahim, 2017). Nevertheless, there is a lack of research on assessing the environmental impact of existing parking solutions in categories such as climate change, ozone depletion, carcinogenesis, eutrophication, acidification, use of mineral and metal resources, and fossil fuels, just to give an example. Research should address the entire life cycle of parking lots, that is, from design, through operation, to decommissioning. The most effective is the analysis carried out at the earliest possible stage of product design, since, according to the so-called eco-design paradox, the possibility of reducing environmental impact over the life cycle decreases as the design process progresses. Such analysis is possible through the use of analytical tools, such as Life Cycle Assessment (LCA).

Research results presented in this article represent the first phase of a broader project on the analysis of the environmental impact of selected parking solutions. The first phase research is concerned with incorporating an extended environmental life cycle perspective into the design and determining the environmental and social profile of a vertical parking solution, i.e., an innovative system of so-called smart parking lot (Fig. 1). It takes about 33 m², which means that two standard parking spaces can accommodate 6 to 16 vehicles.



Figure 1. An example of a smart parking lot.

Source: <http://smartparking-systems.pl/realizacje/>.

Vertical parking lots are becoming increasingly popular due to their vast space savings. They also provide the highest level of security for both parking and property protection, as the car remains in a secure parking structure preventing unauthorized access. Vertical parking lots allow parking spaces to be found relatively quickly; therefore, they do not generate additional costs related to vehicle operation and emissions (Baran, Tandos, 2021; Pashte et al., 2016; Ślęzok, Łuczak, 2015).

2. Material and methods

The analysis of the environmental impact of the innovative vertical parking solution, the so-called smart parking lot, was performed using the Life Cycle Assessment (LCA) method. The method allows to comprehensively analyze the environmental impact of a product throughout its life cycle, i.e., from the acquisition of raw materials and materials, through the production process, distribution to use and management of post-consumer waste. The analysis was carried out following the recommendations of ISO 14040/44 in four steps (ISO, 2006a, 2006b):

- Definition of purpose and scope;
- Analysis of a set of inputs and outputs;
- Life cycle impact assessment;
- Interpretation.

The study was based on the following:

- PN-EN ISO 14040:2009, Environmental management – Life cycle assessment – Principles and structure;
- PN-EN ISO 14044:2009, Environmental management – Life cycle assessment – Requirements and guidelines;
- ISO/TS 14048 Technical specification, Environmental management – Life cycle assessment – Data documentation format;
- Data obtained from the manufacturer of parking solutions.

The analysis also used databases implemented in SimaPro, mainly Ecoinvent version 3.7.1. Ecoinvent (Ecoinvent, 2020) is a database containing LCI (Life Cycle Inventory) data on energy, transportation, waste management, building materials, chemicals, detergents, paper, as well as agricultural products and processes.

3. Analysis of a set of inputs and outputs

Input-output set analysis involves collecting data for specific unit processes. The data for input materials, utilities used, output emissions and waste can come from measurements, calculations or estimates. This is a critical point in the analysis, as the accuracy and correctness of the data determine the uncertainty of the final result.

With regard to the functional unit, the following processes are included in the life cycle of a smart parking lot:

- Process 1 – Steel from the cradle.
- Process 2 – Transport of steel to gate.
- Process 3 – Steel cutting.
- Process 4 – Welding.
- Process 5 – Drilling.
- Process 6 – Coating.
- Process 7 – Trial assembly and disassembly.
- Process 8 – Packaging of finished elements.
- Process 9 – Transport to client.
- Process 10 – Building the foundation.
- Process 11 – Assembly at the client's site.
- Process 12 – Typical use.
- Process 13 – Disassembly at the client's site.
- Process 14 – Transport of used steel to recycling.
- Process 15 – Recycling of steel waste.

The data for the identified unit processes comes from manufacturer estimates and measurements. With the processes described in the Ecoinvent database, the range from cradle to gate and subsequent life cycle stages are captured.

Table 1.
Process modeling data

No.	Modeled processes	Ecoinvent database processes
Cradle-to-gate processes		
1	Steel	Steel, low-alloyed {GLO} market for Cut-off, U
2	Electricity	Electricity, medium voltage {PL} market for Cut-off, U
3	Heating	Heat, central or small-scale, other than natural gas {Europe without Switzerland} market for heat, central or small-scale, other than natural gas Cut-off, U
4	Diesel	Diesel {Europe without Switzerland} market for Cut-off, U
5	Drinking water	Tap water {Europe without Switzerland} market for Cut-off, U
6	Oils and lubricants	Lubricating oil {RER} market for lubricating oil Cut-off, U
7	Cotton textile, woven cotton	Textile, woven cotton {GLO} market for Cut-off, U
8	Welding	Welding, arc, steel {GLO} market for Cut-off, U
9	Paints	Chemical, organic {GLO} market for Cut-off, U
10	Copper wires	Wire drawing, copper {GLO} market for Cut-off, U
11	LEDs	Light emitting diode {GLO} market for Cut-off, U
12	Packaging film	Packaging film, low density polyethylene {RER} production Cut-off, U
13	Packaging cardboard	Containerboard, linerboard {RER} market for containerboard, linerboard Cut-off, U
14	Cement	Cement, unspecified {Europe without Switzerland} market for cement, unspecified Cut-off, U
15	Sand	Sand {RoW} market for sand Cut-off, U
16	Gravel	Gravel, round {RoW} market for gravel, round Cut-off, U
Transport processes		
17	Transporting steel to the gate	Transport, freight, lorry >32 metric ton, euro5 {RoW} market for transport, freight, lorry >32 metric ton, EURO5 Cut-off, U
18	– Transporting finished elements to the client – Transporting used steel for recycling	Transport, freight, lorry 16-32 metric ton, euro5 {RER} market for transport, freight, lorry 16-32 metric ton, EURO5 Cut-off, U
Output processes		
19	Scrap steel	Scrap steel {Europe without Switzerland} market for scrap steel Cut-off, U
20	Wastewater	Wastewater, average {Europe without Switzerland} market for wastewater, average Cut-off, U
21	Waste mineral oil	Waste mineral oil {Europe without Switzerland} market for waste mineral oil Cut-off, U
22	Waste yarn and waste textile	Waste yarn and waste textile {GLO} market for waste yarn and waste textile Cut-off, U
23	Waste paint on metal	Waste paint on metal {RoW} market for waste paint on metal Cut-off, U
24	Waste packaging film	Waste polyethylene {PL} market for waste polyethylene Cut-off, U
25	Waste paperboard	Waste paperboard {PL} market for waste paperboard Cut-off, U
26	Waste concrete	Waste concrete {Europe without Switzerland} market for waste concrete Cut-off, U
27	Waste – LEDs	Waste electric and electronic equipment {GLO} market for Cut-off, U

Source: Own work.

4. Analysis of a set of inputs and outputs

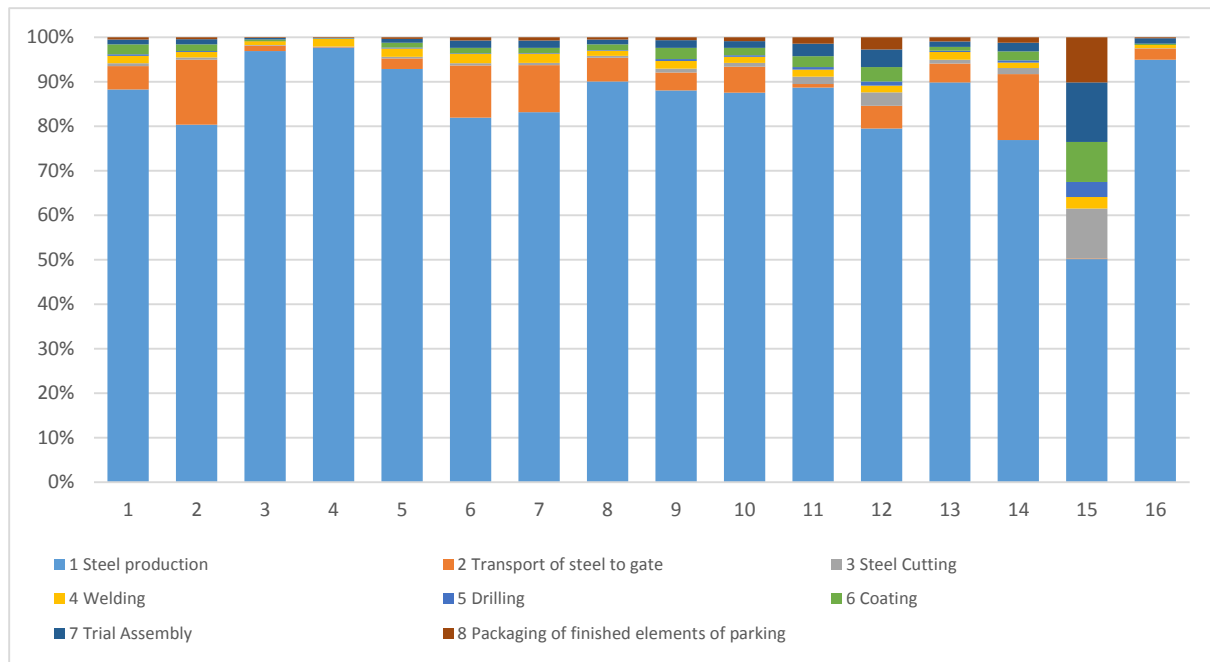
The collected data, presented in Chapter 3, was evaluated for the magnitude and significance of potential environmental impacts of the product system throughout its life cycle. The evaluation was carried out using SimaPro software, along with LCIA methods and the Ecoinvent database. This Life Cycle Assessment phase consists of mandatory elements, including characterization, and optional elements, such as normalization and weighting. Characterization involves calculating the degree of each classified input/output's contribution to their respective environmental footprint impact categories and aggregating the contributions within each category. This requires linearly multiplying the data on a set of inputs and outputs by the characterization factors for each given substance and given environmental footprint impact category. An important concept is the impact category, or aspect of the environmental footprint (e.g., a product has the potential to affect impact categories, such as climate change, ozone depletion, carcinogenicity, eutrophication, acidification, use of mineral and metal resources, as well as fossil fuels, etc.), and the environmental footprint category, or the environmental footprint category.

The collected data was analyzed in two stages:

- “Cradle-to-gate”, which covers all processes from the extraction of raw materials to the moment the product leaves the gate of the industrial plant; it is an analysis conducted to determine the environmental impact of production;
- “Gate-to-grave”, which takes into account processes from use to end-of-life; used to determine a product's environmental impact from the moment it leaves the manufacturing plant.

4.1. Cradle-to-gate stage

Figure 2 shows the results of the analysis in terms of impact categories after the characterization stage. The results in all impact categories are scaled to 100%.



Key: 1. Climate change; 2. Ozone depletion; 3. Human toxicity – non-carcinogenic effects; 4. Human toxicity – carcinogenic effects; 5. Respiratory particulates / inorganic substances; 6. Ionizing radiation – human health effects; 7. Ionizing radiation – ecosystem effects (interim); 8. Photochemical formation of ozone; 9. Acidification; 10. Terrestrial eutrophication; 11. Aquatic eutrophication – fresh water; 12. Aquatic eutrophication – seawater; 13. Ecotoxicity for fresh water; 14. Land use; 15. Resource depletion – water resources; 16. Resource depletion – mineral resources, fossil resources.

Figure 2. Environmental characterization from cradle to gate in terms of environmental impact for each component after the characterization stage.

Source: Own study.

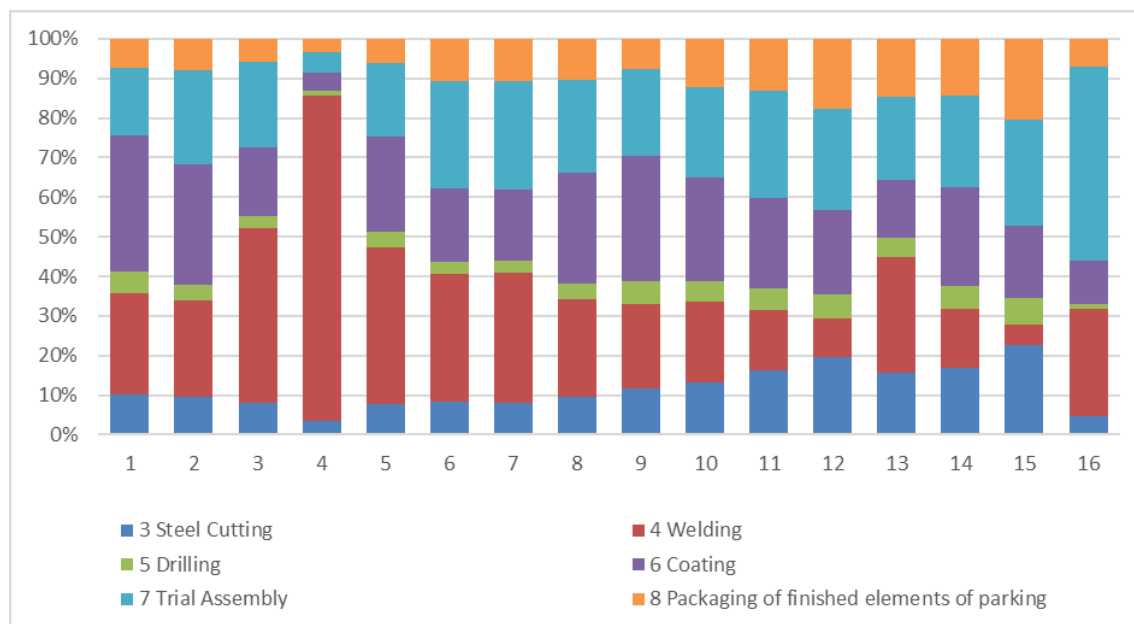
The data presented (Figure 2) shows that in all categories analyzed, steel production has the greatest impact on the environment. The lowest impact is in the category of the depletion of water resources (50.1%), and the highest in the category of human toxicity – carcinogenic effects (97.7%). Notably, the impact in each category applies to the entire steel production process, and therefore also to the use of electricity and thermal energy, transportation processes and metallurgical processes.

The steel-to-gate transport is particularly evident in categories such as depletion of the ozone layer (14.6%), land use (14.8%), ionizing radiation – effects on ecosystems (10.6%). In the case of the impact category, the depletion of water resources is further marked by the impact of the processes of steel cutting (11.3%), coating (9.01%), trial assembly and disassembly (13.4%) and packaging (10.1%). The important issue is, however, that these impacts relate only to a specific impact category and can be interpreted with reference to a single impact category due to the fact that these are characterization results.

After the weighing stage, steel production has the potential greatest impact on the following categories:

- Human toxicity – carcinogenic effects (91.6 Pt);
- Human toxicity – non-carcinogenic effects (17.8 Pt);
- Ecotoxicity for freshwater (3.64 Pt).

To isolate the results for the production process itself, the process of making steel and transporting the steel to the gate were excluded from the analysis at the characterization stage. Figure 3 shows the results of this operation.



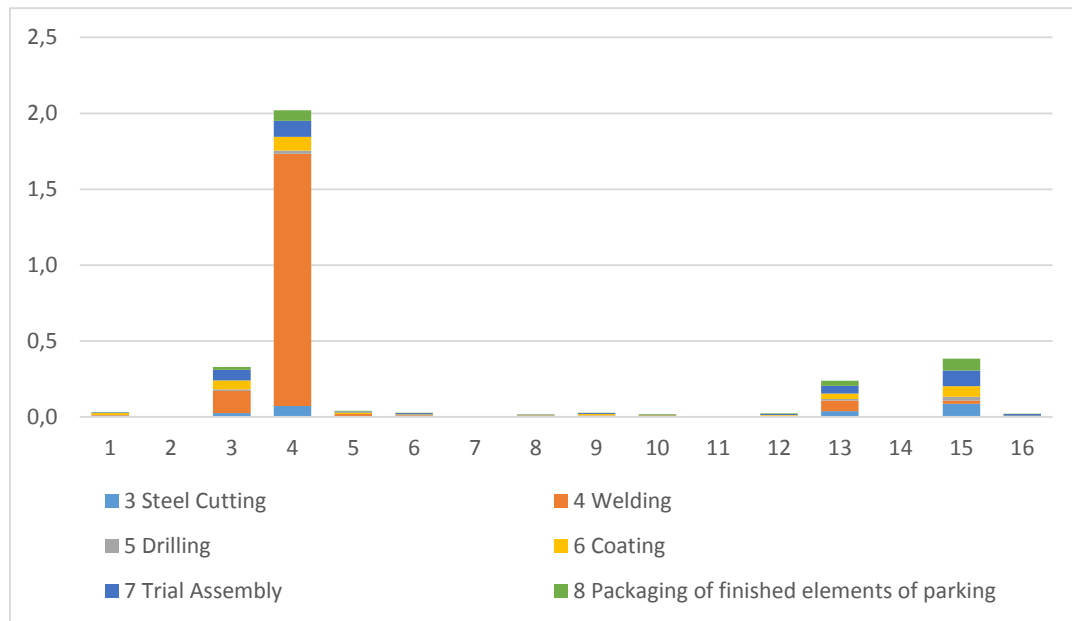
Key: 1. Climate change; 2. Ozone depletion; 3. Human toxicity – non-carcinogenic effects; 4. Human toxicity – carcinogenic effects; 5. Respiratory particulates / inorganic substances; 6. Ionizing radiation – human health effects; 7. Ionizing radiation – ecosystem effects (interim); 8. Photochemical formation of ozone; 9. Acidification; 10. Terrestrial eutrophication; 11. Aquatic eutrophication – fresh water; 12. Aquatic eutrophication – seawater; 13. Ecotoxicity for fresh water; 14. Land use; 15. Resource depletion – water resources; 16. Resource depletion – mineral resources, fossil resources.

Figure 3. Environmental characterization of the production of smart parking elements in relation to environmental impact for individual components after the characterization stage (excluding steel and steel transport).

Source: Own study.

An analysis of the processes directly related to the production of the smart parking lot highlights primarily the impact of the welding process in the category of human toxicity – carcinogenic effects (82.2% in this impact category) and the impact of the trial assembly and disassembly process in the category of depletion of mineral and fossil resources (48.9% in this category).

As can be seen from the analysis of the weighing results, the processes directly related to the production of smart parking lots have the greatest impact on the environment in the category of human toxicity – carcinogenic effect. In this category, the greatest impact is associated with the welding process (Figure 4).



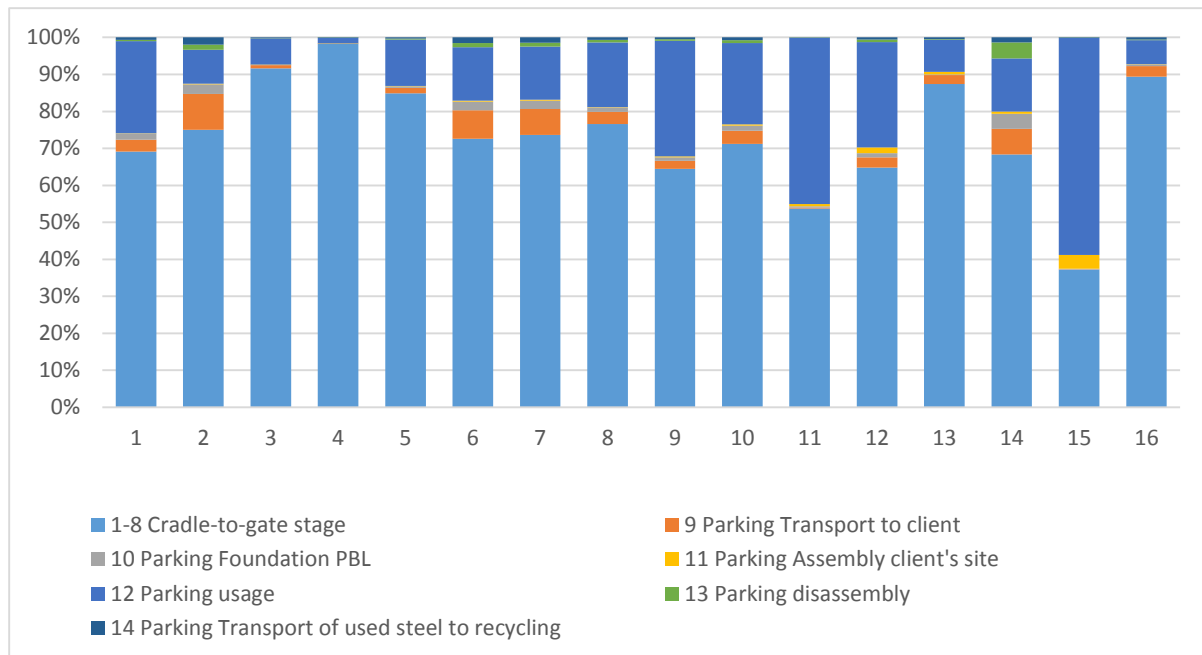
Key: 1. Climate change; 2. Ozone depletion; 3. Human toxicity – non-carcinogenic effects; 4. Human toxicity – carcinogenic effects; 5. Respiratory particulates / inorganic substances; 6. Ionizing radiation – human health effects; 7. Ionizing radiation – ecosystem effects (interim); 8. Photochemical formation of ozone; 9. Acidification; 10. Terrestrial eutrophication; 11. Aquatic eutrophication – fresh water; 12. Aquatic eutrophication – seawater; 13. Ecotoxicity for fresh water; 14. Land use; 15. Resource depletion – water resources; 16. Resource depletion – mineral resources, fossil resources (Table 1).

Figure 4. Environmental characterization of the production of smart parking lots in relation to environmental impact for individual components after the weighing stage (excluding steel and steel transport).

Source: Own work.

4.2. Life cycle stages

Figure 5 shows the results of the smart parking lot life cycle analysis. The inventory data for the life cycle stages after the cradle-to-gate stage are described in Chapter 3. The results presented in all impact categories are scaled to 100%. This presentation of the results does not make it possible to determine whether it is 100% low impact or high impact, but it does highlight the relationships of the processes to each other for each category – this is how the results after the characterization stage are graphically presented. Following the characterization stage, the cradle-to-gate stage impact (described in Section 4.1) is dominant for all categories.



Key: 1. Climate change; 2. Ozone depletion; 3. Human toxicity – non-carcinogenic effects; 4. Human toxicity – carcinogenic effects; 5. Respiratory particulates / inorganic substances; 6. Ionizing radiation – human health effects; 7. Ionizing radiation – ecosystem effects (interim); 8. Photochemical formation of ozone; 9. Acidification; 10. Terrestrial eutrophication; 11. Aquatic eutrophication – fresh water; 12. Aquatic eutrophication – seawater; 13. Ecotoxicity for fresh water; 14. Land use; 15. Resource depletion – water resources; 16. Resource depletion – mineral resources, fossil resources.

Figure 5. Environmental characterization of the life cycle of a smart parking lot in terms of environmental impact for each component following the characterization stage.

Source: Own work.

5. Conclusions

The results of the calculations presented in this article can inspire decisions that, at the design stage, can help effectively reduce environmental impact. In particular, they can form the basis for the development of eco-innovative technical solutions. The results of the calculations show that, considering the total life cycle impact of a vertical parking lot, the greatest environmental burden arises at the cradle-to-gate stages – that is, from the acquisition of raw materials to the manufacturing stage. The carbon footprint for the stage is 54,300 kg CO₂ eq, which is 69.08% of the total life cycle impact in this category. The impact in this category is also relatively large at the use stage of vertical parking – 2.5% of the total carbon footprint. The environmental characterization of smart parking lot production in terms of environmental impact for individual components after the weighing stage (excluding steel and steel transport) shows the greatest impact of the welding process in the category of human toxicity – carcinogenic effect (82.2%). Other impact categories standing out with a significant share are resource depletion – water resources, human toxicity – non-carcinogenic effect, and freshwater ecotoxicity. These impacts are due to the consumption of materials and energy, air emissions

and generated pollutants. In all categories analyzed, steel production has the greatest environmental impact – calculated from cradle to gate. The lowest impact is in the category of the depletion of water resources (50.1%), and the highest in the category of human toxicity – carcinogenic effects (97.7%). Notably, the impact in each category applies to the entire steel production process, and therefore also to the use of electricity and thermal energy, transportation processes and metallurgical processes. The steel-to-gate transport is particularly evident in categories such as depletion of the ozone layer (14.6%), land use (14.8%) and ionizing radiation – effects on ecosystems (10.6%). In the case of the impact category, the depletion of water resources is further marked by the impact of the processes of steel cutting (11.3%), coating (9.01%), trial assembly and disassembly (13.4%) and packaging (10.1%).

Based on the LCA results obtained for the vertical parking lot, it can be recommended to consider applying design strategies for cleaner production and use, and improving energy efficiency. In the context of a circular economy, it is worthwhile to undertake further research on assessing the life cycle impact of various parking solutions on the environment. The result of the research and comparative analysis can be the development of design options to support decision-making.

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COMPLIANCE AS A RELIABLE MANAGEMENT INSTRUMENT OF A COMPANY IN UNCERTAIN TIMES

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Purpose: Determining and discussing selected aspects of the functioning of Compliance management systems in Polish enterprises in perspective of challenges resulting from the current crises.

Design/methodology/approach: The research method used in the paper is the author's observation and interviews with companies with whom she cooperates in the implementation and operation of the compliance management system. The analysis of the results of research conducted on the basis of a standardized survey based on a questionnaire containing closed and open questions carried out in exemplary enterprises was involved as well.

Findings: Research results confirmed the dynamic development of Compliance management in Polish enterprises, which is accompanied by a preventive approach with a key role played by the management in building culture and awareness of compliance in the enterprise.

Research implications: Future research directions should focus on further, expanded research exploration in the area, taking into account international perspective.

Practical implications: The results of the research discussed in the paper have a number of practical implications mainly for the management staff in terms of implementation of compliance management and development of its areas.

Social implications: Building awareness of compliance management system and the advantages of implementing it.

Originality/value: The paper has cognitive value for the development of knowledge, science and further development of the compliance management system in enterprises in Poland.

Keywords: compliance, pandemic, trust, enterprise management in conditions of uncertainty.

Category of the paper: research paper.

1. Introduction

The reality in which modern enterprises have been operating for several years is marked in the first place by the pandemic that has increased the risk of doing business in an unprecedented way (Marinov, Marinova, 2021). The epidemic unpredictability was enforced by the armed conflict in Ukraine and the decision-making inertia of state organs (Aguinis, Burgi-Tian, 2021). The uncertainty that resulted in the inability to assess future conditions and the likelihood of their occurrence forced companies (in the way they organize and manage fundamental changes), mainly in the field of remote work to use modern technologies (Zhong, Yifan, Yameng Li, Jian Ding, Yiyi Liao, 2021). Moreover, this reality becomes more and more complicated month by month due to the growing legislative and regulatory activity of the state, characterized by an abnormally low level of legal regulations and standards for implementing new legal obligations, along with a range of tools supporting these processes. For years, there has been a legal inflation phenomenon in Poland which is currently at a record level. According to Grant Thornton's report "Legal Barometer", in 2021, twenty one thousand pages of the new law, which is 41 percent more than in 2020 was produced. However in the first half of 2022, 955 new legal acts were produced, numbering as much as 14.5 thousand A4 pages (Law Barometer, Grant Thornton, 2022).

The application of the law by enterprises has long ceased to be limited only to its interpretation through the analysis of difficult and complex legal provisions in search of their meaning and correct application. In the current uncertain times, also the design, implementation, execution and, above all, evaluation of organizational processes (which are shaped not only by the provisions of common law, but increasingly by standards and internal regulations as well as codes of good practice) play an increasingly important role (Drozdowski, Rogozińska-Mitrut, Stasiak, 2021).

Therefore, compliance management systems (in short: CMS) play, especially at present, an unprecedented role in the functioning of mature organizations (Gorgoń, Raczkowski, Kraft, 2019).

Compliance is still a relatively new ground of management science and an instrument of risk management in organizations. Due to its complex, multi-faceted nature, compliance cannot be attributed to one scientific discipline. It is naturally derived from and is related to legal sciences but from the methodological point of view it is embedded in the level of organizational management, taking into account aspects of communication, psychology and ethics at the same time (Barcik, 2019). The English term compliance in Polish is translated as "compatibility" (Cambridge Dictionary). However in Poland as in other European countries the term "compliance" is commonly used. Historically the term compliance derives from medical science and means adherence to therapeutic recommendations (Gaciong, Kuna, Adherence, 2008), while in trade it is equated with compliance in terms of compliance mainly with legal

rules with broadly understood legal risk (Barcik, 2016). In order to take into account the interdisciplinary nature and fully precisely and comprehensively define the functions that compliance should fulfill in the organization, the author advocates a broad approach, proposed by B. Jaruga, B. Makowicz, ISO 19600 and ISO 37301. It assumes that compliance is a way of internal organization which minimizes the risk of irregularities in the organization, resulting from non-compliance with legal standards but also any other internal obligations accepted on a voluntary basis (Jaruga, Makowicz, Norma ISO 19600, Norma ISO 37301). In this perspective compliance is a management instrument that enables compliance management with regard to ethical principles, standards, norms and expectations of stakeholders in all types of organizations. The main goal of compliance is to identify threats to the proper functioning of the organization, their monitoring and then taking appropriate supporting and remedial actions. Identification of threats and the related thorough analysis and assessment of the risks that occur allows for precise determination of the levels of compliance properties (Chang, McAleer, Wong, 2020).

The concept of the paper is to examine at what stage compliance is now, how the implementation is going and how the compliance management systems in Polish enterprises have been organized in the current economic situation determined by crises. To achieve this goal the method of observation and interviews with people who deal with compliance in companies (with whom the author cooperates as a legal advisor supporting CMS implementation processes) was used. In addition it was based on the results of the research on the state of Compliance in Poland, conducted in 2021 by the Compliance Institute in which the author has been actively involved for years (Report Compliance in Poland, 2021).

2. Theoretical background

On the basis of the literature it is assumed that compliance in formal terms means a compliance risk management system: Compliance Management System (CMS), which is understood as a system of standards and policies introduced by the organization, as well as activities undertaken in the organization, aimed at ensuring compliance with the principles of ethics and legal regulations, thus minimizing the risk of non-compliance.

A CMS tailored to the structures and needs of a given organization should fulfill the following basic functions (Table 1):

Table 1.
Basic functions of the Compliance Management System

CMS Function	Scope
Preventive function	<ul style="list-style-type: none"> • protection of the organization, its employees, management from the negative consequences of non-compliance, • elimination of damages and reputation risk.
Repressive function	<ul style="list-style-type: none"> • examination of the occurrence of irregularities, • taking appropriate corrective actions, • preparing the organization for cooperation with state authorities.
Advisory and information function	<ul style="list-style-type: none"> • building awareness of the validity and compliance with the law and other standards in force in the organization, • communication at all levels of the organization.
Control and evidence function	<ul style="list-style-type: none"> • monitoring and reporting on irregularities. • collection and analysis of documentation in terms of possible liability in proceedings before state authorities, as well as liability within the organization.
Marketing and quality assurance function	<ul style="list-style-type: none"> • building, protecting and strengthening the reputation of the organization, • strengthening the competitiveness of the organization. • strengthening the trust of stakeholders. • increased confidence in the quality of products and services provided.

Source: Barcik, 2019, p. 95.

CMS is currently standardized based on two ISO standards. The first is the ISO19600 Compliance management systems - Guidelines standard, published in 2014 and it is the so-called B-type standard, i.e. containing recommendations which, however, cannot be the basis for certification. The second standard is ISO 37301 Compliance management systems - Requirements with guidance for use, which was published in 2021 and is a type A standard containing, unlike the previous version, requirements and subject to certification. Both standards have a CMS structure scheme. Below, in Figure 1, a diagram from the ISO 19600 standard is presented, while in Figure 2 - a diagram from the ISO37301 standard.

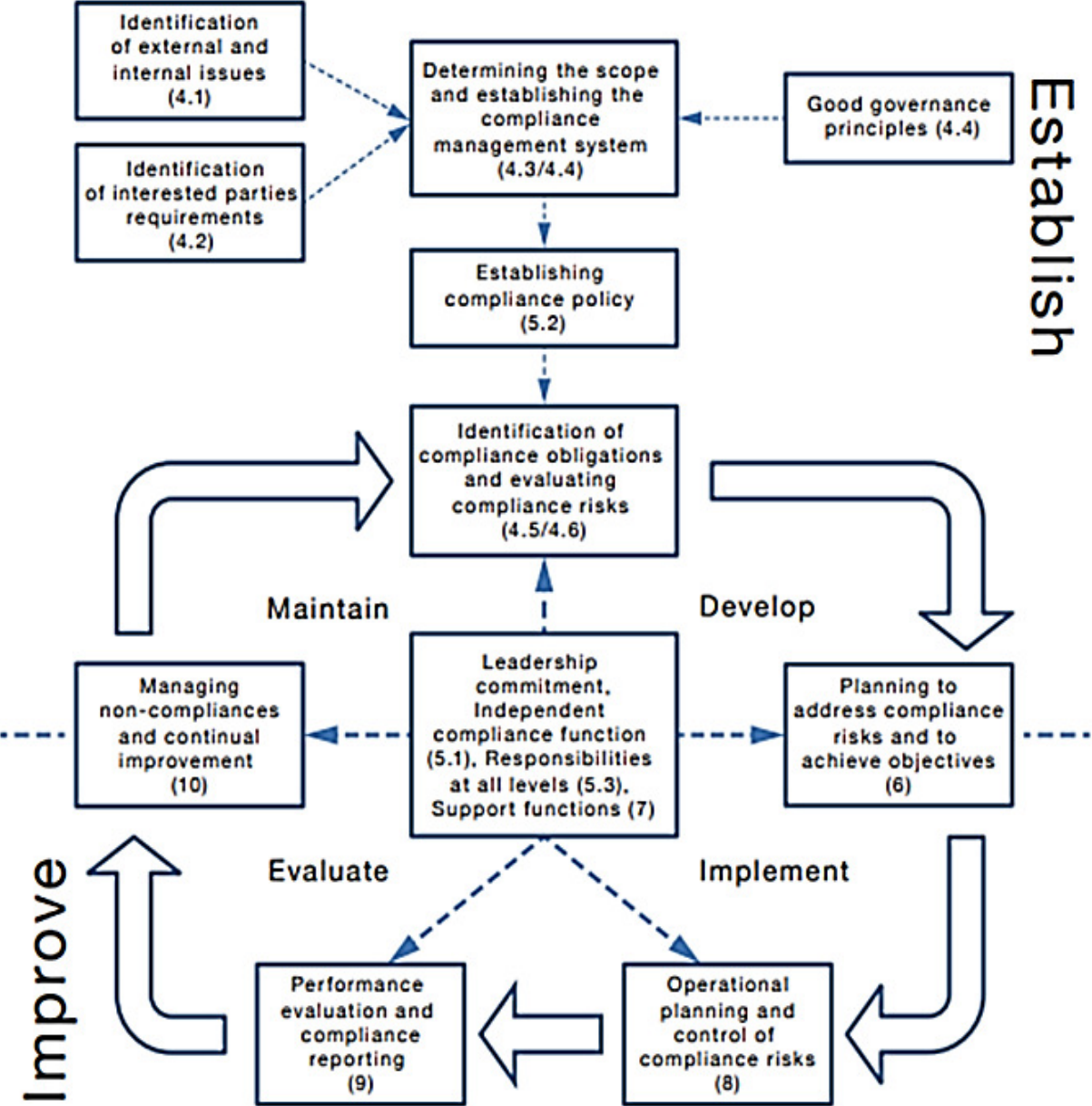


Figure 1. Schematic diagram of the CMS - ISO 19600.

Source: ISO 19600: 2014 (E) Compliance management systems – Guidelines, p.vi.

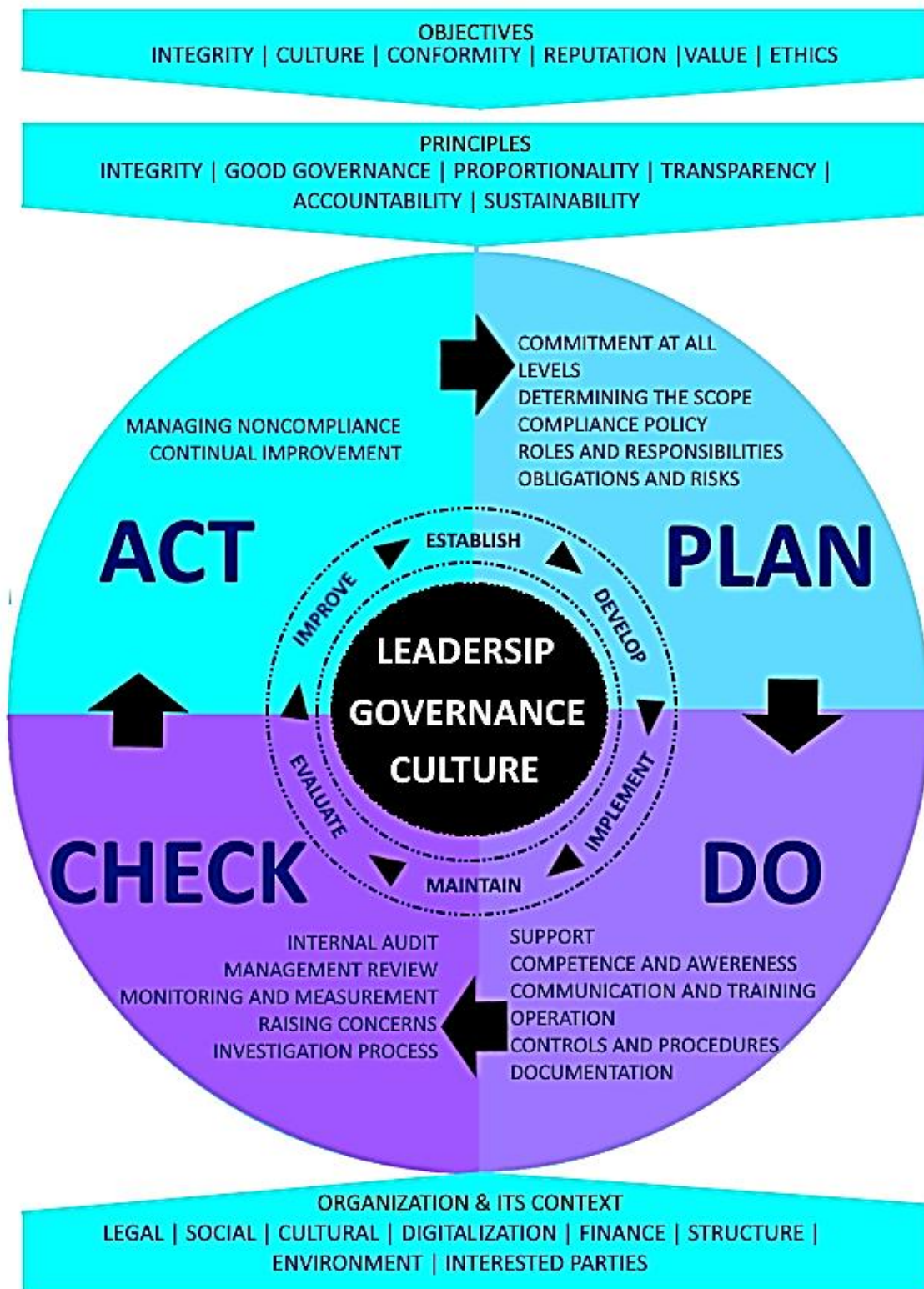


Figure 2. Schematic diagram of the CMS - ISO 19600.

Source: ISO 37301: 2021 (E), Compliance management systems-Requirements with guidance use, p.vii.

The organizational structure of compliance management proposed in both ISO standards was based on such fundamental foundations as: Good Governance rules, universality, long-term nature, transparency, flexibility, responsibility, proportionality and independence. For the purposes of creating a model CMS, three basic, general concepts have been consolidated in standards:

- Risk Management System: risk management model.
- High Level Structure: canon of management system structures.
- PDCA-Model: Plan-Do-Check-Act model of continual improvement.

In the author's opinion, however the CMS scheme presented in the ISO37301 standard is more transparent. This is probably due to the fact that individual elements of the system are included in the PDCA scheme which clearly indicates the stage of the process at which the organization and persons responsible for the system are located. Properly functioning compliance should first of all be rooted in the organizational culture of a company (Jedynak, Bąk, 2021). All employees should follow the system of values adopted in the organization, and this is possible when they are convinced that compliance with the law brings benefits not only to the company, but also to them. Therefore the attitude of the management team is of key importance, as it should set clear landmarks in conflict situations (Makowicz, Jagura, 2020). By placing ethical principles as the foundations of an efficient compliance system, the tone from the top and leading by doing rules become other elements inherently related to CMS. According to the ISO37301 standard, the company's management and top management should demonstrate leadership and commitment to the compliance system through (ISO37301):

- ensuring that the goals and policy of compliance are set and consistent with the strategic direction of the organization,
- ensuring the integration of the compliance system requirements with the organization's business processes,
- ensuring that resources necessary for the compliance system are available; informing about the importance of effective compliance and compliance with the requirements of the compliance system,
- ensuring that the compliance system achieves the assumed results,
- promoting continuous development,
- managing and supporting the staff in order to increase the effectiveness of the compliance system,
- supporting other relevant roles to demonstrate their leadership, which translate into their areas of responsibility.

In summary, it is the management who is ultimately responsible for the CMS in the organization and whether it will achieve its goals. Therefore, the better an example to be followed by top management and the more examples of its exemplary behavior and compliance with compliance rules, the easier it will be to convince the rest of the staff to follow them and enforce them (Wijaya, 2021).

On the other hand, the actions of management in the leading by doing should be as follows (ISO37301):

- ensuring and maintaining the values of the organization,
- ensuring that policies, processes and procedures are created and implemented in accordance with the compliance principles,
- ensuring that they are kept informed of compliance issues, including non-compliance, and that appropriate measures have been implemented,
- ensuring that compliance with compliance is maintained and non-compliance is properly addressed,
- ensuring that compliance responsibilities are assigned to the appropriate positions,
- hiring or appointing staff to positions related to compliance,
- ensuring that the reporting system is in use.

Managers should therefore, by their example, stimulate the organization to develop in the area of compliance and additionally using their position and authority, expand awareness and build an organizational culture based on the principles of compliance (Wolniak, 2019).

In this aspect, an extremely important role is played by the reporting of irregularities (SIN) occurring in the organization (the so-called whistleblowing), which are included in the area of compliance communication and not only fit into the compliance culture, but also determine the effectiveness of the entire CMS, constituting its central area. They are described as “pro-social, based on the principle of trust, activity of the unit informing that members of its organization violate the rules” (Waszak, 2018). Moreover, whistleblowing systems reflect the actual attitude of the organization towards its ethical obligations. They are not only tools of control, but should shape the organizational culture by building greater employees' awareness of their right to confidential reporting of abuse, and thus increasing their sensitivity to breaking ethical principles in the organization and limiting possible conflicts of values between ethics and loyalty and subordination. towards the superior. In order to strengthen the whistleblowing function in the organization, SINS are usually integrated with compliance audits, internal investigations and investigations.

3. Selected research results

The survey research was carried out over a period of 3 months from May to July 2021 by the Compliance Institute under the substantive patronage of the Viadrina Compliance Center at the European University Viadrina in Frankfurt (Oder). A total of 99 respondents took part in the survey, who were only people dealing with CMS in the surveyed companies, usually Compliance Officers. Enterprises represented various industries, with the most numerous group being representatives of the energy, banking and financial sectors (31% in total), and in the remaining scope also the following sectors: food, IT, trade, automotive, transport, healthcare and medical, construction and others (69%). At the same time, the quantitative research was deepened by qualitative research, which was based mainly on interviews, study visits and in-depth "learning" workshops with accompanying discussions in selected enterprises participating in the survey, with which the author cooperates within the framework of professional practice as a legal advisor, supporting CMS implementation processes. It is worth emphasizing at this point that a model often practiced by Polish enterprises is the implementation of CMS with the support of external entities and as many as 70% of enterprises decide to choose a law firm in this respect, which is dictated by the real need for additional external specialist support in a given field of law.

Determining the reasons for implementing CMS in the enterprise became the starting point for the further research process.

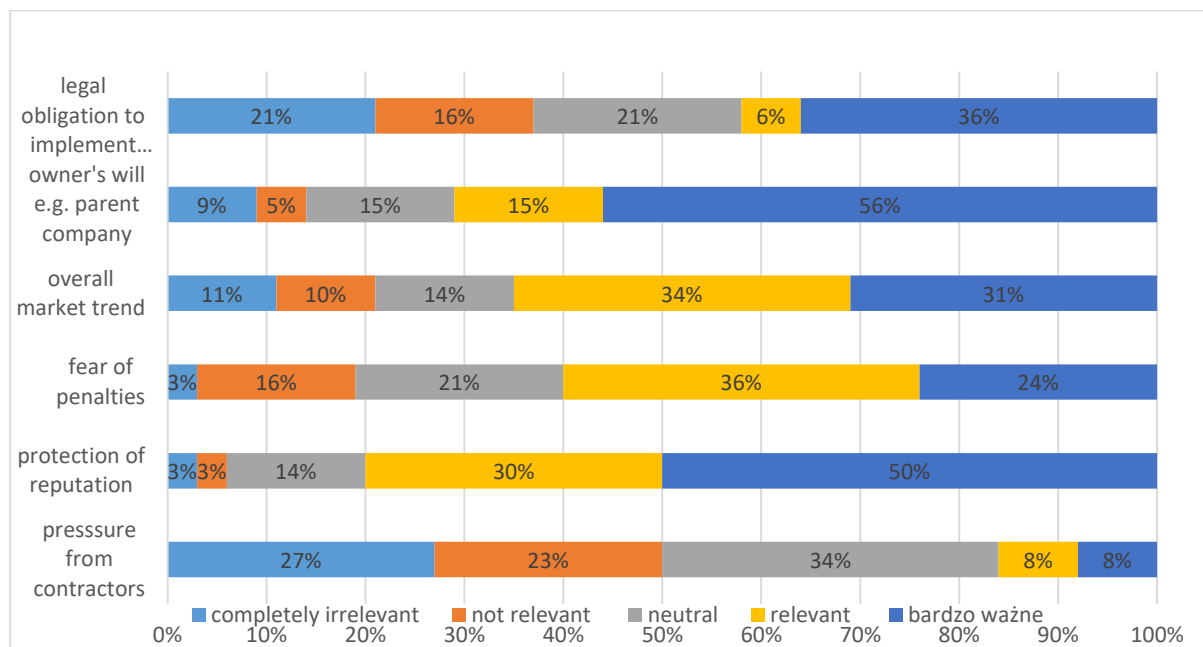


Figure 3. Prerequisites for implementing a CMS in an enterprise.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

The first question about the reasons for implementing CSR in the enterprise was presented in Figure 3. Due to the fact that the answers obtained in this question were not unambiguous, it became necessary to make them more precise during individual interviews. Entrepreneurs from the regulated market indicated the legal obligation to have a CMS as the main premise for its implementation. It is important to indicate the fear of sanctions (for over half of the respondents it is an important or very important reason) and the protection of reputation (for 80% it is an important/very important reason), which in the opinion of entrepreneurs is strongly correlated with the current economic situation, and primarily the risk resulting from operating in an unstable legal environment. In this respect, the respondents showed the greatest fear of being inspected by tax authorities, the National Labor Inspectorate, the Office for Personal Data Protection, the Central Anticorruption Bureau, the Office of Competition and Consumer Protection.

In this context it was important to examine one of the key factors determining the effectiveness of CMS is the company's management board's approach to the risk of non-compliance, taking into account the current conditions.

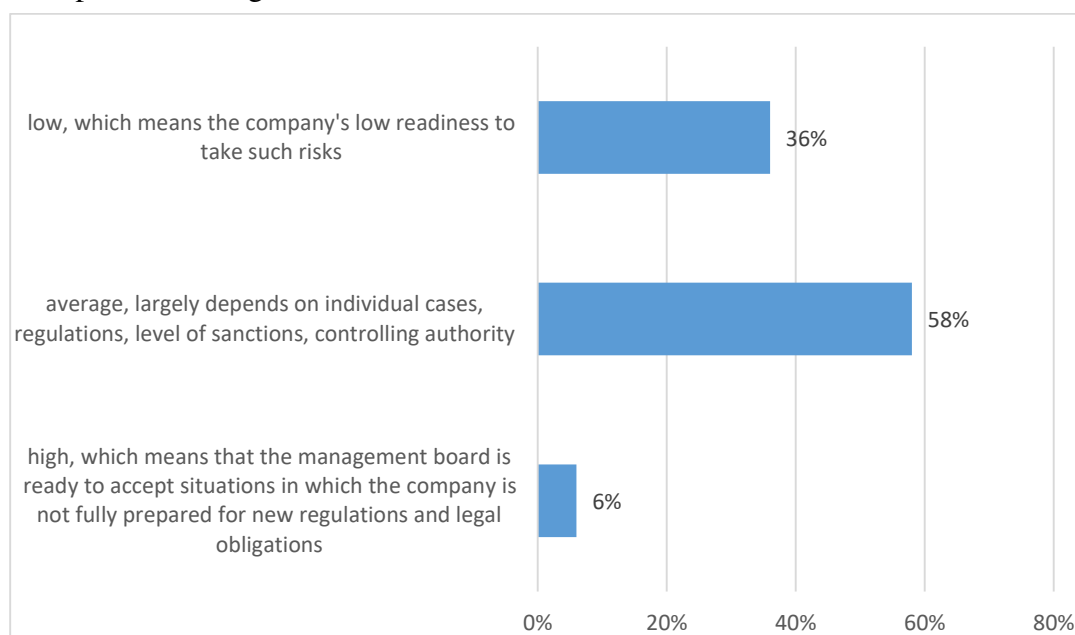


Figure 4. Readiness of the board/management to take risks resulting from new and changing legal regulations.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

According to the outcomes presented in Figure 4. the overwhelming majority of insurance coverage respondents has an approach to accepting legal risk. They are aware of numerous negative legal consequences, mainly in the form of financial sanctions, for possible non-compliance, and generally prefer not to risk their occurrence. Hence, another important issue was to establish the level of interest and openness in the management board's attitude to compliance and readiness for investments related to the implementation and improvement of the CMS. Figure 5 presents the respondents' assessment of the attitude of the management board to the compliance principles in the company - mainly in terms of the implementation of the following principles: ton from the top and leading by doing. On the other hand, Figure 6 shows the level of the management board's involvement in the CMS mainly through the prism of readiness to incur investments related to its implementation and improvement.

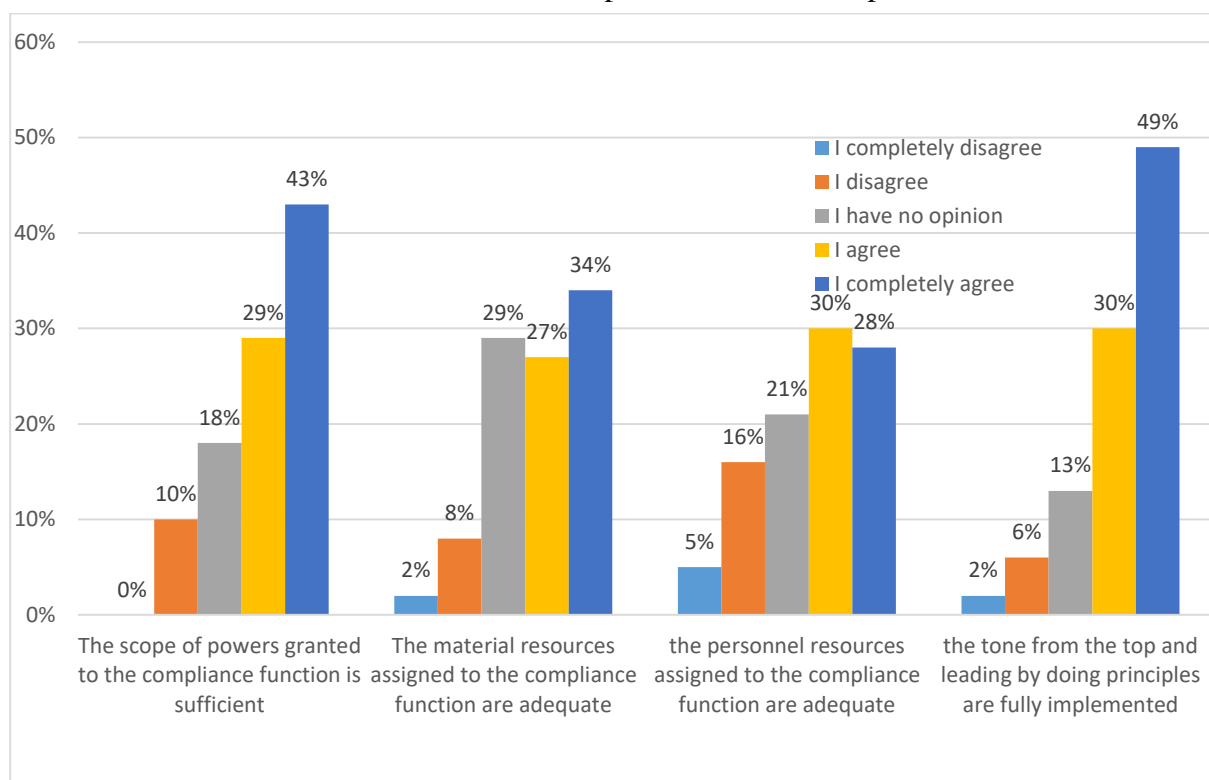


Figure 5. Management's attitude to compliance rules in the company: the principle of tone from the top and leading by doing.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>

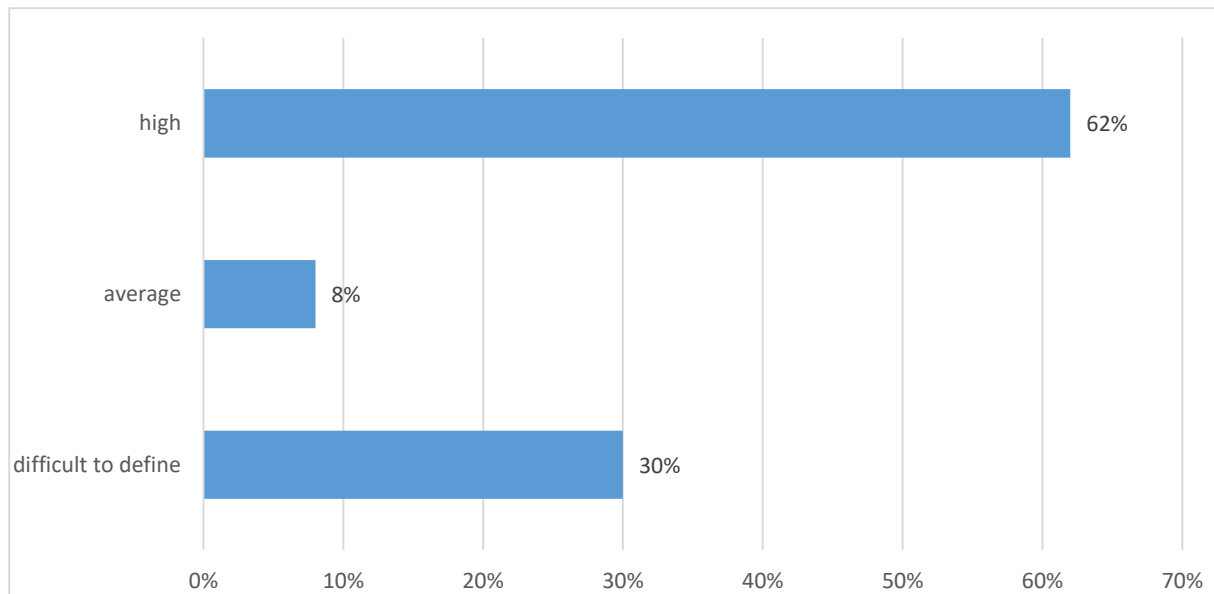


Figure 6. The level of commitment of the management board and readiness for investments related to the implementation and improvement of the CMS.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

Declarations in this regard are undoubtedly encouraging and testify to the maturity of enterprises, however, the in-depth interviews and observations of the author show that the above-mentioned readiness and openness in practice is largely dictated by the fear of sanctions and which have a considerable general and preventive significance and have a significant impact on business decisions and investments. The respondents equate the principles of *ton from the top and leading by doing* with good, ethical actions of company managers. In addition, the implementation of the above-mentioned principles is equated with active actions on the part of the management board supporting the culture of compliance, in this aspect the most frequently indicated activities include: regular contact and discussions with the Compliance Department, messages from the management board confirming the importance of compliance for the functioning of the company, commissioning regular CMS effectiveness studies, participation in compliance training.

The vast majority of the surveyed companies (over 90%) have Irregularity Information Systems and are treated as key elements of the CMS. For this reason, it was important to determine whether employees use them and whether and how investigations are conducted (Figure 7).

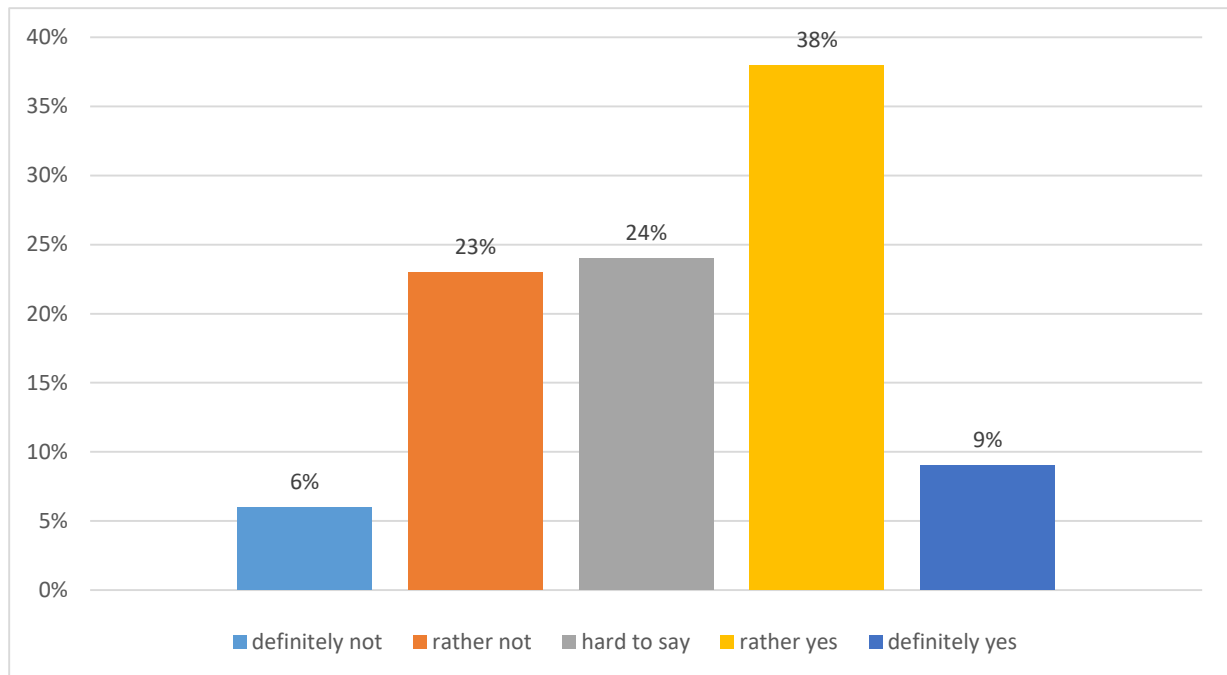


Figure 7. Use of Irregularity Information Systems by employees - Do employees use the possibility of reporting observed irregularities?

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

In this context, some respondents pointed to certain psychological barriers resulting from the Polish cultural and social context and the treatment of the whistleblower as a person disloyal to his colleagues. Investigations after reporting irregularities are standard in companies where SIN operates, while the differences concern the authorities that conduct them. As a rule, these are Compliance Departments, independently or together with the Audit, HR departments or the so-called shop stewards, legal departments, ethics advocates. Unfortunately, in the author's opinion, entrusting the Compliance Departments with conducting explanatory proceedings is not a very good solution. Compliance officers are primarily to build a culture and awareness of compliance, enjoy trust and care for relations within the company. Acting as an investigator appears to interfere with these assumptions and consequently may result in a conflict of interest.

The pandemic and the war in Ukraine and the resulting economic crisis influenced the perception and functioning of CMS in enterprises. In 35%, the CMS has gained importance, and in 65% it has not lost its importance (Figure 8).

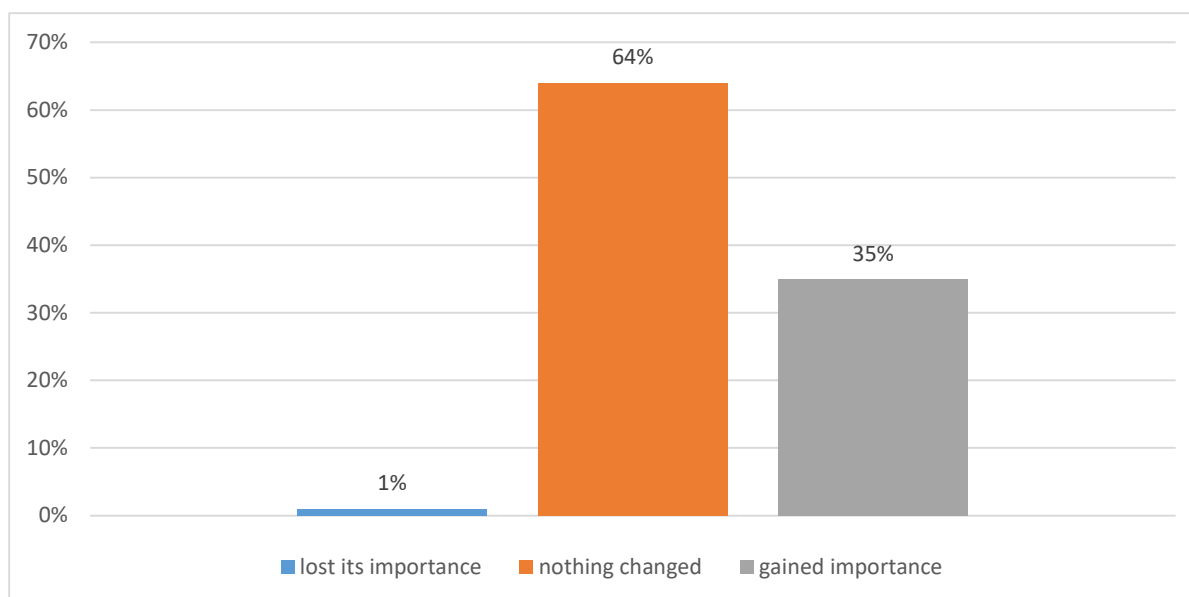


Figure 8. How the pandemic and current economic and political crises affected the CMS in the enterprise.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

It was also established in which areas of compliance risk have gained the most importance in the last two years (Figure 9).

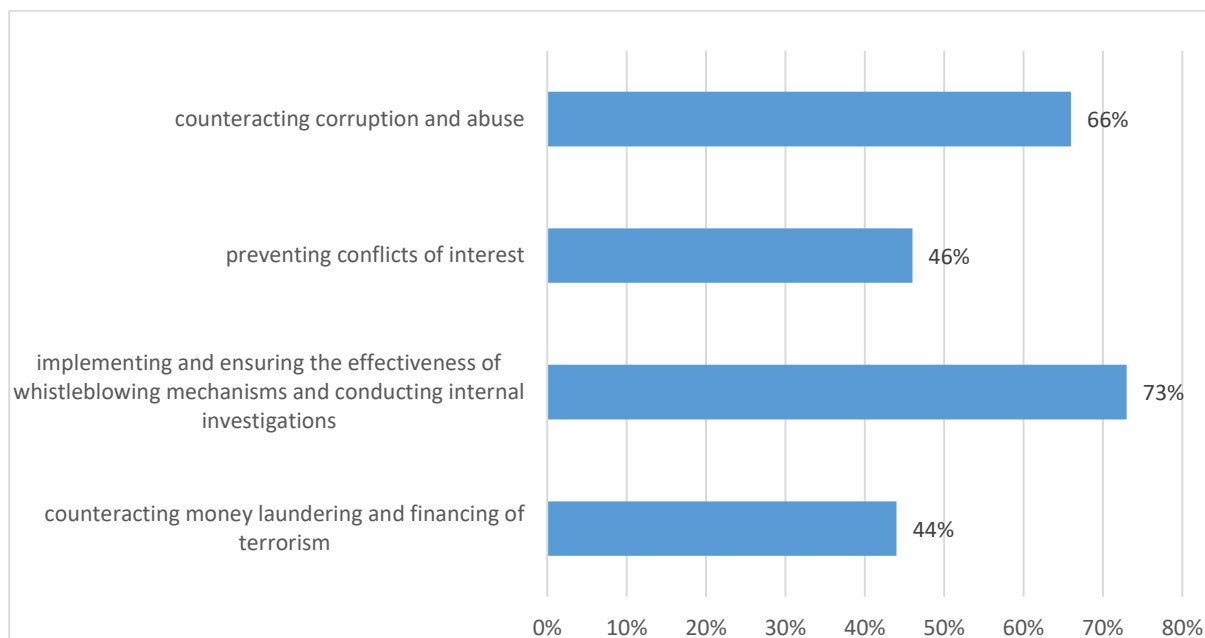


Figure 9. Areas in which compliance risk was of greatest importance for the functioning of the company in the last two years.

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

The answers to this question were conditioned by the challenges posed by the necessity to comply with the EU Directive on whistleblower protection. Frequent indications of a conflict of interest are also significant.

As for the development of CMS in the near future, the vast majority of respondents are already convinced that the importance of CMS will increase (Figure 10).

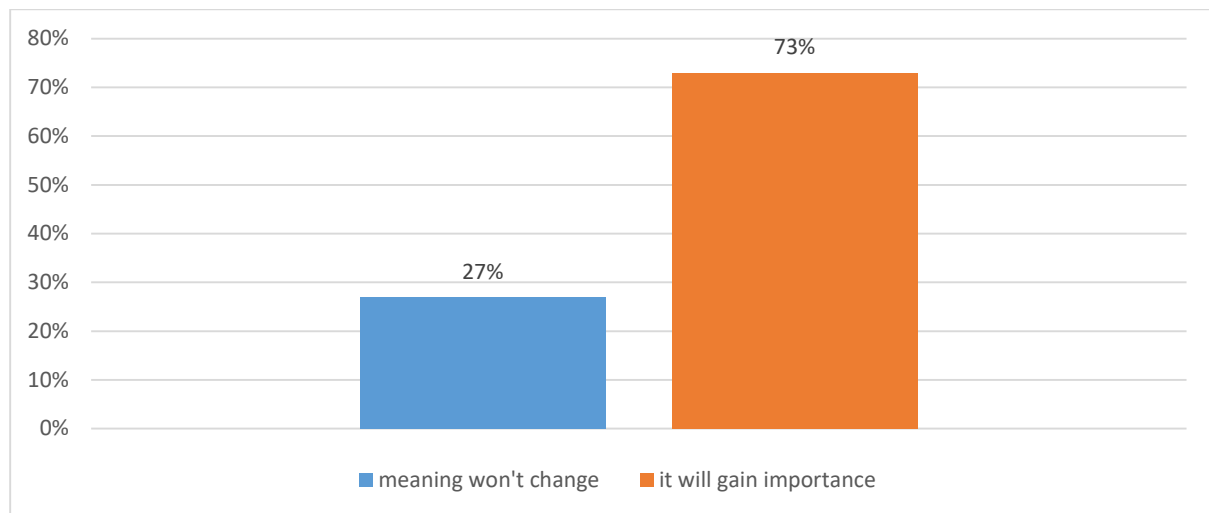


Figure 10. Will the CMS gain, lose or change meaning in your company in the near future?

Source: own elaboration based on Raport Compliance w Polsce 2021. Systemy zarządzania zgodnością: między pandemią a nowym ładem. Edycja 2021, Viadrina Compliance Center, Instytut Compliance, Wolters Kluwer, Available online: <https://instytutcompliance.pl/wp-content/uploads/2021/10/Raport-Compliance-2021.pdf>.

The above results are optimistic and confirm the global trend that compliance is also developing in Poland. The respondents, justifying their answers in this respect, emphasized that they were dictated by the belief that CMS to a greater or lesser extent but it works in crisis conditions that entrepreneurs have been struggling with for several years.

4. Discussion

The outcomes of the research correspond to the overall conclusions discussed in the literature. A systemic approach to compliance risk management entails the need to implement compliance in all processes of the organization (Blecker, Hortnesius, 2014; Jagura, 2017). The basic condition and determining the effectiveness of a CMS is the adaptation of the system to the needs of a specific organization. This is due to the fact that different types of organizations are exposed to non-uniform forms of risks typical of their activities (Polinkevych et al., 2021). Hence, there is a need to apply various, risk-neutralizing measures, adequate for a given organization and existing risk circumstances, in relation to their application and optimization (Crovini, Schaper, Simoni, 2022). The need to adapt the CMS to a specific organization is already visible in the first key decisions preceding the implementation of the CMS.

Namely, it is primarily about deciding whether the system should be internal or external and also whether it should be centralized or decentralized. The internal CMS is integrated with the structure of a given organization and its functioning is the responsibility of the members of the organization usually Compliance Officers who know the organization and the specificity of its activities. In practice such a solution has a positive effect on internal communication, reducing the risk of confidential and sensitive information flowing beyond the organization and CMS processes, conducts training and then, depending on the needs, constantly monitors and adjusts the system. The advantages of the above solution are the independence and specialist knowledge of external specialists. Centralized CMS includes a central compliance department, which from the headquarters position, uniformly manages the system in all departments of the organization, while having a global view of its functioning. This enables central control of the system while maintaining a uniform standard throughout the organization. The decentralized system on the other hand is integrated into individual operational units. Thanks to regular reporting to the CMS department it ensures its comprehensive integration. A decentralized solution results in the proximity of CMS tasks and better adaptation to the current functioning of the organization (Coglianese, Nash, 2020). Another element that is indicated as determining the effectiveness of CMS is integration with management systems functioning in the organization (Barcik, 2020). CMS is usually integrated with internal audit, operational risk management system, social responsibility system, internal functional control (managerial supervision) as well as with anti-corruption systems. Although in the case of the latter, due to the fact that the risk of corruption is considered one of the basic compliance risks, the CMS itself is often treated as an anti-corruption system. CMS integration with the mentioned management systems increases the transparency and efficiency of these systems, and also leads to process optimization.

5. Conclusion

The considerations and research results presented in the article allowed for the analysis and general assessment of CMS in Polish enterprises. The following conclusions can be reached:

- The first key conclusion is the undisputed development of compliance in Poland in particularly difficult, crisis conditions, accompanied by a high level of inflation and legal instability which demotivates entrepreneurs and discourages investors. The above challenges determine the nature of Polish CMS. While in the world the evolution of compliance draws more and more from the achievements and methods of conservative psychology (mainly aiming at focusing on the individual and trying to determine why and under what circumstances the rules are broken and above all how and what

conditions to create to prevent it) in Poland a preventive approach to compliance is more visible.

- The management of the vast majority of enterprises shows protective attitudes in terms of readiness to take legal risk. Is aware of the negative legal consequences of non-compliance, primarily in the form of financial sanctions, and prefers not to risk their occurrence. The sanctions provided for in the Polish legal system are clearly of general and preventive importance and have a key impact on making business decisions. This approach determines the expectations set for compliance systems.
- Management board members play a fundamental role in the organization and efficient functioning of the CMS in the surveyed companies. The adoption of the principles: ton from the top and leading by doing sets the direction for the development of the CMS in the company.
- A prospective area of development and simultaneous challenges determined by the conditions of the Polish cultural circle is the implementation of appropriate systems of informing about irregularities integrated with the CMS.

The obtained research results also outline research perspectives for the future related to a comparative analysis of the specifics, methods and principles of the implementation and functioning of the CMS in an international perspective.

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REVERSE LOGISTICS AT HOME APPLIANCE MANUFACTURERS IN EUROPE AND POLAND – CHALLENGES FACED BY THE INDUSTRY

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Purpose: models of reverse logistics (RL) that consider the sustainable development goals (SDG) and circular economy activities (CEA) are increasingly appearing in the literature. Intention of the article is to show at what stage of implementation of the SDG and CEA the home appliance industry (HAI) is currently at and what challenges it faces in terms of implementing the RL model.

Design/methodology/approach: The paper shows that the information, data, industry positions and reports presented on the website of the Association of Appliance Manufacturers (APPLiA) show that the HAI is too slow in moving towards the SDG and CEA. It also prevents the implementation of theoretical models of RL.

Findings: The article shows that the current actions taken by HAI in Europe and Poland are insufficient to meet the SDG, CEA, and the implementation of full models of RL.

Research limitations/implications: The presented research results refer to the data presented by the HAI of Europe and Poland, as well as the information contained on the websites of the APPLiA Europe and Poland. The presented research results can be related to the information of other relevant industries such as automotive, aerospace and others, so that the hypothesis that the industry insufficiently pursues the SDG and CE and does not take strategic steps towards the implementation of models of RL with special consideration of all CE activities.

Practical implications: The paper points out that for the home appliance industry to realize the SDG and the CE through the implementation of RL, it must use Design for eXcellence (DfX) tools now with a focus on Design for Circular Economy (DfCE) and Design for Logistics (DfL).

Social implications: no social implication.

Originality/value: The article presents the author's model of RL and formulates challenges for the industry that are associated with its implementation. It should draw the attention of various industries to the need to take strategic actions for implementation SDG and CEA.

Keywords: Reverse Logistics, Sustainable Development Goals, Circular Economy Activities.

Category of the paper: Research paper.

1. Introduction

The dynamically changing environment, driven by technological development is itself already creating challenges for enterprises. Proposed in 2012, The Industry 4.0 strategy (I 4.0) has opened unlimited and hitherto unknown possibilities for the reality of the industrial world (Kagermann, Wahlster, Helbig, 2012). When we added, unprecedented situations such as the Covid19 pandemic or the drastically worsening state of the climate, can say, that companies in the third decade of the 21st century “are living in very interesting times”. The deteriorating state of the environment is the responsibility of consumer lifestyles and especially industry, which, despite the many concepts that have appeared in recent years, continue to lag the challenges facing humankind, especially in terms of the environment.

The progressive global degradation of the environment makes it possible to hypothesize that the current business models, which are primarily profit-oriented, will have to be redefined soon. This is unlikely to be the result of the establishment of new SDG by the United Nations (UN), since, as a recent UN report shows, the achievement of the current goals is under severe threat (unstats.un.org, 2022). Among the main reasons for this are the Covid-19 pandemic, the war in Ukraine, and developing to an ever-widening extent, the climate crisis (in 2021, CO₂ emissions increased by 6%, making up more than the reduction that was achieved during the pandemic - a decrease of 5.4%) (unstats.un.org, 2022). While the issue of the Covid-19 pandemic and the war in Ukraine and other parts of the world is not related to the industry, the issue of the climate crisis is a direct consequence of its actions.

The very concept of sustainable development, very correct in its assumptions, becomes helpless when confronted with economic and economic systems, and the recommended transition from a linear economy (LE) to a circular economy (CE) (Kirchherr et al., 2017) does not have the momentum that the environment would expect. CEA, related to the issue of intelligent use and manufacturing of products (rejecting some solutions, thus some products, increasing the intensity of their use, while reducing the consumption of raw materials and materials (Refuse, Rethink, Reduce), extending the life cycle of products with its spare parts (through reuse, repair, refurbishing, remanufacturing or repurposing - Reuse, Repair, Refurbish, Remanufacture, Repurpose) to the rational use of materials using recycling and recovery, including energy recovery ending (Recycle, Recover) should become the new guidelines of every industrial sector – 10R (Potting et al., 2017).

The concept of RL appeared in the literature as early as the 1980s, the twentieth century changing its essence over the following decades to complete in its final form the phased division of logistics (procurement, production, distribution, returns and disposal). Earlier publications on the subject focused on reverse logistics processes such as transportation and warehousing in the context of reverse distribution (Tibben-Lembke, 2002). The focus then was on the issue of taking back from the market products that customers have abandoned purchasing. In the late

1990s and the beginning of the first decade of the 21st century, they began to link RL with the product life cycle. In 1998, Rogers and Tibben-Lembke defined RL as the process of managing (planning, implementing and controlling) the efficient and cost-effective flow of raw materials, finished goods and related information, from the point where the products were consumed or used, to the point of original origin of the products, in order to recover specific value or dispose of them properly - the term utilization and return logistics was then used (Rogers, Tibben-Lembke, 1998). The current shape of RL dictates a broader view of the issue, in which the process of disposal, should be a last resort. This is due to the need to incorporate into the concept of RL the aims of the Framework as well as the principles of CEA formulated within the framework of the 10R principle.

To describe idea of RL also can use the concept of Closed-Loop Supply Chain (SCCL). SCCL is an integrated system coordinating the flow of materials with the need to address diverse issues such as capacity, number, location of infrastructure facilities or coordination of the very flow of goods, materials, and raw materials through the network both towards customers and back. A considerable challenge in this case is also forecasting the demand of finished goods and the supply of products from the market. In such a model, RL has an operational character. It stands for a deliberately designed and organized arrangement for collecting materials from end users to warehouses or production centers to recover any value from the collected goods (Gholizadeh, Tajdin, Javadian, 2020). SCCL thus focus on collecting partially or wholly used products from customers and creating (or using) the value of the products themselves or their components, parts, or materials for newly created products (Guide, Li, 2010).

One of the simpler mathematical models of SCCL for disposables is presented by Krstev D., and Krstev A., They proposed supplementing the traditional logistics phases (procurement, production, distribution extended to the end customer) by forcing a reverse flow of waste products collected from the market by collection centers, which either go to the manufacturer or are recycled - Figure 1 (Krstev, D., Krstev, A., 2022).

Al-Salem et al, on the other hand, pointed out the possibility of dividing logistics into Forward Logistics and Reverse Logistics (Al-Salem, et al., 2016). Their model, shown in Figure 2, considers the stages of delivering a product to the market, reusing them, using common warehouses of different manufacturers for this purpose, ending with reverse warehouses. From both common and reverse warehouses, products go directly to factories, where they are either reused or sent to recycling processes. In their final form, disposal process takes place, as part of recovery operations recovering the energy gained from the process in the final stage.

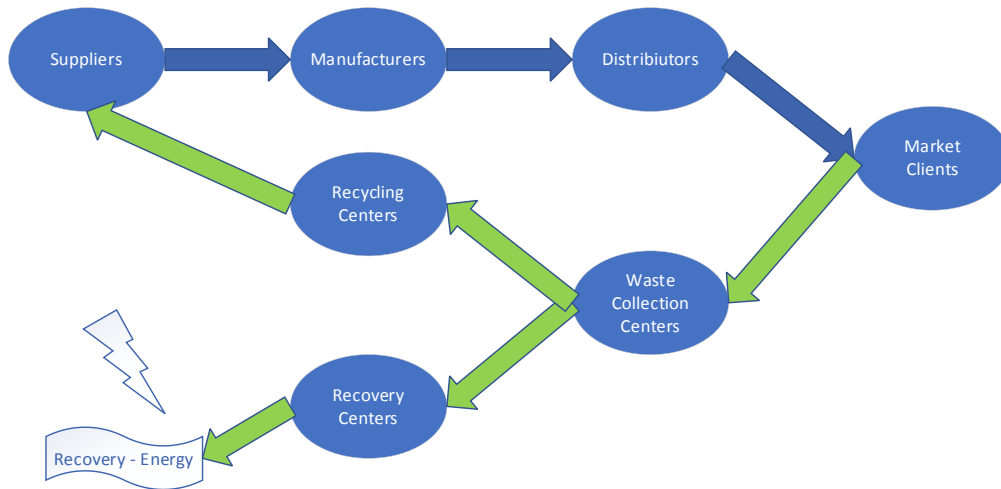


Figure 1. Closed-loop supply chain for single-use devices.

Source: own compilation based on Krstev, D., & Krstev, A. (2022). Reverse Logistics - Possibility, Expectation and Sustainability Perspectives. *Natural Resources & Technology*, 16(1), 3971.

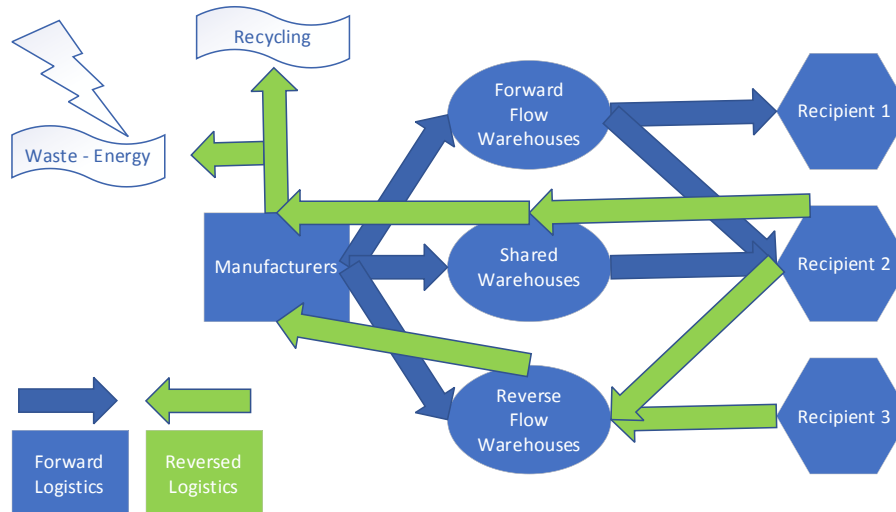


Figure 2. Closed loop supply chain network.

Source: Al-Salem, M., Diabat, A., Dalalah, D., & Alrefaei, M., (2016). A closed-loop supply chain management problem: Reformulation and piecewise linearization. *Journal of Manufacturing Systems*, 40, 3.

In the presented model, it is worth noting the conceptualization of "forward" and "backward" logistic. Relating this to the context of a phase-based view of logistic, in reverse logistics the phases of procurement, production (processing), distribution and returns will remain the same. Logistics in its assumptions will continue to focus on the efficient and effective flow of goods, information, cash, and others., with three basic elements changing:

- 1) the direction of flow (forward - backward),
- 2) the conditions of the processes of supply, production (processing), distribution, and returns dependent on the flows,

- 3) the intensity of logistics processes (transportation, warehousing, packaging including packaging, inventory management and order handling) dependent on the direction of flow and the phases that occur in them.

SCCL should therefore, like the qualitative PDCA/SDCA (Plan Do Check Act / Standardize Do Check Act) cycle (Imai, 2006), execute forward and backward flows, creating or recovering value at each stage. A side effect of these activities should be to minimize waste. The manufacturer receives raw materials and materials from suppliers, balancing waste. From final form of waste recover the energy - Figure 3.

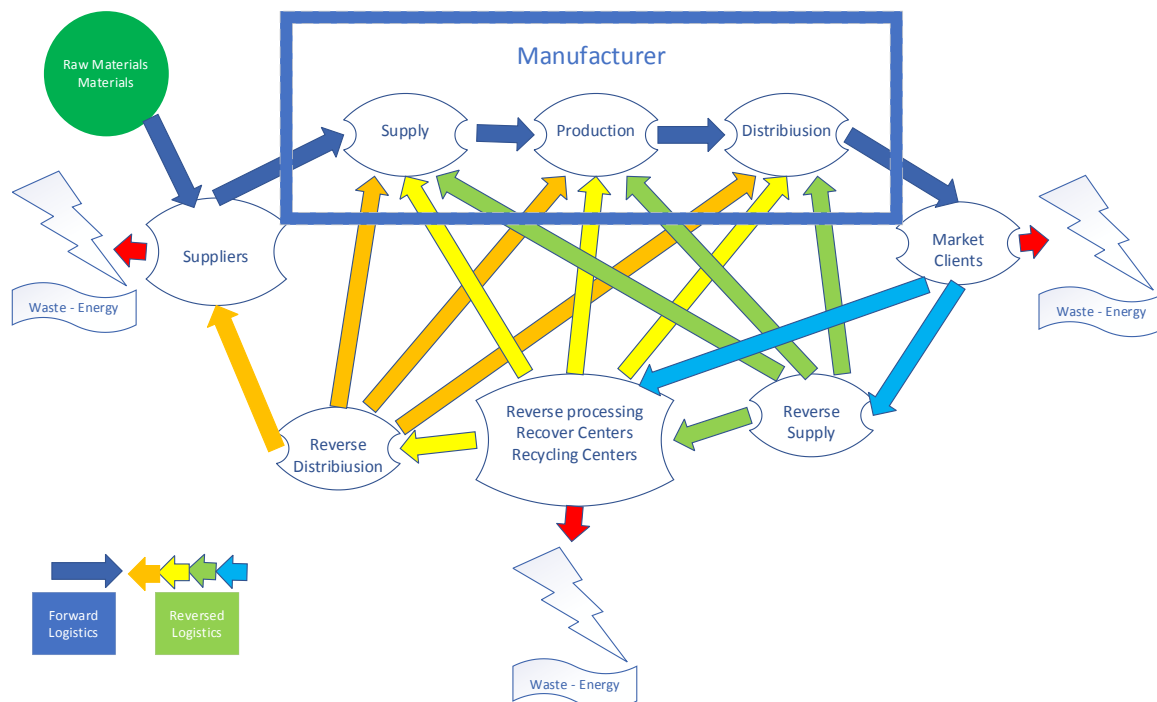


Figure 3. Closed-loop supply chain model considering forward and reverse flows.

Source: own study.

The entire SCCL system should incorporate the technological advances of I 4.0, creating logistics and supply chains at the 4.0 level - L&S.C. 4.0. Its clustered approach and gradual replenishment of materials and raw materials, can shorten the length of supply chains, making them even more resilient and resilient (Bielecki, 2022). A key element in the operation of such a model, becomes the design of products considering the use of reverse flow elements in them under the broad concept of DfX.

The SCCL or RL models presented require a variety of conditions, which include:

- creation of a unified system of identification of raw materials, materials and parts used depicting such attributes as, for example, degree of wear, origin, potential durability, and many others,
- defining take-back rules (minimum, average and maximum life cycle of products), which has a direct impact on the supply of goods taken off the market,

- initiative-taking customer behavior in used product returns (e.g., delivering products to selective take-back points, or taking apart used products and segregating materials according to Reverse Manuals, for example,
- cooperation of enterprises on standardization, modularity and multifunctionality of manufactured materials, components, and others. for their secondary use,
- standardization in product design considering the possibility of recovering specific components from the products used,
- increase involvement of countries and manufacturers (more extensively than is currently) in promote sustainable development and CE,
- regulations on the definition of new products that have used raw materials, materials, parts in them, or issues of warranty, guarantee, and others,
- and others.

It is also important to note the scale of the phenomenon and its periodization. This is because it is not possible to create a closed-loop supply chain system and implement it in a brief period. In this case, setting a roadmap for change and its consistent implementation can contribute to the realization of the goals of SDG and CEA by supply chains.

2. Method and Results

To present the scale of the phenomenon, related to the challenges of implementing the principles of SDG and CEA within RL or SCCL in HAI industry, used information from "Association of household appliance employers representing manufacturers and importers of household appliances in Europe and Poland - APPLiA EU and APPLiA PL". The choice of HAI industry was deliberate and justified by the availability of data and information within the websites of APPLiA EU and APPLiA PL.

The APPLiA association originally appeared under the name CECED Europe, was founded in 1954. In Poland, CECED was registered in 2004. In 2018, the CECED changed the name to the APPLiA. The association functioning in Poland includes 27 companies viz: Aged, Amica, Ariston, Atlantic, Beko, Biazet, BSH, Candy-Hoover, Ciarko, Daikin, De'Longhi, Dyson, Electrolux, Franke, Gorenje, Jura, Kärcher, Miele, MPM, Philips, SEB Group, Samsung, Smeg, Teka, Vestel, Vorwerk, Whirlpool to which more than 50 brands known in Poland belong (<https://applia.pl/o-nas/>, 2022).

For research used the APPLiA EU and APPLiA PL for the information, materials and industry reports they have. Four areas were using for aggregation of data related directly or indirectly to SDG and CEA. These areas included:

- 1) examination of general information (goals, ongoing projects, trends, and others.),
- 2) survey of press and information materials,
- 3) examination of industry positions,
- 4) examination of reports in the context of data to find the challenges facing the home appliance industry.

The first area involved the extraction of general information. The association's European website has three primary goals:

- 1) promoting sustainable lifestyles (appliances with resource-saving and energy-saving features that promote sustainability),
- 2) living in a connected home (designing connected, smart, innovative, and ultramodern appliances that improve comfort and implement sustainability guidelines),
- 3) accelerating Europe's economic growth (a global, free, sustainable, open, and fair-trading system) (<https://www.applia-europe.eu/topics>, 2022).

In each of the goals presented, APPLiA EU headquarters also mentions the need to cooperate on the issues with EU bodies with regulatory influence.

In addition to the goals, the website offers information about initiatives undertaken by APPLiA EU which include:

- ways to deal with f-gases,
- the development of compliance templates to allow suppliers to meet requirements arising from the implementation of EPREL - the European Registry for Energy Labeling,
- seeking solutions to minimize microplastic pollution,
- electricity saving tips for household appliances (<https://www.applia-europe.eu/initiatives>, 2022).

The Polish side of APPLiA presents three main topics:

- closed-loop economy,
- energy efficiency, and
- product safety.

On the APPLiA website, you can find a closed-loop CE model with "Circular devices" as its centerpiece - Figure 4. APPLiA's CE model starts from the stage of obtaining raw materials, through design, manufacture, use, repair to the recycling and recovery stage.

The first step is the efficient and rational use of resources and materials, which, incidentally, also follows from the basic paradigms of production management. The next phase is design that considers legal guidelines for eco-design and energy efficiency. As APPLiA EU declares, all products designed, manufactured, and delivered to the European Union (EU) market follow applicable legal requirements. During designing products, it is considering the main guidelines such as the use of raw materials and materials, energy efficiency, technological advances, and customer preferences. In the next phase, production, the aims are to reduce the environmental impact of production processes smoothly and gradually. In the use and consumption phase, the overriding goal is to deliver products to the market that minimize

energy and water consumption. The next stage is reuse after repair processes. According to statements by APPLiA EU - in 2018, more than 91% of repair requests, ended in actual repair. The recycling and recovery complete the circle, leading to the closure of the circuit (<https://www.circularappliances.eu/home>, 2022).

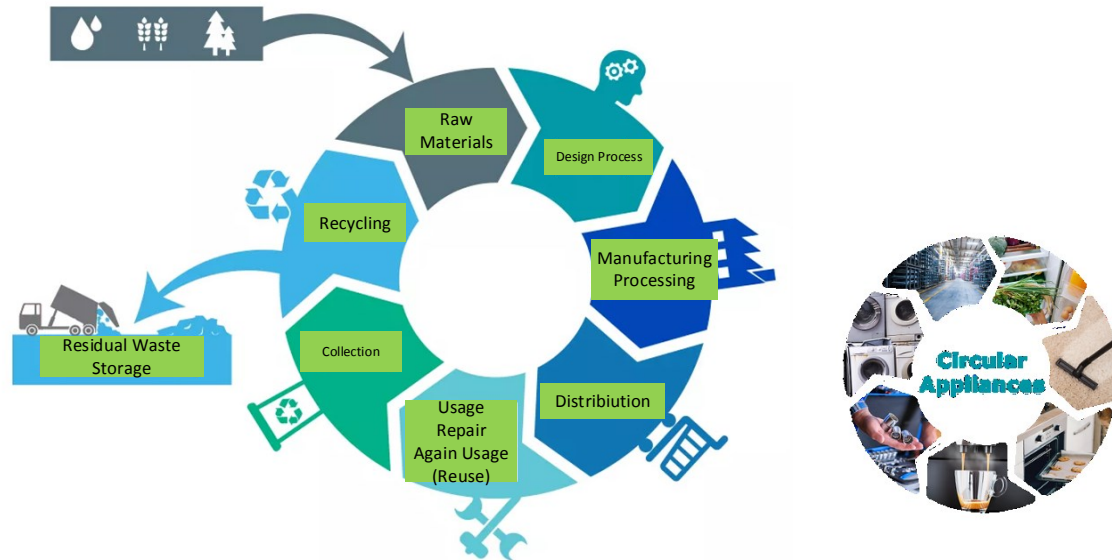


Figure 4. Closed-loop economy model according to APPLiA PL and APPLiA EU.

Source: <http://applia.pl/tematy/gospodarka-obiegu-zamknietego/>, 21.12.2022;
<https://www.circularappliances.eu/home>, 23.12.2022.

On the APPLiA website, it can find specific publications which are supporting presented model. In one of them entitled “Reaching a Circular Economy: what's on the EU's plate?”, Paolo Falcioni, CEO of APPLiA EU points out, among other things, the issue of legal normalization of eco-design, setting limits within CO₂ emissions (The Carbon Border Adjustment Mechanism (CBAM) - EU border price adjustment mechanism taking into account CO₂ emissions), the right to repair (understood as extending the life of products and repairing them by competent people - service), reducing F-gases and creating legal standards for batteries (<https://www.applia-europe.eu/topics/>, 2022).

APPLiA EU's press materials, in general, are related to the association's goals and initiatives. Recent articles from 2022 dealt with:

- APPLiA's launch of an industry-wide energy conservation campaign,
- the launch of a handbook on appliance repair,
- a report on leading the home appliance sector in the energy transition,
- information on the election of a new president of APPLiA EU,
- information on EU safeguard measures that hinder the competitiveness of EU manufacturing industry growth, and the vote of selected EU committees,
- F-gas issues in the context of competitiveness, innovation, and sustainability,
- sustainable products initiative (<https://www.applia-europe.eu/press-releases>, 2022).

As for press materials, 17 press articles have been published on APPLiA PL website since the first material appeared on July 19, 2018 (<https://applia.pl/media/materialy-prasowe/>, 2022). Slightly more than 70% of the articles (12) have had the lack of their content on the website - only their titles were available. The largest number of press article titles concerned the issue of changing energy labels five articles (23% of all articles), which in most cases were advertising materials. Among the titles and press materials were also:

- "Opening of the year" conference materials,
- a promotional campaign for the home appliance industry educating a new generation of technicians,
- reports on industry performance,
- appeals to relevant government units on issues related to the industry's performance in the market,
- and others.

A review of the official positions of the home appliance industry in Poland dealt with issues related to sustainable development and CE in several cases. As early as February 23, 2018, APPLiA PL (then still CECED-Poland) issued a position paper on the "Roadmap for Transformation to a Closed-Circle Economy," in which it highlighted issues of extended producer responsibility for the product and sustainable consumption. It also highlighted issues of minimizing energy and water consumption. Among the topics to which the appliance industry presented specific positions were references to (starting with the oldest):

- National Energy Efficiency Action Plan 2017,
- the draft law on waste,
- the two-year transition period for eco-design and labeling requirements; and the eco-design requirements themselves and new labels for clothes dryers,
- Poland's energy policy with a time horizon of 2040,
- extended producer responsibility in waste equipment,
- processing standards in waste equipment,
- product fees for electro-recycling,
- the law on energy efficiency,
- choice of method for calculating levels,
- actively support the process of replacing obsolete electrical appliances,
- amendments to the Law on Waste,
- Eco-design and labeling action plan for 2020-2024,
- EU draft regulation on batteries,
- EU draft CBAM mechanism,
- EU framework project on eco-design of sustainable products,
- EU draft on fluorinated gases (F-gases),
- national waste management plan 2028 (<https://applia.pl/media/stanowisko-branzy/>, 2022).

The topics of the gave opinions on sustainability and CEA are in line with industry policies across the European Union. It was expanded to include economic and market issues. In 2021-2022, APPLiA EU addressed the following issues (starting with the oldest) related to sustainability and CEA relating to:

- battery regulation,
- sustainability strategies in the chemical area,
- regulatory approaches to sustainable product initiatives,
- F-gas regulations,
- risks arising from the EU's revision of the Eco-Design Directive,
- retrofitting old and inefficient heating and cooling systems,
- recommendations on home appliances resulting from the UN Climate Conference in Glasgow and the position on the Glasgow Accords,
- mandatory building standards to address high energy prices and achieve the EU's decarbonization goals,
- the six proposals of the Fit for fifty-five package - the emissions trading scheme, the Social Climate Fund, renewable energy, and energy efficiency directives; energy taxation and the carbon limit adjustment mechanism (CBAM),
- sorting instructions for consumers,
- standardization strategies to support digital and green transformation (<https://www.applia-europe.eu/applia-media/position-papers>, 2022).

The last part of the study concerned the reports presented by APPLiA. They show that energy consumption for major household products is related to space heating - Figure 4.

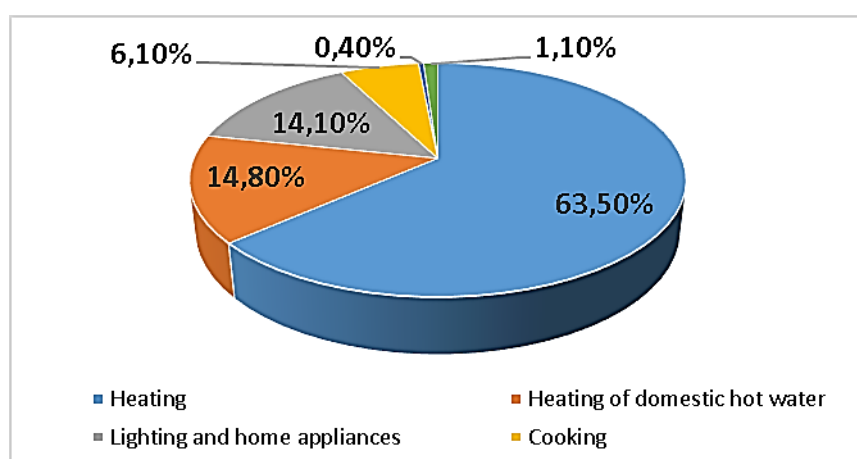


Figure 4. Household energy consumption for major household appliances.

Source: own compilation based on https://assets.website-files.com/6273d40fda4fa648b967fc54/634c73c4316ad0f573e417e0_APPLiA-Statistical-Report.pdf, p. 22, 27.12.2022.

The figure 4 presented, that space heating and water heating devices consume just under 80% of energy. This is related to the design of energy-efficient appliances, the majority of which (more than 90%) in 2020 were appliances with energy labels (A to A+++). In the same report, the industry boasts that in 2018, 91% of requests to manufacturers to repair defective appliances resulted in actual repair, with the largest repair cost for large appliances - 44% was labor, 39% was the cost of replacement parts, and 16% was the cost associated with transportation. Thus, between 2011 and 2018, the production processes managed to reduce waste by 12%, water consumption by 61% and energy consumption by 17% (<https://www.applia-europe.eu/statistical-report>, 2022).

The report presented the issue of circularity of material flows in the white goods industry. APPLiA EU data shows that:

- 6.3 million tons of materials entered the market,
- in EU households installed 7.9 billion appliances - 69 million tons of materials,
- 6.2 million tons of materials were placed on the market, of which 3.7 million tons of materials were recovered (<https://www.applia-europe.eu/statistical-report>, 2022).

It should be noted that the collection of materials is due to the law on Extended Producer Responsibility (EPR), which obliges companies to finance recycling, a minimum of 65% of the weight of equipment sold.

APPLiA PL's 2020 report shows that the number of household appliances delivered to the market in Poland is quite sizable and counted in millions of units, as shown in Figure 5.

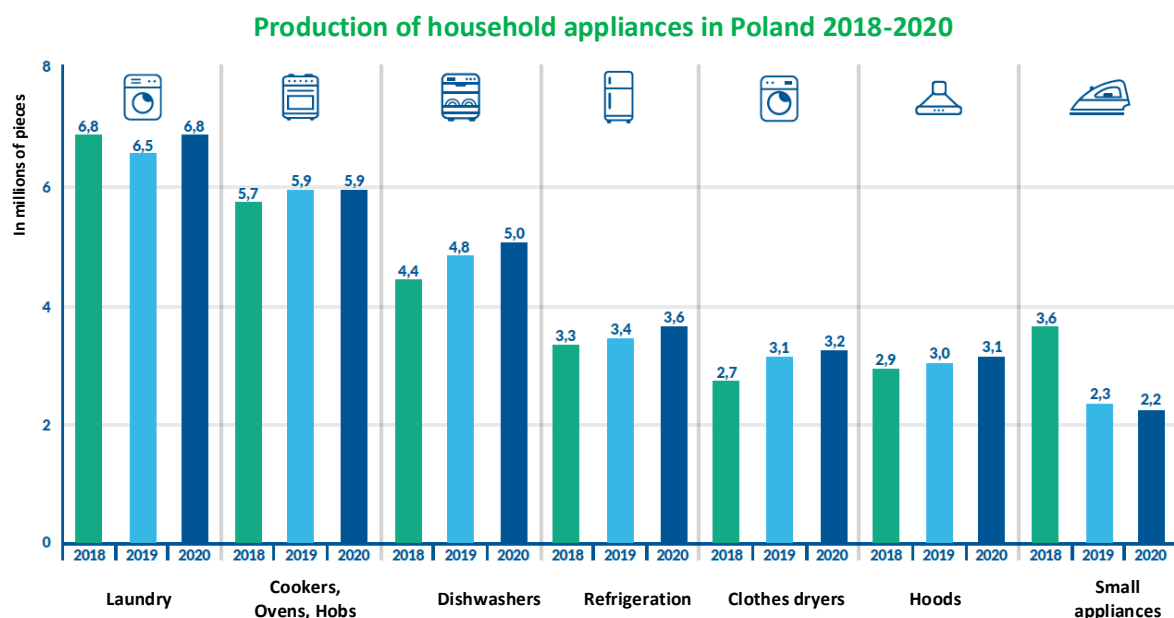


Figure 5. production of household appliances in Poland 2018-2020.

Source: APPPLiA PL, http://applia.pl/wp-content/uploads/2021/03/Aplia_raport_2021_v3.pdf, p. 6, 27.12.2022.

The 2021 report shows that the level of production of household appliances in 2021, despite the pandemic and initial signs of crisis, has held up - Figure 6.

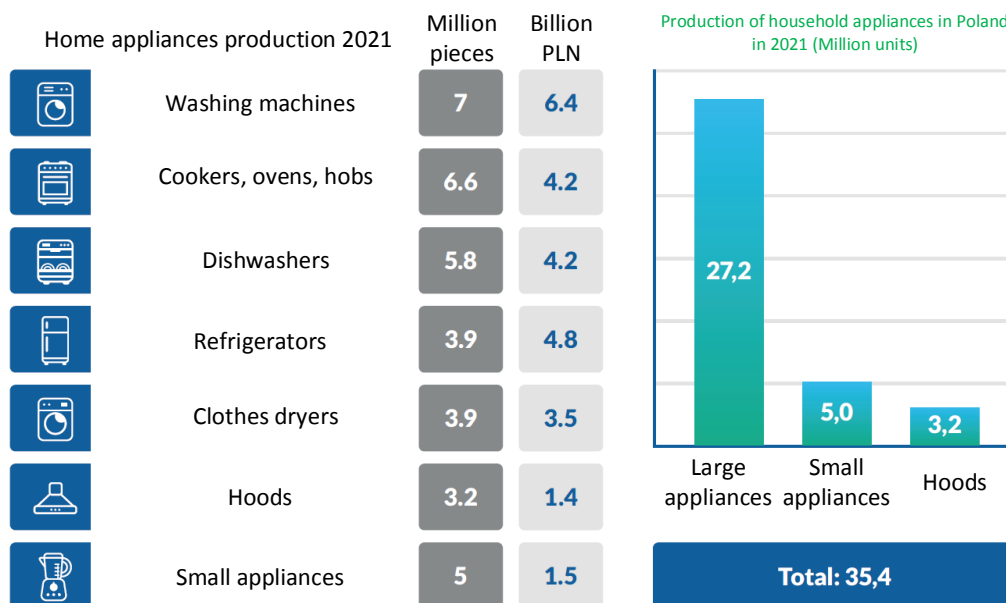


Figure 6. Production of household appliances in millions of units.

Source: http://applia.pl/wp-content/uploads/2022/09/Raport-AGD-2021.22_APPLIA-Produkcji-AGD_220526.pdf, p. 8, 27.12.2022.

This means that a considerable number of household appliances are delivered to the global market each year, which, in the case of the assumptions of SDG and CEA, is quite a challenge for this industry. Now, from the data presented in the reports of the APPLiA PL association, we manage to collect 60% of waste equipment and recover slightly more than 50% of raw materials - Figure 7. The mass of collected and processed waste equipment in the white goods industry between 2010 and 2020 has quadrupled (<https://www.applia-europe.eu/statistical-report, 2022>).

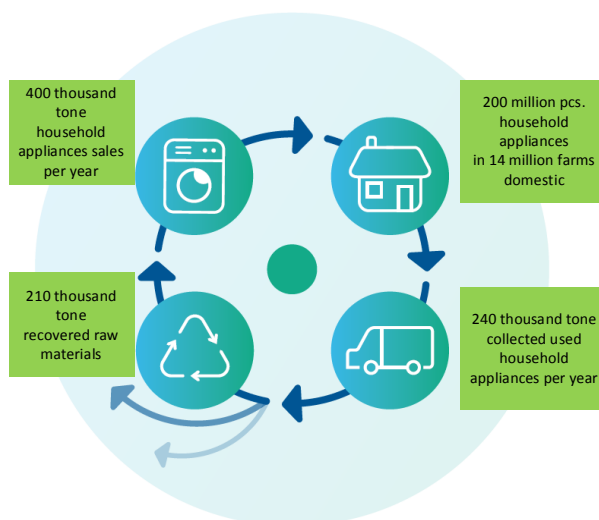


Figure 7. Production of household appliances in millions of units.

Source: http://applia.pl/wp-content/uploads/2022/09/Raport-AGD-2021.22_APPLIA-Produkcji-AGD_220526.pdf, p. 13, 27.12.2022.

The measures taken by the household appliance industry related to the SDG and CEA are due to legal norms. However, in the context of such fast-moving climate change, one may try to ask whether they are sufficient, and to what extent do they fit with the selected RL models and the goals of SDG and CEA presented in the literature? At this scale of production, the challenges that the home appliance industry faces about RL are quite specific, and they will be presented in the next section of the article.

3. Reverse logistics for large household appliances - challenges facing the industry

The presented results of the study of the information materials of home appliance manufacturers supply a good basis for presenting the challenges facing the industry in the context of RL and the goals of the SDG and CEA. A good reference point for conducting such an analysis can be the model presented by Potting et al. (Potting, et al., 2017) mentioned earlier, the model of transition from LE to CE described through 10R (Refuse, Rethink, Reduce, Re-use, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover).

If one were to attempt to analyze the materials studied in the context of the 10Rs, it can be seen that the analysis of these materials can be broken down not only into which of the aforementioned CEA are currently being used by the APPLiA industry, but also relate this to the context of the activities used - business or social - Table 1.

The previously mentioned 12% reduction in waste, 61% reduction in water consumption and 17% reduction in energy consumption in production processes certainly have their business context, bringing tangible savings to APPLiA companies. At the same point, it should be noted that the social context of these changes is already less noticeable. Of course, the implementation of new norms of energy, water consumption, and others., gives tangible benefits to consumers, but the savings in water, energy, or material consumption in production processes, do not necessarily reduce product prices, and in the author's opinion, these are insufficient measures in terms of the dynamics of climate-related changes.

Analyzing Table 1, the APPLiA industry implements only 40% of the CEA, which are core competencies of the business conducted. In the materials on APPLiA's website, it was not possible to find information on the multi-functionality of the products offered (Refuse), increasing the intensity of use (Rethink) even if only by promoting the "sharing economy", reusing products that consumers have given up - Reuse, refurbishing products - Refurbish, using products or their parts in new products fulfilling the same or separate functions - Remanufacture and Repurpose.

Table 1.

Scope of CEA of the production chain used in the APPLiA industry based on the research conducted

Economy model	Scope of CEA	CEA	Description of CEA	CEA in APPLiA industry	
				Business context	Social context
Model CE	Smart use and manufacture of products	R0 Refuse	Make a product redundant by giving up its function or finding the same function with a radically different product that is used	None	None
		R1 Rethink	Increase the intensity of use of a product (e.g., by sharing it with others)	None	None
		R2 Reduce	Increase product manufacturing efficiency and reduce consumption of raw materials and natural materials	Twelve percent reduction in waste, 61% reduction in water consumption, 17% reduction in energy consumption, reduction in fluorine gas use, reduction in microplastic pollution	Reduction in energy and water consumption of household appliances due to new standards - energy labels (A+++ to A by 2020 and A to G from 2021), reduction in fluorine gas use, reduction in microplastic pollution
	Extend the life of the product and its parts	R3 Reuse	Reuse by another consumer of a discarded product that is still in good condition and fulfills its original function	None	None
		R4 Repair	Repair and keep used products so that they can be restored to their original function	More than 91% of equipment repaired by service centers	
		R5 Refurbish	Restore an old product and update it	None	None
		R6 Remanufacture	Use discarded products or their parts in new products, performing the same functions	None	None
		R7 Repurpose	Use discarded products or their parts in new products, but in such a way that they perform distinct functions	None	None

Cont. table 2.

Model LE	Rational use of materials	R8 Recycle	Recycle Process materials to achieve the same (high grade) or lower (low grade) quality	Over 52.5% of recovered materials including batteries
		R9 Recover	Incinerate materials with energy recovery	no data available, although it is reasonable to assume that some materials go to waste incinerators

Source: own study based on J. Potting, M. Hekkert, E. Worell, A. Hanemaaijer, Circular Economy: Measuring Innovation in the Product Chain, PBL Netherlands Environmental Assessment Agency, The Hague 2017, p. 5.

A separate issue becomes the question of legislation formulated by the EU and associated countries. A number of positions that have been put forward by the APPLiA industry both in Poland and in Europe are more in the nature of lobbying for legislation rather than creating specific solutions to accelerate the fulfillment of the goals of SDG and CEA. The "When it comes to repair, #DontDespair" campaign, which promotes equipment repair, seems to be a return to practices common in the 1980s and 1990s that earlier generations took for granted. The eco-design guidelines, defined in 2009 (<https://eur-lex.europa.eu/legal-content>, 2022) establishing general rules for determining eco-design requirements for energy-related products, are inadequate in the context of humanity's environmental challenges. The very fact that the 2009 regulations are in place, with such a rapidly changing environment, may raise some concerns.

It is not the intention of the article's author to criticize the European white goods industry. It can be hypothesized that conducting a study of other industries, would show even more omissions or even actions against SDG and CEA (e.g., diesel gate affair of VAG group (Mazur, 2020)). The article is intended to show that the issue of RL and its implementation in industrial reality for the purposes of SDG and CEA is specific challenge, and only joint action of, for example, the spheres of science and business can give tangible benefits to the environment. And the scale of the phenomenon is significant.

According to the information materials of APPLiA PL alone, seven million washing machines and 5.8 million clothes dryers will be produced in Poland in 2021 (Figure 6). If only a one-to-one assumption is made, this means that at least 12.8 million have hit the market:

- housings,
- tanks,
- drums,
- motors,
- water pumps,
- heaters and heat pumps,
- electrical harnesses, and others.

And this is only 2021, and as previous year's show (Figure 5), the scale of production was similar.

This means that in a few or a dozen years (assuming, optimistically, such a long product life cycle), to close the circuit, we will need to collect these appliances from the market, which will be characterized by the fulfillment of far more CEA than the current (four).

If each washing machine regardless of the method of loading and dryer has minimum dimensions in cm (depth/width/height) of 60x40x80, which is about 0.192 m³, then with such a scale of production, about 2,500,000 m³ of appliances will have to be taken from the market, having an idea of how they can be managed. If we assume that a standard curtain-sided trailer has a volume of 91 m³, (internal length 13.68 m, width 2.48 m and height 2.7 m (<https://www.dsv.com/pl-pl/>, 2022), this means almost 27,500 trailers receiving used equipment, which then needs to be stored (depending on the cubic capacity of the warehouse, the values here may vary), and then recycled or recovered in a specific way, taking the final form of CEA. And we are talking here only about washing machines and dryers, leaving out such products from large household appliances as refrigerators, ovens, or gas stoves. The calculation also omits all small household appliances, the volume of which, due to their size and price, is also a concrete contribution to the overall phenomenon.

From the point of view of the facts presented, for any industry and the business models used today, RL is becoming a costly undertaking requiring multidisciplinary cooperation of the scientific and business spheres. The organization of the RL network itself (order handling of returned products, their transportation and storage along with packaging and wrapping, management of used product inventory) opens an interesting field for conceptual discussion on a model view of RL.

However, an even greater challenge is facing the sphere of product design, which, using DfX concept, must increasingly consider issues of Design for Sustainable Development (DfS), Design for Circular Economy (DfCL) or Design for Closed Loop Supply Chain (DfSCCL). This raises a number of questions, among others from the following areas:

- market (e.g., will customers want to buy products that would use used raw materials, materials, or components in some part; will they want to use old products for other functions, and others.),
- legal (e.g., how the issue of warranty for these products is to be managed, what is the manufacturer's responsibility in this regard; how to harmonize the law globally, and others.),
- operational (e.g., how to consider in now design products, the need to use certain components in the future; what number of components will be usable; how to control the quality of used parts; how RL systems are to be built, and others.),
- geopolitical (how these systems are to work on a global scale, whether agreement is possible across all divisions and interests, and others.),
- and others.

Certainly, in current business models, these questions in many cases seem meaningless and pointless. Considering such convoluted questions in times of economic crises or the challenges that have confronted the global economy because of the Covid19 pandemic or the war in Ukraine is already enough of a problem. It seems, however, that sooner rather than later the climate will raise the same questions in an accelerated formula, and then we will have to deal with corrective rather than preventive measures, which in the theory of management science and quality (especially quality) are far less effective.

4. Summary

As presented in the article, the issue of RL has many critical points that complicate the effectiveness of its implementation. Assuming the full realization of SDG17 - Partnerships for the Goals: helping the whole world develop by enabling effective cooperation and communication between countries (<http://www.un.org>, 2022), the very issue of building an efficient and effective RL system is very complicated and complex. Transparency and climate cooperation are increasingly appearing in public speeches, becoming a fashionable and catchy topic. Unfortunately, the response to these topics, which for the moment is proposed by the industry together with the economies of specific areas of the world, seems to be far from sufficient.

The example of home appliance manufacturers in Europe is not an isolated one, and in the article was used only to illustrate the current activities of one of many industries. The research shows that the APPLiA association clearly emphasizes concern for the environment, presents a number of actions taken, but against the background of current challenges and opportunities, certainly public expectations are much higher. In conclusion, it should be emphasized that those of the companies or industries that are the first to embark on the difficult road of redefining current business models in favor of real (rather than apparent) solutions to climate problems, using RL that realize the goals of UR and CEA, will ultimately benefit, contributing to the protection of life on Earth.

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CAPITAL STRUCTURE OF POLISH JOINT STOCK COMPANIES IN THE PROCESS OF INTERNATIONALIZATION

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Purpose: In the scientific literature in Poland, but also in the world, there is a lack of publications defining the relationship occurring between the internationalization of the enterprise and the structure of financing. Therefore, the extent to which the various stages of internationalization of the enterprise defined according to the literature affect the capital structure was examined. It was investigated whether the sector of the business has an impact on the occurrence or non-occurrence of these relationships.

Design/methodology/approach: To investigate this, the ratios of internationalization of sales and the share of debt in total company financing were compared, and Lillefors and Fisher-Snedecor statistical tests were applied to 44 construction industry companies listed on the Warsaw Stock Exchange. The results of the research were compared with the results of studies previously conducted at home and abroad.

Findings: It was shown that a statistically significant relationship between internationalization and changes in capital structure was found in the sector. It was found that the peculiarities of the construction sector indicate the high capital intensity of the internationalization process of these companies and the high dependence of the internationalization process and the formation of the capital structure of this process.

Originality/value: The lack of research in this area demonstrates its originality. It has been shown in pilot studies conducted before the stage of target research for the following article that the specifics of the sector determine the dependence on the capital structure or the complete absence of this dependence.

Keywords: Internacjonalizacja, strategia finansowania, struktura kapitału.

Category of the paper: Research paper.

1. Introduction

Companies that are interested in internationalizing their operations are also obliged to determine their capital structure in the process. Determining the stages of internationalization of the enterprise and the appropriate financing of each stage will guarantee the success achieved by the enterprise in the international arena. As a company goes through the stages of the

internationalization process, its capital structure may change and modify. Carrying out each of the stages of internationalization without financing them appropriately may prove to be a risky approach, as its liquidity, for example, may be at risk.

The research was conducted within the construction sector, which stood out in the pilot study, the highest international activity of the sector's companies.

2. Literature on the internationalization of enterprises

An enterprise that is interested in developing and conquering new markets in the years to come faces the need to go through the process of globalizing its existing operations. In the era of modern technology development, the process of globalization of enterprises is becoming even more dynamic than before. According to (Zorska, 1998), globalization is a higher, more advanced and complex process of internationalization of economic activity. Direct investment also has a large share and importance in the process of internationalization of enterprises (Dunning, 1958). Among the rich Polish (Grzegorzcyk, Krawiec, 2019) and foreign literature related to the process of internationalization of enterprises, it is necessary to mention only some of them, especially in the context of the research conducted in the article.

A special type of internationalization of a company is the internationalization involving the internationalization of its executives. There are studies in the literature that attempt to determine the relationships that exist between the internationalization of executives and its capital structure (Yousef, Almoumani, Samara, 2020). Consideration is given to the relationship between the internationalization of executives and the propensity to increase or decrease the share of debt in the company's total financing. The authors' research seems to show that there is an inverse proportionality between the internationalization of executives and the propensity of a company to increase its share of debt. This is explained by the fact that there is then a reduction in information asymmetry in the relationship between managers and investors. Less risk is incurred in raising funds, as management becomes more responsible and efficient. In an attempt to reduce the risk of operations, there is a reduction in the size of foreign funds raised and a smaller share of total financing.

J. Wyrobek and P. Lanne cite most of the studies that either confirm that the process of internationalization of enterprises increases the demand for foreign capital (Wyrobek, Lanne, 2019) or formulate the hypothesis that in the process of internationalization there is a demand for fixed capital.

The research conducted by J. Wyrobek and P. Lanne between 2007 and 2017 aimed to test two hypotheses:

1. Internationalization increases company debt.
2. The scale of internationalization has a positive effect on the level of debt (the greater, the greater the debt).

Both hypotheses were positively verified during the study. Among the reasons for this, the authors include:

1. Lower operational risk for a company operating internationally especially with geographic diversification of sales.
2. Higher attractiveness of offered products and brand strength.
3. Lower risk and cost of possible bankruptcy.
4. Higher loan collateral assets.
5. Improved accessibility to attractive investment projects.

M. Kosowska, A. Bera state that "the resulting from the responses of the surveyed enterprises (increase - footnote J.B.) of equity capital and the apparent increase in foreign long and short-term capital (here, for example, bank loans) is a confirmation of the increased need for financing of enterprises at the start of operations abroad and during its continuation". The authors note that small business entities "despite increasing equity capital ... do not spend this source on investments abroad as much as one might assume, treating this instrument as a kind of security (necessary when operating in a more risky foreign market)" (Kosowska, Bera, 2019). In contrast, foreign funds are used for the development of international expansion. The authors point out that changes in the capital structure of a company that has entered the process of internationalization means de facto changes in the implemented financing strategy. The need for micro, small and medium-sized enterprises to raise additional funds in the process of their internationalization is also pointed out by (Brojakowska-Trzaska, 2015). "There is a greater need for capital, and at the same time international companies have increased opportunities to access financial markets (it is necessary - note J.B.) preserved independence in making strategic decisions, or risk management in terms of exchange rates, capital costs, or country risk". It must be taken into account that SME companies always have a relatively worse financial situation than large companies, which may result in an increasing need for foreign capital in the process of internationalization.

All this makes capital providers more willing to make their funds available, and the enterprise can use them without fear of not being able to repay its obligations. One of the primary factors determining the size of debt in relation to total enterprise financing will be the size of existing (anticipated demand) for the products and services offered by the enterprise.

3. Stages of the research process

The study of the dependence of internationalization and capital structure was carried out among Polish listed companies from 2010 to 2021. In connection with the adopted indicators¹ and the stages of internationalization defined in the literature, it was decided to select a sector that would represent, depending on the company - the diversity of the level of advancement of the internationalization process. In this way, the dependence of the process (and development) of internationalization on its capital structure in the company under study can be analyzed much more accurately. There are currently 42 sectors defined on the stock market. Based on the analysis of the international activity of individual companies in the sectors, it was decided to choose the construction sector, to which 44 joint-stock companies belong². The construction sector in the analyzed period was one of the most diverse sectors among Polish listed companies in terms of international activity. Based on analyses of the financial statements of listed companies in the construction sector, three areas of international activity were defined:

1. Export products and/or services to other countries.
2. Subsidiaries of the company opened in foreign locations.
3. Acquisition of companies located in host countries.

The study of the dependence of internationalization and capital structure was carried out among Polish listed companies from 2010 to 2021. In connection with the adopted indicators³ and the stages of internationalization defined in the literature, it was decided to select a sector that would represent, depending on the company - the diversity of the level of advancement of the internationalization process. In this way, the dependence of the process (and development) of internationalization on its capital structure in the company under study can be analyzed much more accurately. There are currently 42 sectors defined on the stock market. Based on the analysis of the international activity of individual companies in the sectors, it was decided to choose the construction sector, to which 44 joint-stock companies belong⁴. To study the phenomenon of internationalization, it was decided to select appropriate financial indicators to study the relationship between the degree of development of internationalization in a given company and its capital structure. The degree of development of the company's international activity is defined in the following article as an indicator in which the relationship between the company's international sales and its total revenues is described. In the category of international sales, three areas related to the degree of involvement of a given enterprise in the internationalization process are defined. The first area, which is also characteristic of the first

¹ Financial ratios used in the empirical study of the article: 1. Share of international sales / total revenue, 2. Capital structure of the respective company.

² Warsaw Stock Exchange website, accessed online 9.09.2022.

³ Financial ratios used in the empirical study of the article: 1. Share of international sales / total revenue, 2. Capital structure of the respective company.

⁴ Warsaw Stock Exchange website, accessed online 9.09.2022.

stage of internationalization, is the company's export activity. An enterprise's export activity, which is related to its internationalization process, is defined as the sale of products and/or services outside the country in which the enterprise's original activities are registered, carried out from the moment the enterprise is founded and formally registered. The second area of the company's international activity is related, in the research below, to the revenue generated by the company's newly opened subsidiaries abroad. The third area of an enterprise's international activities is related to acquisitions by Polish companies of enterprises located in host countries - defined in the literature as one of the most advanced activities of an enterprise related to its international activities. Each of the three areas mentioned in the literature is described as the corresponding degree of advancement of the enterprise in its internationalization process - export as a manifestation of the least involved internationalization process, market acquisition as the most advanced internationalization process. The capital structure of a company that is internationally active is an important aspect of financing the activities undertaken in the internationalization process. A review of the literature in this area showed that there is no clear research indicating the answer to the research question posed: is a certain level of capital structure related to the degree of internationalization of the enterprise? Accordingly, a research hypothesis was established:

H0: There is a relationship between internationalization and the capital structure of the company.

Verification of the hypothesis was carried out using the described research methods. In the two mentioned financial areas of the construction sector, the dependence of participation (international activity index) on capital structure (Pearson) and the differences between capital structures depending on the demonstrated activity of the company in international markets were examined. In the first group, the relationship between share and structure was examined for the entire sector, with no grouping according to demonstrated international activity. The relationship between the share of international sales in total revenue was examined using Pearson's index. In connection with the research conducted in the article, auxiliary hypotheses were also set. In order to verify the auxiliary hypotheses, it was decided to use parametric statistical tests. On the other hand, the conclusions obtained from the conducted statistical tests will allow the determination of further research directions in the study of the relationship between the internationalization of a company and its capital structure. Accordingly, the contents of the research hypotheses are presented below:

H1: The capital structure of an enterprise that exports its products (services) and enterprises that are not internationally active are statistically significantly different from each other.

H2: The capital structure of an enterprise exporting its products (services) and enterprises earning revenues from foreign subsidiaries are statistically significantly different from each other.

H3: The capital structure of an enterprise that does not undertake international activities and enterprises that earn revenue from market acquisition are statistically significantly different from each other.

H4: The capital structure of an enterprise exporting its products (services) and enterprises earning revenues from established foreign subsidiaries are statistically significantly different from each other.

H5: The capital structure of an enterprise exporting its products (services) and enterprises earning revenue from market acquisition are statistically significantly different from each other.

H6: The capital structure of an enterprise earning revenue from foreign subsidiaries and enterprises earning revenue from market acquisitions are statistically significantly different from each other.

Parametric statistical tests were used to test the auxiliary statistical hypotheses set. The possibility of using parametric statistical tests was preceded by performing Lilefors normal distribution tests for all financial indicators (share of international sales in total revenues and share of foreign liabilities in total liabilities). The performed normal distribution tests confirmed the existence of this distribution for the studied financial indicators. Accordingly, the next stage of the study used the Fisher-Snedecor parametric statistical test, and was conducted for six groups separated within the construction sector. The first group is enterprises that do not show any international activity only realize sales in the country. The second group is enterprises that only realize exports. The third group of surveyed enterprises are companies that establish international cooperation and set up a subsidiary of their branches abroad. The last group is the companies that are most advanced in the internationalization process and seek to acquire markets in their activities. In the second stage of the study, each of the groups of companies for which different activity in international markets was found were paired to test statistically significant capital differences for each group. A total of 1008 statistical tests were performed. Forty-eight enterprises were sampled for testing. The statistical test took into account two financial areas of enterprises - the share of foreign sales in total revenue (Table 1) and the capital structure of the enterprise (Table 2). Due to the extensiveness of the data and the large number of construction companies in the sector, it was decided in the empirical part to present only a selected group of indicators of the share of international sales in total revenues and their selected capital structures. On the other hand, the results of the statistical tests conducted for the research hypotheses will be presented in a collective manner as the number of tests confirming the hypotheses in the number of total tests conducted for the group.

4. An empirical study of the relationship between the internationalization process and capital structures of construction sector companies

In accordance with the methodology presented in the previous section of the article, the following are selected values of the indicator of the share of international sales in the total revenue of a given company in the construction sector.

Table 1.

Share of international sales by three groups of companies' internationalization activities

N	K	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	1	0,41	0,42	0,42	0,43	0,45	0,38	0,37	0,35	0,36	0,35	0,43	0,45
2	1	0,72	0,54	0,49	0,46	0,75	0,66	0,67	0,63	0,63	0,66	0,68	0,66
3	2	0	0	0	0	0	0	0	0,57	0,14	0,81	0,63	0,35
4	2	0	0,79	0,07	0,81	0,87	0,78	0,88	0,94	0,43	0,70	0,45	0,23
5	3	0,26	0,16	0,16	0,17	0,13	0,16	0,23	0,27	0,13	0,15	0,01	0,04
6	3	0,25	0,27	0,40	0,39	0,42	0,43	0,23	0,33	0,48	0,59	0,22	0,35

Designations in the table: N - the ordinal number of an enterprise in the clothing sector, K - stage of the internationalization process.

Source: own elaboration.

Table 1 presents data for selected companies in the construction sector. It was decided to have a smaller range of data presented, since the analyzed sector contains 44 companies, the presentation of all calculated indicators would result in a lack of transparency in the data. Therefore, it was decided to select representatives that represent different levels of advancement in the internationalization process. The table includes an indicator for six companies. Companies with the number 1 and 2 (column 1 - symbol N) are representatives of the sector, which in the period under study showed activity in the internationalization process related to the export of their products (column 2 - symbol K).

The share of exports in total revenues is higher for enterprise two - especially the difference can be seen in the comparative analysis from 2016. Included in group two are enterprises 3 and 4 (column 1), which receive revenues from operating foreign subsidiaries of their units. Company three from 2010 to 2016 reported no such revenues (it reported them in export activities), then in 2017 in its financial reporting it showed that 0.57 of all revenues are revenues received from the company's opened foreign subsidiaries.

The second company in the second group analyzed, showed a greater ability to generate revenue from foreign subsidiaries. The last group of analyzed enterprises are those that show revenues from the acquisition of markets. As for the adopted indicator that defines the degree of involvement of enterprises in the internationalization process, it is by far the smallest compared to the other groups analyzed in the article. Therefore, this means that the degree of involvement of enterprises in the internationalization process is the highest in the first group - those exporting their products, and the lowest for the third group - in which they show revenues

from the acquisition of markets. Table 2 shows the indicator for capital structure. Due to the limited volume of the article, it was also decided to present data on selected companies only.

In addition, it should also be noted that within the defined groups of companies there are differences in the achieved values of financial indicators related to the measured level of internationalization of the company (the share of international sales in relation to the total revenue generated by the company). A good example here is company 5 and 6 in group three and the level of the indicator in 2019 - 2021 (Table 1).

Table 2.

Capital structure in selected construction sector companies

N	K	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	0	0,54	0,49	0,51	0,44	0,42	0,35	0,28	0,54	0,46	0,50	0,42	0,30
2	0	0,32	0,39	0,37	0,38	0,45	0,48	0,51	0,51	0,58	0,58	0,58	0,53
3	1	0,44	0,54	0,64	0,58	0,59	0,73	0,70	0,66	0,61	0,59	0,56	0,56
4	1	0,48	0,48	0,43	0,41	0,40	0,34	0,32	0,31	0,33	0,30	0,24	0,34
5	2	0,44	0,52	0,45	0,53	0,48	0,63	0,69	0,64	0,51	0,47	0,50	0,53
6	2	0,57	0,54	0,51	0,50	0,43	0,52	0,50	0,56	0,59	0,60	0,67	No
9	3	0,59	0,47	0,44	0,42	0,48	0,46	0,44	0,46	0,52	0,57	0,58	0,56
10	3	0,39	0,44	0,37	0,41	0,50	0,36	0,39	0,42	0,35	0,34	0,31	0,31

Designations in the table: N - the ordinal number of an enterprise in the clothing sector, K - stage of the internationalization process.

Source: own study.

Table 2 presents data for selected companies in the construction sector. It was decided to have a smaller range of data presented, since the analyzed sector contains 44 enterprises, the presentation of all calculated indicators would result in a lack of transparency in the data. Therefore, it was decided to select representatives for which the results of their capital structure in the period under study are presented in Table 2. The table includes the capital structure indicator for ten companies. The number of data in Table 1 and Table 2 differ, as Table 2 additionally presents a group that shows no activity in the internationalization process (the participation rate in this case for each period analyzed is 0). In the zero group, i.e., those companies that are not active in the internationalization process, the capital structure appears to be similar. The share of liabilities in total capital for the other groups presents itself in a similar range. On the basis of the tabular summary alone, it is impossible to determine whether the capital structures of individual enterprises differ from each other depending on the degree of the internationalization process. The breakdown of the capital structure in individual companies in the construction sector, presented in this way, was used to conduct a statistical analysis to show statistically significant differences between individual companies. Table 3 shows the aggregate results of the Fisher-Snedecor test for each group of enterprises and their capital structures.

Table 3.

Results of Fisher-Snedecor (tests 1-6) and Pearson (test 7) statistical tests for each group of companies

Test	Study of group relations ⁵	Results (+)	Results (-)	Total	Supporting hypothesis
1	Gr 0 and Gr 1	51	93	144	H1
2	Gr 0 and Gr 2	54	90	144	H2
3	Gr 0 and Gr 3	63	81	144	H3
4	Gr 1 and Gr 2	31	113	144	H4
5	Gr 1 and Gr 3	50	94	144	H5
6	Gr 2 and Gr 3	42	102	144	H6
7	Share / Structure	100	44	144	H0
x	Total	391	617	1008	X

Designations in the table: N - the ordinal number of an enterprise in the clothing sector, K - stage of the internationalization process.

Source: own study.

The compilation of the aggregate results in Table 3 relates to the statistical tests conducted to examine significantly statistical differences in capital structures according to the degree of internationalization for individual companies.

For test number 1, an examination of the relationship of capital structures in group "zero" and capital structures of enterprises in group "one" was performed. Out of 144 tests performed using the Fisher - Snedecor test, 51 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalization process (group 1 - exports) and companies that have no activity related to the internationalization process. On the other hand, the remaining 93 tests carried out showed the need to reject the hypothesis of statistically significant differences in the two groups (auxiliary hypothesis H1).

For test number 2, an examination of the relationship of capital structures in group "zero" and capital structures of enterprises in group "two" was performed. Of the 144 tests performed using the Fisher - Snedecor test, 54 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalization process (group 2) and companies that have no activity related to the internationalization process. On the other hand, the remaining 90 tests conducted showed the need to reject the hypothesis of statistically significant differences in the two groups (auxiliary hypothesis H2).

For test number 3, an examination of the relationship of capital structures in group "zero" and capital structures of companies in group "three" was performed. Of the 144 tests performed using the Fisher - Snedecor test, 63 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active

⁵ Group 0 - companies in this group do not show any international activity related to the internationalization process, group 1 - companies in this group are at the beginning of the process of internationalization of their activities, in their financial reports they present the level of export of their products and/or services, group 2 - companies in this group report on revenues generated by subsidiaries opened in foreign markets, group 3 - companies in this group report information on acquisitions of companies located in host countries.

in the internationalization process (group 3) and companies that have no activity related to the internationalization process. On the other hand, the remaining 81 tests conducted showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H3).

For test number 4, an examination was made of the relationship of capital structures in the "first" group and capital structures of enterprises in the "second" group. Out of 144 tests performed using the Fisher - Snedecor test, 31 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalization process (group 2) and companies that have no activity related to the internationalization process. On the other hand, the remaining

113 tests conducted showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H4).

For test number 5, an examination of the relationship of capital structures in the "first" group and the capital structures of companies in the "third" group was performed. Of the 144 tests performed using the Fisher - Snedecor test, 50 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalization process (group 3) and companies that show a more advanced internationalization process. On the other hand, the remaining 94 tests conducted showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H5).

For test number 6, an examination was made of the relationship of capital structures in the "second" group and capital structures of enterprises in the "third" group. Of the 144 tests performed using the Fisher - Snedecor test, 42 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalization process (group 3) and companies that are more advanced in the internationalization process than group two. On the other hand, the remaining 102 tests conducted showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H6).

Test 7 examined the relationship of the share of international sales in total revenue to capital structure. Test 7 did not divide into groups according to the degree of internationalization. A study of the relationship within the entire construction sector was conducted. Accordingly, a total of 44 companies participated in the level 7 statistical test for which two financial indicators were calculated: the degree of internationalization and capital structure. The result of the tests showed that out of 144 tests, the vast majority, as many as 100 tests, confirm the existence of a relationship between the degree of internationalization and the capital structure of a given enterprise.

5. Summary of the results of the conducted research

The results of the obtained statistical research indicate the necessity of the research hypothesis. Accordingly, it should be considered that there is a relationship between capital structure and the internationalization process of a company. In the case of the study of the dependence of capital structure on the degree of the internationalization process of a particular enterprise, it is also necessary to adopt the sub-hypotheses set. According to the theory of the literature (Wyrobek, Trzaska) in the field of internationalization, it should also be noted that the adoption of the main hypothesis and sub-hypotheses is strongly related to the specifics of the construction sector.

This is because the construction sector studied in the article shows:

1. High level of capital intensity of investments undertaken - especially new investments.
2. Sources of financing for new investments from foreign capital are a relatively expensive source of financing these days.
3. Internationalization of the construction sector is associated with often risky investment decisions - without securing an adequate source of financing (which consequently affects the capital structure), new investment projects may end up incurring high financial losses in the enterprise.

It is also important to note additional aspects related to the research conducted in the above article.

1. Most of the tests that show the need to reject the hypothesis give data that is not quite correct due to the shortcomings of the source data present in the database.
2. It would be useful to develop research into the extent to which there are differences between capital structures.

In particular, it is important to note and emphasize the information that the conducted studies of the dependence of internationalization and capital structure should also be carried out in other sectors of the economy. The specifics of the sector can be very important and affect the final results obtained in the results of studied.

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DETERMINANTS SHAPING THE SENSE OF WORK SATISFACTION IN UNIFORMED SERVICES

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Purpose: The aim of the study was to determine the factors that shape the sense of work satisfaction for selected uniformed services and to learn the level of satisfaction of servicepersons in terms of working in their respective services covered in this study.

Design/methodology/approach: The research utilized the diagnostic survey method, a survey technique using a questionnaire addressed to employees of selected uniformed services based in the Silesian Voivodeship. Intentional-random selection was used, taking into consideration gender, age, service seniority, education, and corps, resulting in the inclusion of 174 employees of selected uniformed services in total. The survey included 22 statements. Assessments were made by granting points on the Likert scale, where 1 means "strongly disagree" and 5 means "strongly agree". The study was carried out over a period of five months (February-June) 2022.

Findings: The conducted research allowed to identify key areas that require corrective action. The most significant gaps between the assessment and the expectations of the members of the examined uniformed services were identified in such areas as: fair treatment, perspective of professional development, the value of performed tasks, or interpersonal relations.

Research limitations/implications: Due to the fact that the survey only included uniformed services, the biggest challenge was the access to respondents. That is why, this study is a pilot one and it is recommended to carry out extended studies in order to verify the results presented here.

Practical implications: The study allowed to obtain an initial assessment of the sense of satisfaction among the members of the uniformed services covered.

Social implications: The analysis of factors determining the sense of satisfaction with the work performed in uniformed services constitutes an important element impacting the potential improvement of the management of officers in the studied services.

Originality/value: Due to the specific character of work in the uniformed services that includes numerous threats to health and life, as well as working under stress, it is important to study the factors affecting the sense of satisfaction with the performed work in order to improve the management of human potential.

Keywords: satisfaction, satisfaction determinants, uniformed services, employee potential management.

Category of the paper: empirical research paper.

1. Introduction

Protection of the state's internal security is ensured by a large group of entities, most of which belong to the public administration system. These units are referred to as uniformed services. In the literature, the term "uniformed services" is used to describe public entities, organized on the model of the army and implementing statutory determined goals of a special kind, regarding security and order (Liwo, 2015, pp. 9-21). Therefore, the uniformed services include such formations as: the Army, Police, Government Protection Bureau, civil and military special forces, State Fire Service, Border Guard, Customs Service, Prison Service, as well as municipal guards, personal and property protection services, Forest Guard, State Hunting Guard, State Fisheries Guard, National Park Guard, Railway Security Guard, Road Transport Inspection, Marshal Guard, and Military Gendarmerie (Maciejko, Rojewski, and Sulawko-Karetko, 2011, pp. 133-238). The term "uniformed services" is often used interchangeably with the term "militarized services" and classification of a given formation into a specific service category is based on both external criteria (for example: uniform, possession of weapons, etc.) and internal criteria (concerning the tasks and functioning of a given formation) (Szustakiewicz, 2012, pp. 22-23).

The 21st century brings various threats to public security, which in turn requires uniformed services to constantly adapt to ongoing changes and improve their skills, because they have an impact on the effectiveness and efficiency of the state's actions to protect security, especially in crisis situations, such as e.g., COVID-19 pandemic. Therefore, it is important to create working conditions that allow to attract and retain the best employees, as well as to maintain a good atmosphere in the organization.

The interest in work satisfaction only began at the beginning of the 20th century, leading to a significant impact on areas related to management systems, leadership styles, development of personnel policy, and human management procedures. When reviewing the literature concerning work satisfaction, one can notice that the vast majority of scientific considerations concern state and private enterprises, while relatively little interest is shown in relation to uniformed services, what was an incentive to write this paper.

Due to the role played by the uniformed services in ensuring a sense of public security, an attempt was made to examine the factors affecting the satisfaction with the performed work in relation to the representatives of selected uniformed services: the Police, the Armed Forces, the State Fire Service, and the Border Guard. Despite the fact that these formations differ, the determinants affecting the satisfaction of the surveyed soldiers and officers are similar. The aim of the theoretical part of this article is to define the determinants shaping the employee satisfaction, while the empirical part constitutes a presentation of the results of my own research concerning the level of satisfaction with the work among servicepersons of selected uniformed services.

2. Work Satisfaction Determinants

The success of an organization constitutes the result of the work of all of its employees, regardless of the held position, which is why it is so important to create the correct atmosphere facilitating effective work and influencing the level of employee satisfaction. The term "satisfaction" is derived from Latin (*satis* – sufficient, and *facere* – to do) and means "a sense of pleasure and fulfilment with something" as well as "compensation for harm or offence done to someone". Therefore, job satisfaction can be defined in a highly simplified manner as a degree to which an organization satisfies the needs and expectations of its employees. According to M. Dobrowolska, the concept of satisfaction is perceived as a constant disposition, a tendency for an employee to treat activities and working conditions in a specific manner, or as a process of processing information coming from the environment, announcing satisfying needs or positions, which is the effect of integrating information concerning events occurring within the organization and everything that is related to the operation of an individual in a specific professional role (Dobrowolska, 2010, pp. 229-248).

The concept of "satisfaction" is closely related to both the needs and expectations of employees, which is why it can be treated as a function of balance between human resources invested in work, such as: time, education, experience, commitment, and what is received in return, e.g. remuneration, promotion, training opportunities or relations with co-workers (Robak, 2013, pp 73-83). According to S. Borkowska, satisfaction and dissatisfaction are related to "what" motivates an employee and "how" it motivates that person. Having different dimensions, they can constitute an expression of satisfying a need, the consequences of comparing the achieved effect to an actual behaviour, a factor controlling and correcting human behaviour, or the cause and causative force of a behaviour (Borkowska, 2008, pp. 317-353). K.N. Wexley and G.A. Youkl treat satisfaction as a certain set of sensations, as well as the employee's attitude towards work (Lewicka, 2010, p. 52).

The terms "satisfaction" and "contentment" are often used interchangeably in the subject literature. Most researchers treat them as synonyms, although they are sometimes differentiated by the time of their occurrence. Contentment can be temporary, while satisfaction is usually experienced after a long period of the former. According to E.A. Locke, work satisfaction is the result of perceiving one's own work as one that allows achieving important values, while these values are consistent with the needs or help in meeting basic human needs. In other words, what the employee perceives as valuable at work constitutes a result of that person's internal needs. Therefore, the more important a given expectation is, the stronger the assessment of its fulfilment affects job satisfaction (Sowińska, 2012, pp. 45-56). Whereas, L. Berry defines job satisfaction as an assessment expressed in the form of affective reactions and cognitive judgements regarding the extent to which the performed work is beneficial (or not) for a given person (Rostkowska, 2008, p. 44).

There is a rightful belief that a satisfied employee is more effective and committed, which translates into that person's positive behaviours expected by the employer, such as: fewer absences, greater loyalty, or an increase in the number of pro-social behaviours. The relation between job satisfaction and the level of performed work bases on three notions. The first one assumes that job satisfaction is associated with an increased effectiveness of task performance, which leads to increased productivity, and thus to the profit of the organization. The second notion indicates many variables mediating in the relation between satisfaction and performed work. The third one suggests that properly performed work leads to satisfaction.

Depending on the theory, the definition of work satisfaction will include slightly different categories (which an employee assesses when thinking about own work), which are a source of satisfaction. Most of them are repeated in different concepts. The most frequently mentioned ones include: economic aspects of work, working conditions, interpersonal relations, as well as tasks performed as part of duties (Czerw, Bajcar, Borkowska, 2011, p. 31).

In many theories, employee satisfaction becomes a condition for positive motivation to work or is treated as one of the components affecting motivation. Undoubtedly, satisfaction is most strongly associated with F. Herzberg's two-factor concept that divides the factors of influencing an employee into hygiene factors and motivators. The first group only reduces employee dissatisfaction, while the second one increases motivation, contributing to productivity. According to F. Herzberg's theory, in order for the motivation process to be effective, managers should initially provide their employees with proper hygiene factors (Heller, 2000, p. 11). In turn, U. Gros proposes dividing factors affecting job satisfaction into three main groups: organizational factors, social factors, and personal factors. The first group contains factors that are directly related to work, such as the type of tasks performed by an employee, remuneration, perspective for promotion, work safety, company functioning and development policies. The second group contains social factors referring to the organizational atmosphere, mutual respect at work, arrangements with superiors and colleagues, as well as relations with customers. The third group of work satisfaction determinants consists of personal factors, i.e., individual features of employees over which the organization has no influence, but which nevertheless are very significant in terms of shaping the level of satisfaction (Gros, 2003, p. 115).

According to the conducted research, the impact on the achieved level of satisfaction depends most often on the following factors: remuneration, the possibility of promotion, the perspective of professional development, the value of performed tasks, occupational safety, stress, labour standards, fair treatment of all employees in terms of remuneration, and interpersonal relations (Gruszczyńska-Malec, Rutkowska, 2005, p. 59).

For the purposes of this article, work satisfaction will be understood as the difference between expectations and work experiences of a given person (Drenth, Thierry, Wolff, 1998, p. 278).

3. Methodology of own research

The survey was conducted among the servicepersons of four selected uniformed services: Police, Armed Forces, State Fire Service, and Border Guard. The professional specificity of the selected services makes it particularly valuable to conduct empirical research with the participation of uniformed personnel, who have tied their professional development with an implementation of a specific social mission. Uniformed services are organizations with a strict hierarchy of service, in which decisions are made and communicated in the form of commands and orders, and work is also associated with a constant readiness to act. The aim of the study was to determine the factors shaping satisfaction with the work in selected uniformed services and actual the level of work satisfaction among the personnel included in the study. The survey was conducted using the diagnostic survey method, with a survey technique utilizing a questionnaire, which was addressed to employees of selected uniformed services in the Silesian Voivodeship. Intentional-random selection was used, taking into consideration gender, age, service seniority, education, and corps. The survey included 22 statements. Assessments were made by assigning points on the Likert scale, where 1 means "strongly disagree" and 5 "strongly agree". A scale with odd number of possible answers also allows the respondent to indicate a neutral position. Due to the number of researched persons, the survey was conducted over a period of five months (February-June) in 2022. The research was carried out on a sample of 212 uniformed workers from police stations, military units, Polish Fire Service units, and Border Guard units in the Silesian Voivodeship. After eliminating incorrectly completed surveys, 174 responses were subjected to statistical analysis as 100% of the research sample. Due to the number of respondents, the presented results cannot be treated as representative for the entire researched uniformed services in the Silesian Voivodeship, nevertheless they still constitute an interesting empirical material. The research has a pilot character.

4. Research results

4.1. Characteristics of the study group

The research analyzed survey results obtained from 174 servicepersons of selected uniformed services. The respondents included 52 police officers, 39 firefighters, 46 border guards, and 37 soldiers. In the surveyed group, the vast majority (151 people) were men, which constitutes 87% of all respondents. There were 23 women in the study, forming just 13% of the study group. Tertiary education was declared by 95 respondents (55%), secondary education was indicated by 67 people (38% of the respondents), while primary education was indicated

by 12 respondents, representing 7% of the group. The largest group of respondents consisted of officers in the 34-41 age range (76 respondents or 43%), followed by those over 42 years (58 respondents), and those in the 25-33 age range (40 respondents or 24%).

Taking into consideration work seniority, the largest group consisted of people who have remained in the service for 11-15 years – 59 people (34%), followed by people declaring 4-10 years of service (44 people or 25%), and those who have worked for 1-3 years (35 people or 20%). 30 respondents, which constitutes 17% of the sample, declared work seniority of more than 15 years. On the other hand, the least numerous group of respondents (6 people, which constitutes only 4% of respondents) were servicepersons just beginning their work in uniformed services. The final criterion used in the metric concerned the corps. The majority of respondents – 78 people (45%) are part of the non-commissioned officer corps (korpus podoficerski), the second group in the study, consisting of 49 people (28%), was part of the officer corps (korpus oficerski). The last group consisting of 47 people (27%) belonged to private corps (korpus szeregowych) (Figure 1).

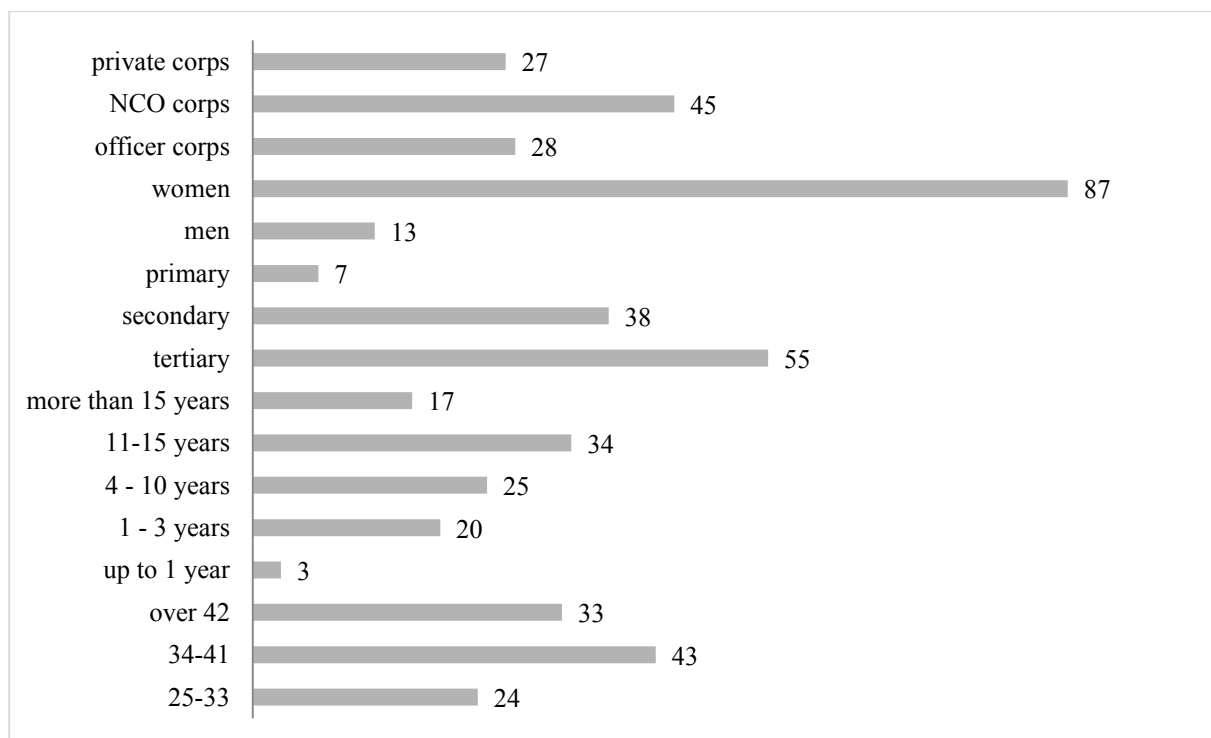


Figure 1. Structure of people participating in the work satisfaction survey due to: gender, age, education, seniority, and corps (%).

Source: own study.

Table 1. presents the characteristics of the examined group of officers with a distinction between individual examined uniformed services. Taking into account the age criterion, in the conducted survey, the highest percentage of young officers up to 33 years of age worked in the Border Guard (30%), the age group of 34-41 was best represented in both the Fire Service and the Border Guard (46%), and respondents over 42 years were most common in in the Police (42%), followed by Armed Forces (38%), State Fire Service (28%) and Border Guard (24%).

The second criterion taken into consideration in the study was seniority, which in the surveyed group looked as follows: respondents working in a given service for a period shorter than 1 year formed 7% of BG personnel, 5% of SFS personnel, and 2% of the Police and Military personnel taking part in the study. The largest percentage of respondents with work seniority between 1 and 3 years was found in the Police (36%) and SFS (31%), and the smallest one was found in the Armed Forces (3%). The work seniority in the range of 2-10 years in the studied group has been reported as follows: 31% for the Police, 33% for SFS, 21% for BG, and 14% for the Armed Forces. Work seniority in the range of 11-15 years was most often represented in terms of the Army (51%) and BG (41%), followed by SFS (26%), and the Police (21%). The longest work seniority in the surveyed group has been found in the Armed Forces (32%), followed by BG (24%), the Police (10%), and SFS (5%).

The next criterion consisted in the education of the surveyed representatives of uniformed services. In all the studied services, most servicepersons had tertiary education, amounting to 65% in BG, 57% in the Armed Forces, 50% in the Police, and 46% in SFS. Servicepersons declaring only secondary education formed 54% of respondents from FS, 37% from the Police, 35% from the Armed Forces and 30% from SFS. In the conducted study, the largest percentage of women was represented by BG (24%) followed by the Police (15%), and the Armed Forces and State Fire Service (5% each). Men constituted 95% of the respondents from the Armed Forces, and SFS, 85% from the Police and 76% from BG. The final criterion characterizing the surveyed uniformed services was the corps, which includes the officer corps, (korpus oficerski), NCO corps (korpus podoficerski), and private corps (korpus szeregowych) and their equivalents. The largest percentage of the officer corps members was represented by the Border Guard and Armed Forces (35%), followed by the State Fire Service (23%), and the Police (21%). The NCO corps was also most numerously represented by Armed Forces (51%), followed by SFS (46%), Police (43%), and BG (41%). The private corps and its equivalents were most commonly represented in the Police (36%), followed by SFS (32%), BG (24%), and the Armed Forces (14%).

Table 1.

Characteristics of the examined group of servicepersons divided by the specific uniformed services

Criteria		Police		Armed Forces		State Fire Service		Border Guard	
		n	%	n	%	n	%	n	%
		52	100	37	100	39	100	46	100
Age	25-33	14	27	2	5	10	26	14	30
	34-41	16	31	21	57	18	46	21	46
	over 42	22	42	14	38	11	28	11	24
Work seniority	up to 1 year	1	2	0	0	2	5	3	7
	1-3 years	19	36.5	1	3	12	31	3	7
	4-10 years	16	31	5	13.5	13	33	10	21
	11-15 years	11	21	19	51	10	26	19	41
	more than 15 years	5	9.5	12	32.5	2	5	11	24

Cont. table 1.

Education	tertiary	26	50	21	57	18	46	30	65
	secondary	19	37	11	30	21	54	16	35
	primary	7	13	5	13	0	0	0	0
Gender	Female	8	15	2	5	2	5	11	24
	Male	44	85	35	95	37	95	35	76
Corps	officer	11	21	13	35	9	23	16	35
	NCO	22	43	19	51	18	46	19	41
	private	19	36	5	14	12	31	11	24

Source: own study.

4.2. Work satisfaction research in selected uniformed services

The research proper was initiated by the examination of the preferences of the surveyed members of selected uniformed services, related to the factors affecting their satisfaction with the performed work. Respondents were asked to assess how important each of these factors is for them and what impact they have on their job satisfaction level. For this purpose, Herzberg's two-factor theory was adopted. The possible choices included hygiene factors such as working conditions, remuneration, interpersonal relations, safety, job security, standards, organizational policy, job position and stress, as well as motivational factors such as recognition, promotion opportunities, perspective of professional development, the value of the performed tasks, and fair treatment of employees.

The respondents considered the following factors to be important or very important, as they have a significant impact on their satisfaction level: remuneration and work safety (100%), the possibility of promotion and perspective of development (98%), work standards (97%), employment stability and stress (97% each), the value of performed tasks (96%), interpersonal relations (94%), and fair treatment (93%) (Figure 2).

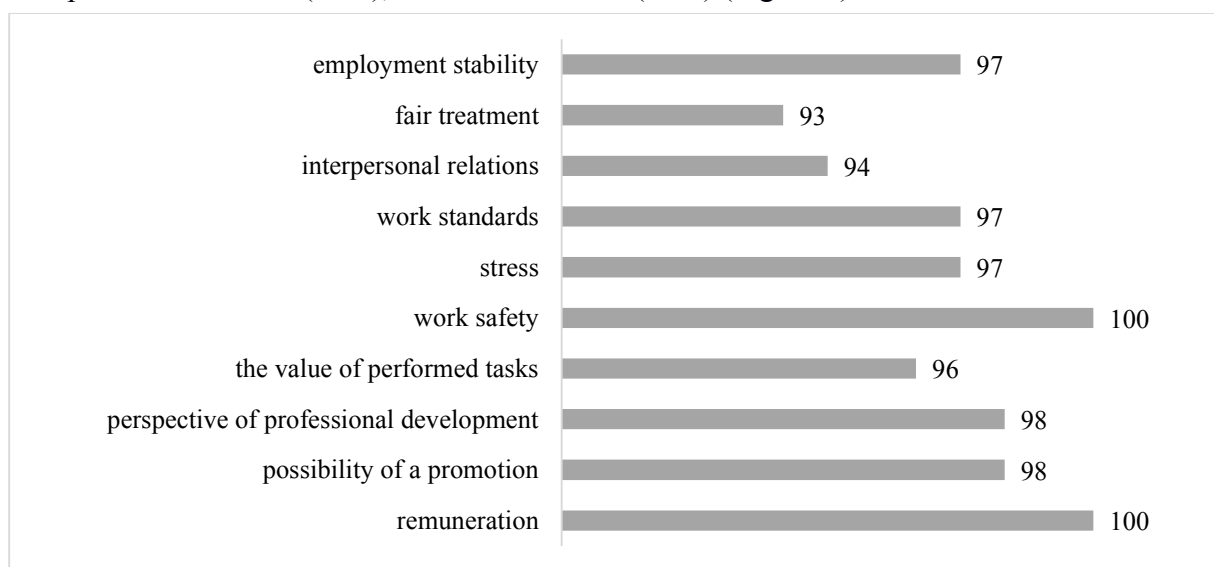


Figure 2. Work satisfaction factors recognized by members of uniformed services to be important or very important.

Source: own study.

Table 2 presents the factors of work satisfaction recognized by uniformed personnel as important or very important in individual uniformed services. Members of all four services participating in the study reported that the most important factors having an impact on their work satisfaction are remuneration and work safety (100%). Similarly important for all the studied uniformed services are labour standards, perspective of professional development, stability of employment, and possibility of promotion. The biggest discrepancies were observed in the assessment of the issues such as stress, fair treatment, interpersonal relations, and the value of the performed tasks.

Table 2.

Work satisfaction factors recognized by uniformed personnel as important and very important in the individual uniformed services

Criteria	Police	Armed Forces	State Fire Service	Border Guard
remuneration	100	100	100	100
possibility of a promotion	97	98	98	100
perspective of professional development	98	99	99	98
the value of performed tasks	96	92	99	97
work safety	100	100	100	100
stress	100	92	100	97
work standards	96	98	100	96
interpersonal relations	93	91	98	94
fair treatment	97	91	91	93
employment stability	98	97	99	96

Source: own study.

In the following part of the study, an attempt was made to determine how the factors indicated by respondents in the first part of the study as important and very important are assessed by the members of the respective uniformed services. For this purpose, a five-point Likert scale was used. In the conducted survey, the respondents had to respond to statements regarding the following issues:

1. Remuneration: My unit offers me good employment conditions.
2. Possibility of promotion: In my unit, selected candidates are prepared to take up higher positions.
3. Perspectives of professional development: In my unit, great importance is attached to employee development.
4. Values of the performed tasks: I consider my work and performed tasks as my mission.
5. Occupational safety: Applicable procedures are known to all employed persons.
6. Stress: Performed work is associated with a high degree of occupational stress.
7. Work standards: I am convinced that my unit complies with the applicable standards.
8. Interpersonal relations: I am satisfied with the relations and cooperation with colleagues. Cooperation, mutual trust, and responsibility are important at my work.
9. Sense of fairness: I am convinced that officers are treated fairly.
10. Employment stability: My job provides me with a sense of job security and a sense of security in general.

Table 3. presents the results of research concerning the experienced level of satisfaction with the performed work in the examined uniformed services.

Table 3.

Research results concerning the perceived level of satisfaction with the performed work in the examined uniformed services (%)

I definitely agree	I rather agree	I neither agree nor disagree	I rather disagree	I definitely disagree
22	30	20	8	20
18	31	24	11	16
14	28	25	14	19
17	25	28	9	21
23	28	29	9	11
30	31	19	8	12
23	29	23	11	14
19	24	28	11	18
11	20	25	18	26
27	33	12	15	13

Source: own study.

The conducted research shows that 52% of respondents are satisfied with the received remuneration, and 28% of respondents disagreed with that statement. It can be assumed that this result can be attributed to the fact that the 73% consists of members of the officer and NCO corps, and only 27% of respondents belong to the private corps. Respondents with a seniority of more than 10 years declared the greatest satisfaction with their remuneration with this percentage increasing along with work seniority. It should also be noted that members of the uniformed services usually enjoy certain privileges not available to employees in the private sector. They also receive various salary bonuses, which can amount to up to 50% of the basic remuneration resulting from their respective paygrade.

Almost half (49%) of the respondents agree with the opinion that in their units people are selected for promotion, and are subsequently properly prepared for a higher position, while 42% of respondents positively assess the activities of their employers in terms of professional development planning opportunities. Respectively 27% and 33% of military and non-military servicepersons who took part in the study disagree with these statements. When discussing issues related to both promotion and career planning in uniformed services, one should take into account their specific character and the fact that the career path in the discussed groups is highly formalised. In these groups, horizontal movements involve the transfer of staff within posts at the same management level, whereas vertical movement involves both transferring employees to lower levels of the organizational structure (demotion), as well as promotions associated with movement to higher levels. In the case of uniformed services, promotion is literal, as it means progress through the formally arranged ranks. In such services, appointment of an individual to an official position, transfer and dismissal from a position is decided by a superior, i.e., Chief of Police, Chief of the General Staff of the Polish Army, Chief of the Border Guard, or Chief of the State Fire Service and takes the form of a personnel order, which

is an administrative decision and is therefore based on the general principles of the Code of Administrative Procedure. Moreover, appointing an individual for a position depends on the education, professional qualifications (basic course, specialist course, and higher vocational training), as well as job seniority within the selected uniformed service. The set of the above-mentioned employee movements (and above all horizontal movements and promotions) creates the so-called employee career path, i.e., a specific path that the employee follows from the moment of taking the first position, through successive functions, performed roles, as well as duties and rights, to the intended position, constituting that person's career goal. There is also a third type of movement, i.e., one outside the organization, what creates the so-called problem of employees leaving the company (Suchodolski 2004, p. 152). Planning professional development is therefore closely related to the development of the members of uniformed services, with motivating, and planning human resources. It is also the result of the strong need for the officer and the service in which that person serves. On the other hand, planning an individual career path means tightening relations between the organization and an employee, extending the time perspective of the relation with the organization, commitment to shaping the competences in accordance with the model expected in the organization, as well as the time horizon of increasing competences and promotion. (Fryczyńska, Jabłońska-Wołoszyn, 2008, p. 136).

A feature distinguishing uniformed services from other social groups also consists in a high level of discipline (Liberacki, 2018, p. 106). It seems that the role played today by members of the uniformed services cannot be overestimated. In the face of dynamically emerging threats, no country is able to function smoothly without bodies that uphold the law, order, and public security. The task of the uniformed services is to protect citizens, defend national borders, combat natural disasters, and conduct rescue operations. The service, as the name implies, is not only a simple paid job, but also a kind of mission or vocation. In the conducted study, 42% of the surveyed servicepersons positively assessed the value of the performed tasks and 30% of respondents disagreed with this statement. It can therefore be assumed that the majority of servicepersons chose their professional path guided by the desire to help the persons in need. On the other hand, it should be remembered that the consequence of such an approach to work in the studied services means significant sacrifice of one's own privileges and personal way of life, which may explain the 30% of negative responses.

The threat to health and life of servicepersons performing their duties constitutes an integral part of their work. A high sense of danger and work under stress can lead to mistakes, shortcomings, crimes committed when performing official tasks, as well as tragic effects of the impact on personal life. That is why following and understanding the applicable procedures is necessary in the work of uniformed services. 51% of respondents agree with this statement, while 20% believe that the enforced procedures are not always known and followed by their colleagues.

Due to the specific character of work, members of uniformed services belong to professional groups particularly exposed to stressors. The type of performed service, the shift nature of the work, and the psychological and emotional cost they incur promote fatigue and, as a result, also burnout. During the service, and especially during interventions, military and non-military personnel of the uniformed formations are often forced to quickly adapt to a situation that can change rapidly. Often acting in extreme situations, uniformed services must be aware of the real danger associated with the need to act in an unpredictable and difficult environment. Immediate threat is considered to be one of the most serious stressors of working in uniformed services. 61% of respondents agree with the statement that the performed work is permanently associated with severe stress and only 20% of respondents disagree with this statement.

Another issue researched in terms of the uniformed services consisted in compliance with the standards determining their work. These standards are aimed not so much at organizing, disciplining, and regulating, but at cultivating traditions, building bonds and strengthening a positive image of a given service. In other words, it can be said that the standards determine the functioning of a given uniformed service and shape relations with other people who are not members of a given group. Majority of respondents (52%) positively assessed compliance with standards in their services, while 25% voiced the opposite opinion. The results reflect the transformation of Polish uniformed services as compared with their operation in the 1990s. This is related to both better equipment and education of the servicepersons included in this study.

When examining the relations of soldiers and officers with their co-workers, 43% assessed this aspect positively, while 29% granted it low ratings.

Uniformed services, characterized by hermetic, hierarchical structures of vertical subordination, have not yet developed effective mechanisms to protect against unfair treatment of their members, manifestations of discrimination, mobbing or harassment. Despite many positive changes in the uniformed services in Poland, there has been no change in the mentality of some superiors who believe that "superiors have rights, and subordinates have only duties". Among the surveyed servicepersons, only 31% believe that they are treated fairly and 44% declared experiences of unequal treatment. This issue was most commonly related to the assignment of responsibilities and workload.

Work stability is important because it translates into many areas of life, including making investment decisions or a general sense of security and satisfaction. In the conducted research, 60% of respondents believe that their sense of professional satisfaction is highly influenced by stable employment, and almost half (46%) believes that employment stability gives them a chance to advance in the hierarchy and allows them to utilize various privileges (Table 4).

Table 4.

Work satisfaction factors considered by uniformed personnel as important and very important, and the assessment of these factors in the examined uniformed services

Work satisfaction factor	Factors affecting job satisfaction		Assessment of important and very important factors in the services included in this study	
	Very important and important factor	Insignificant and rather insignificant factor	Very important and rather important factor	Insignificant and rather insignificant factor
remuneration	100	0	52	28
possibility of a promotion	98	2	49	27
perspective of a professional development	98	2	42	33
the value of performed tasks	96	4	42	30
work safety	100	0	51	20
stress	97	3	61	20
work standards	97	3	52	25
interpersonal relations	94	6	43	29
fair treatment	93	7	31	44
employment stability	97	3	60	28

Source: Own study based on the results of own research.

5. Research conclusions

The quality of tasks performed by members of uniformed services to ensure state security and public security depends, among others, on their sense of satisfaction with the performed work. This concept refers to the field of employee expectations, and therefore is highly subjective and might not reflect reality. Employees use their own life experience, observations and the value system to assess job satisfaction in a given organization (Knopp, 2021, p. 66). In the milieu of uniformed services, it was confirmed that less satisfaction with official duties translates into lower employee motivation, and vice versa – higher work satisfaction results in higher motivation to work (Pietras, 2012, p. 181).

Comparing the expectations of employees in terms job satisfaction factors with their actual occurrence, it can be seen that there are significant gaps (Table 4). The greatest gap in terms of satisfaction occurs in relation to such factors as: fair treatment, perspective of professional development, the value of performed tasks or interpersonal relations. In turn, there is a small gap in terms of issues such as job stability, stress, labour standards, and wages. The conducted research presents the discrepancies between factors that are declared and those that actually occur in the studied service, indicating a certain lack of consistency. This also indicates that positively assessed factors to a large extent compensate for those factors that are assessed

negatively, what probably results from the age of the respondents, their seniority, or the awareness of the current situation on the labour market.

Summing all the above, it can be concluded that the factors of job satisfaction considered by uniformed personnel to be informed or very important coincide with the assessments of a significant part of members of the examined uniformed services. Despite the discrepancies between expectation and actual assessment, the surveyed servicepersons are satisfied with their work. 58% of respondents stated that their work was satisfying, while 42% of respondents did not feel satisfied with their work.

6. Summary

Soldiers and officers who are satisfied with the performed work are extremely valuable for their superiors because they identify with the goals of the unit they serve in, are motivated, loyal and, most importantly, they have a positive impact on the attitudes of other co-workers. Listing the research results and their analysis confirmed that in the case of the examined uniformed services, the most important factors shaping job satisfaction include such determinants as remuneration, occupational safety, the possibility of promotion, and a perspective of professional development, followed by the value of the performed tasks, the level of stress, work standards, interpersonal relations, and fair treatment by superiors. More than half of the servicepersons experience satisfaction with the performed work and is attached to a given service. Summing the above considerations up, it can be stated that despite the existing discrepancies affecting the sense of satisfaction with the performed work, representatives of the uniformed services included in this study do not consider changing jobs and are satisfied with their work. An analysis of the factors determining the sense of satisfaction with the work performed in uniformed services constitutes an important element facilitating the improvement of the management of the members of examined services.

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CIRCULAR ECONOMY IMPLICATIONS FOR E-COMMERCE – AN EXAMPLE OF INDIVIDUAL RETURNABLE PACKING

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Purpose: Circular economy affects the need for changes in the area of packaging in e-commerce. The article demonstrates the results of the research conducted in the field of expectations regarding the features of the packaging already present on the e-commerce market in accordance with the circular economy model as well as those concerning the online buyers' expectations regarding the parameters of packaging currently available and planned to be introduced – reusable unit packaging.

Design/methodology/approach: A review of the selected literature enabled the depiction of the essence of the circular economy and its implications for the functioning of packaging in e-commerce. Own research was conducted using the survey method – the questionnaire in an electronic form was made available from 04 May to 26 June 2021. 1213 respondents from all over the country took part in the survey.

Findings: Effective implementation of circular economy entails the introduction of modifications in each link of the supply chain – including packaging used in e-commerce and reverse logistics, i.e., employment of returnable packaging. This will require the cooperation of product manufacturers with packaging producers, logistics operators and transport companies servicing the last mile, and consequently the creation of new business models in supply chains that require close cooperation in the handling of returnable unit packaging.

Research limitations/implications: Since the selection of the sample for the study was non-random – the snowball method was used, the study itself is unrepresentative and the results cannot be generalized to the entire population of Poland. Research on the implementation of returnable unit packaging in e-commerce should be continued in the light of the circular economy requirements.

Practical implications: Study results enable the indication of the features of the returnable unit packaging in e-commerce indicated as important by the respondents, mainly: the material of the packaging (degradable, biodegradable or recyclable); reusability; protection against external factors (including unauthorized opening); packaging size that corresponds to the size of the product; how the product is packaged and the type of closure (e.g. ease of opening); resilience. The respondents see the need to introduce returnable packaging in e-commerce.

Social implications: The new social (influence on customer behavior to return packaging) and institutional (redesign of supply chains to improve reverse logistics) conditions will be required to introduce the returnable unit packaging in e-commerce, but then it may contribute to e.g., waste and carbon footprint reduction.

Originality/value: The article draws attention to a very narrow section of the circular economy model which covers the reusable unit packaging that can be used in e-commerce (to reduce the scale of packaging waste production in Poland/Europe). The results of the research may be cognitively interesting for the entities that operate on the e-commerce market – both producers of goods and logistics operators.

Keywords: circular economy, reverse logistics, returnable packaging.

Category of the paper: Research paper.

1. Introduction

The constantly growing amount of waste poses a challenge for the modern economy (and the environment), e.g. 95% of plastic packaging is used only once, thus raw materials worth USD 80-120 billion become waste and, what is more, the negative externalities generated by them are estimated at USD 40 billion (Ellen MacArthur Foundation, 2016). Moreover, it comprises one of the main use of primary raw materials – 40% of plastics and 50% of paper used in EU are intended for packaging. Polish Chamber of Packaging Recycling and Recovery (www.pioiro) reports that Europeans produce on average almost 180 kg of packaging waste per year (per person). In addition, rising online retail sales (an increase of 3.2% in June 2022 compared to June 2021¹) means that individual transport packaging present in economic circulation – most often used only once – is also growing in number. Circular economy model (circular economy, circularity, CE) draws attention to the issues of reducing the negative impact of the production and consumption on the environment (in particular in the context of reducing greenhouse gas emissions and waste generation) and thus may be employed to address the issue as described above. It constitutes an EU priority as it covers the entire product life cycle: from production (product and process design), through consumption to waste management and secondary raw materials market (*Waste*). Thus, reusable packaging of individual retail items employed in e-commerce could be a specific solution applied here.

The article presents the circular economy model and its impact on the need for changes in the functioning of packaging in e-commerce, as well as the results of research on the expectations of online buyers regarding the features of packaging currently available and planned to be introduced – reusable unit packaging. The article strives to answer the following questions:

¹ The largest increase was recorder in the following groups: ‘textiles, clothing, footwear’ (by 13.2%), ‘other’ (by 11.0%), ‘pharmaceuticals, cosmetics, orthopedic equipment’ (by 10.9%) and ‘food, beverages and tobacco products’ (by 7.9%) (www.parp.gov.pl/component).

- According to the circular economy model, what type of packaging should be used in e-commerce market?
- What are the users' expectations regarding the packaging used in e-commerce?
- What are the users' expectations regarding the packaging of the designed unit returnable packaging that could be used in e-commerce?
- What is the attitude of online buyers towards the reusable packaging that could appear on the market?

The article is of theoretical and empirical nature.

2. The essence of circular economy

The foundations of the circular economy assumptions can be found in the works of environmental economists on waste-free (e.g., Ellen MacArthur Foundation, 2015; Pieńkowski, Kośmicki (2016)). The interest in the concept is visible not only in the economic practice but also in theoretical discourse (though it is difficult to reach agreement on its one universally accepted definition). The European Commission emphasizes that in CE the value of products (or resources in general) is maintained for as long as possible and the generation of waste is kept to a minimum (Communication from the Commission, 2015). With a slightly more detailed viewpoint, World Business Council for Sustainable Development indicates that the goal of circular economy is to retain as much value as possible from resources (products, parts, materials) and to create a system that ensures long life, optimal reuse, refurbishment, remanufacturing and recycling (WBCSD, 2017). The Responsible Business Forum, on the other hand, associates the circular economy essence with the cradle to cradle concept (C2C), i.e. such a way of designing and manufacturing products in accordance with the sustainable development philosophy so that after their use they can be put back into circulation (Gospodarka okrężna). Thus, the reusable unit packaging idea – that could become a reality in online trade – is in line with the C2C concept. Furthermore, from the point of view of the subject of the article, the approach presented by Deloitte is also significant. According to Deloitte, circular economy serves as a development strategy that enables economic growth while optimizing resource consumption and significantly transforms the patterns of production and consumption chains as well as redesigns industrial systems to take into account the entire life of the product together with its packaging (from creation, through repeated use and environmentally safe withdrawal from economic circulation).

The presented approaches enable the creation of sustainable supply chain management, i.e. managing the economic, social and environmental impact of the supply chain throughout the product life cycle in order to create value for all stakeholders involved in the process.

(Wandosell et al., 2021) Individual packaging used in transport to the final customer, but also during the return of the purchased product to the logistics operator/manufacturer as part of the so-called reverse logistics, comprises one of the elements of this chain, yet crucial from the e-commerce functioning point of view².

The circular economy should be implemented in accordance with the 3xR rule (reduce, reuse, recycle), i.e.:

- reduction of the amount of waste (including packaging, e.g. by introducing returnable, reusable packaging to e-commerce) and the raw materials used,
- extension of the life of raw materials (e.g. by reusing, repairing them),
- recycling (composting).

As a tool for assessing planned solutions, the 3xR principle suggests that the higher they are in the hierarchy, the better and, for example, reusing packaging is more desirable than recycling it. In addition, it points to eco-design (i.e. designing that considers the environmental impact along the entire value chain) and systemic thinking (about the entire products and services life cycle) so packaging used in e-commerce remains designed in such a way that it can be reused numerous times and then composted. (Svanes et al., 2010)

3. Packaging in e-commerce

The Gemius report shows that 77% of Polish Internet users shop online. The covid-19 pandemic has affected the way of the purchase – one third of the respondents shop more often, and almost one third of the respondents order more products online than before the pandemic. (E-commerce in Poland 2021) As a consequence, the number of individual packaging used to deliver products to customers is increasing. Thus, from the perspective of the functioning of economics and ecology of the supply chains, the issue of packaging management and/or reuse becomes particularly important. In addition, the amount of returning purchases is also growing, which implies the necessity not to increase the number of packaging in use, but instead to offer a packaging that can be returned to the seller as a part of reverse logistics and reused to deliver an online order to the customer.

According to the EU Directive 94/62/EC, e-commerce uses commercial (basic) packaging – for goods offered for sale, collective – for larger online purchase, and transport – that facilitate handling and secure the purchase on the way from the manufacturer/logistic center to the customer, this type constitutes an additional burden for packaging management. The report of

² According to Council of Logistics Management, reverse logistics is a broad term referring to the logistic management of skills and activities involved in recycling, management and disposal of product and packaging waste. It includes reverse distribution which enables the flow of goods (in disposable or reusable packaging – ABP) and information in the direction opposite to basic logistic activities (Szołtysek, 2009).

the Institute of Environmental Protection – National Research Institute shows that only 45% of packaging waste from municipal systems was recycled in 2020. Despite the selective collection, less than 29% of plastics, 54% of metals and 60% of paper and cardboard packaging are recycled. Meanwhile, the goals set by the EU in the area of raw materials recovery assume that at least 70% of packaging waste is to be recycled annually by 2030 (Nowicki). With changing consumer consumption habits along with the continued growth of online retailing (and the focus of logistics operators and transport companies on the last-mile logistics), a holistic approach to waste management in supply chains is becoming an urgent challenge. The entities involved in creating the offer and providing customers with online purchases should notice the issue of the increased amount of packaging in supply chains (and many are already doing it) and take joint actions aimed at applying the circular economy assumptions in this area. Not only will this enable the implementation of the sustainable development policy by enterprises (including the environmental pollution reduction), but it will also facilitate the reduction of costs and therefore lead to a broadly understood minimization of resource consumption. Circular economy resource efficiency means more than a departure from wasting resources (removed as waste), but rather their more effective use (also in connection with extending the life of products and their cycles), switching to renewable resources and conscious consumption. Such a way of thinking (and acting) should be visible in relation to the packaging in the supply chains – when shopping on-line and returning goods. Environmentally friendly packaging can be related to:

- materials – use of 100% biodegradable materials or those obtained from secondary raw materials,
- production method that minimizes the consumption of e.g. water and reduces the carbon footprint,
- reusability – designing the packaging that can be reused in the commercial circuit extending its life cycle (GlobalWebindex Report).

Interestingly, modern packaging is designed not only to protect the goods and facilitate transport, but also to offer additional functionalities. (Coelho et al., 2020) QR codes or smart labels improve transport efficiency, ensure control over the transported goods and their protection; enable the customer to track shipments in real time (thanks to the access to current GPS data). Furthermore, modern technologies allow the packaging to monitor temperature, humidity and whether the shipment has been dropped, tilted or opened.

4. Methods

Cardboard packaging (and also poly mailers) is most often used in e-commerce. Global WebIndex research shows that users expect e-commerce cardboard packaging to be:

- recyclable – 64% of respondents,
- reusable (not necessarily in the same form) – 53% of respondents,
- filled with the products that are not overpacked – 46% of responses,
- biodegradable – 39% of respondents,
- made of recycled materials – 36% of responses (GlobalWebindex Report).

A survey was conducted to recognize the expectations/opinions of on-line buyers with regard to the parameters of unit transport packaging currently in circulation and compare them with the expectations regarding reusable packaging that could be introduced³. The survey questionnaire was made available in electronic form (access via an internet link – respondents answered the questions themselves) – the on-line survey (CAWI) was carried out from 04 May 2021 to 26 June 2021. 1213 respondents from all over the country anonymously took part in it⁴. The selection of the sample for the study was non-random; the snowball method was used (sampling methods make the study unrepresentative so the results cannot be generalized to the total population of Poland). The report on the entire study – with a wider scope – was presented to the client and remained unpublished. Only the results of the study that correspond to the purpose of the article will be presented below.

5. Results

It is difficult to indicate an unambiguous, narrowly defined set of features of a unit transport packaging important for the respondents (cf. Table 1). Nevertheless, most of the respondents paid a lot of attention to the following:

- protection against external factors and damage,
- protection against an unauthorized opening,
- packaging size corresponding to the size of the product,
- package resilience.

³ The study was conducted on the basis of a contract for research and development signed by the Logistics and Innovation Faculty of the University of Lodz with Arvato sp z o.o. on April 2, 2021. Selected results are presented in the article.

⁴ Among the respondents, 62% were women, 37% were men, and 1% of the respondents did not specify their gender. People aged 17 to 79 took part in the study. The largest amount, nearly 50% of the total, comprise respondents aged 21-30, i.e., those who will be the main online buyers in the near future. Most of the respondents - 76% - are city dwellers, while 24% of the respondents indicated the village as their place of residence.

Table 1.

Features of the unit transport packaging of the product (and the share of a response frequency in %)

	It does not matter	It matters a little	It is important	It is very important	I have no opinion
Aesthetics	25.1%	40.4%	26.6%	6.6%	1.2%
Information of the package not being thrown	6.4%	21.8%	47.9%	22.8%	1.2%
Color	50.6%	38.3%	7.6%	2.1%	1.4%
The material of the package is degradable, biodegradable, or recyclable	14.6%	26.4%	37.1%	19.3%	2.6%
Reusable	11.9%	26.2%	39.3%	20.7%	1.9%
The name of the product manufacturer placed on the packaging	44.5%	35.3%	13.3%	4.9%	2.1%
Protection against external factors	5.1%	14.8%	45.6%	33.6%	0.8%
Protection against unauthorized opening	4.0%	11.0%	43.5%	40.7%	0.7%
Protection against destruction	2.4%	9.1%	43.4%	44.3%	0.8%
Consignment labelling	10.8%	26.4%	43.8%	17.3%	1.7%
Packaging size corresponds to the size of the product	4.5%	15.1%	44.0%	35.4%	1.0%
The method of packaging the product	5.6%	16.6%	45.4%	30.8%	1.6%
Closure type (e.g., ease of opening the package)	11.0%	23.7%	40.4%	23.2%	1.6%
Appearance	36.8%	36.8%	19.0%	5.9%	1.5%
Comfortable to use (e.g., a handle)	27.2%	35.4%	25.7%	9.3%	2.3%
Resilience	3.9%	14.3%	45.9%	34.4%	1.5%

Source: own study.

To sum up, the very basic function of the packaging, i.e., product protection, remains the most important for the majority of respondents.

Table 2 presents the share of respondents' answers regarding the potential features of the new returnable packaging (possible to be used as part of online shopping). According to the respondents, very important and the most important features comprise:

- information about the package not being thrown,
- the material of the package (degradable, biodegradable, or recyclable),
- reusability,
- protection against external factors, unauthorized opening and destruction,
- consignment labelling,
- packaging size matching the product size,
- product packaging method, type of closure (e.g. ease of opening the packaging),
- resilience.

Table 2.

Potential features of returnable product packaging in online shopping and the share of a response frequency (in %)

	It does not matter	It matters a little	It is important	It is very important	I have no opinion
Aesthetics	23.4%	41.3%	26.5%	6.4%	2.3%
Information of the package not being thrown	7.3%	20.2%	45.5%	24.4%	2.6%
Color	33.6%	47.2%	13.0%	3.7%	2.4%
The material of the package is degradable, biodegradable, or recyclable	6.3%	17.2%	40.0%	33.6%	2.9%
Reusable	3.4%	8.0%	35.0%	51.4%	2.3%
The name of the product manufacturer placed on the packaging	32.9%	38.6%	19.0%	6.9%	2.6%
Protection against external factors	2.7%	7.2%	38.8%	48.9%	2.4%
Protection against unauthorized opening	3.2%	7.1%	37.4%	49.7%	2.6%
Protection against destruction	2.8%	5.7%	36.4%	52.7%	2.5%
Consignment labelling	11.7%	24.7%	40.0%	20.6%	3.0%
Packaging size corresponds to the size of the product	4.9%	12.3%	41.5%	38.0%	3.3%
The method of packaging the product	6.8%	14.8%	44.2%	31.1%	3.1%
Closure type (e.g., ease of opening the package)	7.6%	17.1%	42.6%	29.8%	3.0%
Appearance	27.0%	41.1%	22.1%	6.8%	3.1%
Comfortable to use (e.g., a handle)	18.1%	29.9%	33.6%	15.3%	3.1%
Resilience	2.2%	5.9%	36.9%	52.4%	2.6%

Source: own study.

To determine the differentiation of the respondents' views (or lack of it) on the unit transport packaging currently functioning in e-commerce and the reusable packaging that can be introduced, the weights assigned to individual packaging features were compiled (cf. Table 3).

Table 3.

Comparison of the weights assigned to standard and potential packaging features in online shopping

	It does not matter		It matters a little		It is important		It is very important		I have no opinion	
	1	2	1	2	1	2	1	2	1	2
Aesthetics	0.10	0.12	0.10	0.12	0.05	0.05	0.02	0.01	0.05	0.05
Information of the package not being thrown	0.02	0.04	0.06	0.06	0.08	0.08	0.06	0.05	0.05	0.06
Color	0.19	0.17	0.10	0.14	0.01	0.02	0.01	0.01	0.06	0.05
The material of the package is degradable, biodegradable, or recyclable	0.06	0.03	0.07	0.05	0.07	0.07	0.05	0.07	0.11	0.07
Reusable	0.04	0.02	0.07	0.02	0.07	0.06	0.06	0.11	0.08	0.05
The name of the product manufacturer placed on the packaging	0.17	0.17	0.09	0.11	0.02	0.03	0.01	0.01	0.09	0.06
Protection against external factors	0.02	0.01	0.04	0.02	0.08	0.07	0.10	0.10	0.03	0.05
Protection against unauthorized opening	0.02	0.02	0.03	0.02	0.08	0.07	0.12	0.11	0.03	0.06
Protection against destruction	0.01	0.01	0.02	0.02	0.08	0.07	0.13	0.11	0.03	0.06
Consignment labelling	0.04	0.06	0.07	0.07	0.08	0.07	0.05	0.04	0.07	0.07
Packaging size corresponds to the size of the product	0.02	0.03	0.04	0.04	0.08	0.08	0.10	0.08	0.04	0.08
The method of packaging the product	0.02	0.03	0.04	0.04	0.08	0.08	0.09	0.07	0.07	0.07

Cont. table 3.

Closure type (e.g., ease of opening the package)	0.04	0.04	0.06	0.05	0.07	0.08	0.07	0.06	0.07	0.07
Appearance	0.14	0.14	0.09	0.12	0.03	0.04	0.02	0.01	0.06	0.07
Comfortable to use (e.g., a handle)	0.10	0.09	0.09	0.09	0.05	0.06	0.03	0.03	0.10	0.07
Resilience	0.01	0.01	0.04	0.02	0.08	0.07	0.10	0.11	0.06	0.06

Legend: 1 - currently functioning packaging, 2 - new returnable packaging.

Source: own study.

Changes in expectations as to the features of the new returnable packaging compared to the currently functioning packaging are insignificant, although the respondents indicated certain elements that should be made more visible in the new returnable packaging: the material of the packaging (it should be degradable, biodegradable or suitable for recycling); its reusability (though it is consistent with the definition of returnable packaging, the respondents pointed out to this feature), and the size of the packaging should correspond to the size of the product. Paradoxically, according to the respondents, the importance of the *convenient to use* feature of the new packaging seems less important than in the currently functioning packaging.

In conclusion, it is worth emphasizing that the respondents notice the necessity to introduce returnable packaging to the market. More than half of them (50,6%) indicated that reusable packaging should complement the offer of existing packaging on the market and replace it over time. And 19,9% of the respondents claim that reusable returnable packaging should replace other packaging while 20.9% – it should supplement the offer of the packaging already existing on the market.

6. Discussion

The analysis of the ‘Development prospects of the e-commerce market in Poland’, conducted by PwC, shows that there are currently over 150,000 enterprises on the Polish market that offer access to goods and services via online stores and sales platforms. The value of e-commerce in Poland is estimated to amount to PLN 92 billion (one of the fastest growth in Europe) and in 2026 it is expected to reach PLN 162 billion. (www.parp.gov.pl/component) Hence, the significance of individual transport packaging – whether it is disposable or, in accordance with circular economy, reusable – will increase. Thus, research towards the implementation of reusable unit packaging used in e-commerce should be intensified.

Effective implementation of circular economy entails the introduction of modifications in each link of the supply chain (perceived in terms of the value chain) – including packaging used in e-commerce and reverse logistics, i.e. employment of returnable packaging (Radhakrishnan, 2015). This will require the cooperation of product manufacturers with packaging producers, logistics operators and transport companies servicing the last mile, and consequently the creation of new business models in supply chains that require close cooperation in the handling

of returnable unit packaging (in search of interdisciplinary solutions and ensuring their scalability). Thus, from the circular economy perspective, in the long run, it will be necessary to redesign supply chains (to improve reverse logistics), invest in new – returnable packaging for the distribution of products purchased online and create customer-friendly and cost-effective return processes for enterprises, which may bring the following benefits:

- less waste,
- reduction of the carbon footprint,
- promotion of the circular economy,
- cost optimization.

7. Summary

To sum up, circular economy is a model of production and consumption consisting of, among others, sharing, reusing (here: individual transport packaging used in e-commerce), renewing and recycling of materials and products already existing (as long as possible to extend their life cycle). This means reducing waste to a minimum – when a product's life cycle comes to an end, the raw materials and waste that comes from it should remain in the economy (and thus generate additional value) (www.europarl.europa.eu).

The directions of change in supply chains can be linked to the results obtained in the study, namely:

- for the customers buying on-line – individual transport packaging needs to fulfill basic protective functions,
- there were no significant differences in customer expectations regarding returnable packaging compared to traditional packaging used in online shopping,
- differences in the importance of individual packaging features for users of future returnable packaging may serve as a guideline for those designing returnable packaging for e-commerce,
- the vast majority of respondents notices the possibility of packaging reuse,
- the vast majority of respondents see the need to introduce returnable packaging to the market (some of them point to the need to replace the existing packaging with the returnable one), which corresponds with the circular economy idea.

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THE PRESENCE OF ETHICS IN MANAGEMENT TEXTBOOKS

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Purpose: The theoretical goal is to learn what ethical values are actually present in management concepts. We achieve this goal by analysing the content of management manuals. The practical goal is to draw the attention of the authors of textbooks and people teaching the basics of management to ethical deficiencies present in management textbooks and, as a result, deficiencies in the education of people studying management.

Design/methodology/approach: In the article, we used a quantitative and qualitative content analysis method. This method consists in a systematic study of the content of a text in search of the most frequently occurring words and concepts. The aim is to discover ethical content in management textbooks.

Findings: In the analysed textbooks, only an outline of ethics can be found as a set of moral norms and values recognized/preferred in the business environment in business activity. However, we will not find ethics understood as a philosophical reflection on morality/ethos. We also found a great deal of variation in management textbooks regarding the presence of ethical values.

Research limitations/implications: In the study, we took into account nine popular management textbooks. This made it possible to determine the dominant ethical content in the entire group of textbooks, without the possibility of formulating binding conclusions regarding the differentiation between various teaching and research centres.

Practical implications: The results achieved may become an inspiration to write textbooks on the basics of management with more extensive ethical threads, adequate to the humanistic challenges facing management.

Social implications: The results of the study may make us aware of the need to prepare management manuals that will prepare managers for ethical management.

Originality/value: Conclusions regarding management ethics are formulated on the basis of empirical research. In the study, we used content analysis (qualitative and quantitative) not used in ethical research.

Keywords: ethics, business ethics, management ethics, management textbooks.

Category of the paper: Research article.

1. Introduction

Management courses are taught in 163 Polish universities¹. Our initial assumption was that, since management concerns people, management textbooks should have some ethical content, that they would discuss and propagate a set of humanistic and social values, and not only utilitarian or economic ones.

We have decided to examine whether or not and to what extent ethical content and problems are present in the process of education students who in the future may become managers of institutions, organizations, and businesses. In addition, we have assumed that an analysis of the content of these textbooks might reveal the dominant attitude to ethics in management in centers of higher learning.

We have selected nine management textbooks currently in use in Poland². This decision has been made for the following two reasons: 1. it is through textbooks that students are taught the essential values associated with management; 2. textbooks are a more universal tool for transferring knowledge and humanist values than other forms of publication (articles, many-author books); consequently, they can have a greater impact on the formation of students' ethical beliefs and their opinions concerning the importance of ethics in management. The choice of these textbooks has been motivated by the fact that they are most often mentioned in the syllabi of introduction to management courses and approved as teaching materials by various public and non-public universities located in Warsaw, Krakow, Wrocław, and Gdynia.

2. Management ethics or ethics in management?

The search for ethics in management textbooks requires clarification of basic concepts, which is what has made us start to look for the ways in which the terms “ethics of management” and “ethics in management” are used. We have noted several ways of understanding and using these terms:

- They are often used as synonyms, also interchangeably with business ethics (Zbiegień-Maciąg, 1996; Kuzior, 2017, p. 69).

Management ethics is regarded as part of business ethics.

- Management ethics is treated as the professional ethics of managers. It is understood as a set of norms of behavior that managers follow in their actions. It includes the attitude of the organization/company to the employee, the attitude of the employee to the

¹ <https://opinieuczelnia.pl/kierunki-studiow/zarzadzanie/>, 20.07.2022.

² A list of the analyzed textbooks can be found in the qualitative analysis section, point 5 below.

company and the attitude of the company to other entities³. Wojciech Gasparski's and Aleksandra Kuzior understanding of these terms is similar (Gasparski, 2012, pp. 307-318; Kuzior, 2021, pp. 79-82).

- Management ethics is “a specialized field of ethics. Its subject is, generally speaking, morality in business. It is an interdisciplinary science, i.e., it uses the achievements of many academic disciplines, primarily management sciences, ethics and philosophy. The science of management ethics is concerned both with purely ethical issues and with issues related to the social responsibility of organizations”. This concise definition can be found in the Polish Wikipedia entry⁴.
- In *Encyklopedia zarządzania*⁵ (or *Ceopedia*), there is no entry “management ethics” or “ethics in management”; there are others, e.g., “ethics”, “business ethics/in business”, “ethics in marketing”, “ethics in financial reporting”, “professional ethics”. Similarly, in management textbooks, we find no definition or explanation of this term.

Thus, our search for a specific and precise meaning of the term “management ethics” or “ethics in management” has not been satisfactory. This term denotes ethical reflection, or a set of ethical norms formulated and addressed to professions and roles related to broadly understood business operations and the management of an organization. After all, it is of secondary importance whether we use the term “management ethics”, “ethics in management” or “business ethics”; more important than the terminology is whether we want to see the management process in terms of ethical requirements it involves. As Aleksandra Kuzior put it: “Proper management of human resources requires high ethical standards, based on such basic values as: respect for dignity, respect for the right to freedom, following the principles of justice, honesty and responsibility” (Kuzior, 2021, p. 81).

It is worth noting that the *Encyklopedia zarządzania* (or *Ceopedia*), which has 8189 pages and 7891 articles [in *Ceopedia* 3544 articles and 4554 pages], and is, according to the organizers, the largest in Poland and one of the world's largest “knowledge database” devoted to management and related fields, does not devote much space to ethical content. This relatively meagre representation of ethical issues may suggest that the representatives of management sciences do not attach much importance to ethics in management. The basic concepts include terms that may have an ethical meaning: ethics (etyka), business ethics (etyka biznesu),

³ See *Encyklopedia pwn.pl*, entry “Etyka zarządzania” [Management Ethics]. <https://encyklopedia.pwn.pl/haslo/etyka-zarzadzania;3898969.html>, 20.07.2022.

⁴ https://pl.wikipedia.org/wiki/Etyka_zarzadzania [20.07.2022]; there is no corresponding entry in English; the closest entry in English is “business ethics”, where we find the following definition, “Business ethics (also known as Corporate Ethics) is a form of applied ethics or professional ethics, that examines ethical principles and moral or ethical problems that can arise in a business environment. It applies to all aspects of business conduct and is relevant to the conduct of individuals and entire organizations”. https://en.wikipedia.org/wiki/Business_ethics, 8.12.2022.

⁵ See https://mfiles.pl/pl/index.php/Strona_główna, 20.07.2022 (https://ceopedia.org/index.php/Main_Page [08.12.2022]). This Encyclopedia has been created by scholars of the Cracow University of Economics, the authors of the articles are faculty members and students of the Cracow University of Economics, the Jagiellonian University and other universities.

professional ethics (etyka zawodowa), common good (dobro wspólne), management philosophy (filozofia zarządzania), corruption (korupcja), nepotism (nepotyzm). However, the definitions and explanations are general, and often devoid of ethical content. Thus, for instance, a norm is understood only in an organizational and legal meaning of the term. The last update of the website was recorded on September 17, 2021, which might indicate low activity on the part of the administrators.

3. Ethics and management

Understood as a set of activities, processes and decisions used in relation to resources, people, capital, and organization to ensure effective functioning and the achievement of a set goals, management is a phenomenon common in social life. All kinds of things are managed: a company, an organization, time, finances, work safety, documents, information, knowledge, projects, innovations, risk, to name the most frequently cited examples. The widespread use of the term “management” in relation to almost all spheres of collective and individual life is as significant as it is interesting. It may testify to the dominant belief that everything can and indeed must be managed. This overuse of the word “management” may be of interest to social psychologists as a testimony to the universality of people’s ideas. The representatives of management sciences sometimes point this out (Oleksyn, 2008; Sułkowski, 2005; Sudoł, 2021)⁶, but they also warn that this common understanding of management should be avoided in scholarly studies of management (Sudoł, 2021, p. 413-414). Thus, according to S. Sudoł, “We should speak of management only if all three of the following conditions are met: 1) management is not related to the activity of individuals (e.g., a scholar writing a book), but to the joint activities of teams of people, 2) management is an organizational process (related to an institution), 3) the managing entity has control over this process” (Sudoł, 2012, p. 414).

Management as a social practice has existed for a long time, but the science of management emerged at the turn of the nineteenth and twentieth centuries during the industrial revolution, when the great number of industrial plants created the need for efficiently organized production process and cooperation⁷.

⁶ Oleksyn points to “a huge expansion of how people understand the term ‘management’, its meaning having become almost total”, so much so that these days “everything is managed” (Oleksyn, 2008, p. 54); Ł. Sułkowski (2005, p. 54) expresses a similar concern: “Nowadays, the term ‘management’ tends to be overused in relation to all social processes (as when people talk about conflict management or organizational culture management), and even in relation to abstract entities (chaos management)” qtd after S. Sudoł (Sudoł, 2012, p. 413).

⁷ https://mfiles.pl/pl/index.php/Teoria_zarzadzania, entry by Alice Janik and Ewa Marzec, 26.07.2021. the same entry now is much shorter in terms of its content, 23.07.2022; see also Sudoł, 2012, p. 413-421. See also Pietruszka-Ortyl, 2012, pp. 423-441.

The importance attached to management skills and to management knowledge, the existence of universities and disciplines educating future managers of organizations and companies are social facts that arouse the curiosity of researchers in the field of social sciences and humanities, especially those dealing with business ethics (otherwise also called ethics of economic life or ethics of economic activity). The term “business ethics” is used in a number of different senses⁸, such as:

1. a philosophical reflection on morality/ethos, that is, on a set of virtues and moral convictions that should condition the decisions and actions of businesspeople (applied ethics, which employs general philosophical and axiological assumptions to study economic activities of groups and individuals);
2. a set of moral norms and values recognized (accepted, preferred, respected) in the business environment; it is sometimes called the ethos of these professional groups;
3. a discipline practiced at the interface of practical ethics and managerial operations related to the economy, trade, business, indicating the moral dimension of economic activity and a set of appropriate standards (beliefs, norms, values) of deciding and acting in business activity; these standards being defined in terms of what is morally good, and not solely according to economic criteria (in other words, as professional ethics addressed – often in the form of ethical codes – to people with jobs related to business activity);
4. a requirement to apply socially accepted moral norms (so-called ethics or general morality) in economic activity.

Management ethics (in the context of management) has become part of business ethics. According to Agata Stachowicz-Stanusch, in the 1980s American literature in the field of management saw an increase of interest in moral issues. Meanwhile, in Poland, management sciences exist and develop independently of business ethics. Perhaps because these sciences have been recognized as a foundation of economic activity defined in terms of orientation towards profit, organizational and economic effectiveness, ethical values, and norms are beyond the scope of the respective scholars.

Agata Stachowicz-Stanusch, however, is an optimist in her belief in the growing role of ethics in business (Stachowicz-Stanusch, 2016, pp. 83-84, 94).

⁸ As pointed out by many business ethics scholars, e.g., J. Dietl, W. Gasparski, ed 1999; Gasparski 2021; Lewicka-Strzańska 1999; Klimczak 1999; Porębski 1997; Zadroga 2009.

4. Method of research

In view of the fact that, judging from available literature, it is chiefly business ethicists who show interest in management ethics, we decided that the four approaches to business ethics mentioned above can be applied to management/management science.

We have examined the contents of nine management textbooks selected for this research. To facilitate the comparison, we have prepared the following lists: a list (key words) of basic ethical terms and terms denoting general and specific values (as it is impossible to talk about ethics without using these terms); a list of ethical terms expressive of the ethical assessment of economic phenomena; a list of the names of stakeholder groups (or groups of interested participants in business activity). We have established the proportions of occurrence of these groups of terms in individual textbooks. Because the occurrence of ethical terms is not equivalent to the presence of active ethical reflection, we examined the context of statements in which these terms occur (whether they relate to ethical issues, whether they are explained, and whether they are part of proclaimed/postulated norms). The juxtaposition of quantitative results with content analysis has allowed us to enquire about the presence of ethics manifested in the following ways:

- as reflection on the moral aspects of management and economic activity, involving the indication of norms, values and standards that determine acceptable conduct in business organizations and the justification of their importance;
- as a set of postulates/recommendations regarding the priorities of the organization/company formulated not only for economic and effective/pragmatic reasons, but also in terms of ethical values (e.g., corporate social responsibility, social effects, public good, human rights);
- as a set of ethical terms used with no theoretical background or explanation.

The answer thus obtained has allowed us to determine the degree of the authors' interest in ethics and the presence therein of ethics understood in a manner similar to the approaches to business ethics detailed above.

We put forward the following research hypotheses:

1. Management concerns people, which is why ethics should be present in management textbooks in the form of separate sections (chapters or smaller units), in which concepts and problems important in ethical management are presented.
2. In addition to such sections, authors should use crucial ethical terms present in management ethics (business ethics).
3. Since management concerns people, among the ethical terms present in management textbooks, preference should be given to those that apply to people.

Following upon these hypotheses, we went on to formulate the following research questions:

1. Are ethical concepts (theories) present in management textbooks?
2. Do management textbooks contain terminology that describes important ethical issues and thus represents ethical values?
3. What ethical issues and values are present (and recommended) in management textbooks?

In our study, we used the content analysis method (Babbie, 2008). This method involves a systematic study of the content of a text, aiming to discover the most frequently occurring words and themes. The method is used to discover the basic structure of the examined text in terms of how it reveals this text's main ideas (themes, the message).

We use two variants of this method:

1. The qualitative variant, which involves looking for sections, chapters, subchapters which directly address ethical problems. The presence of separate sections devoted to ethics testifies to the level of importance a textbook's author attributes to these problems. This classification allows us to determine whether an author finds it necessary to address ethical problems at all, but it does not allow us to compare what ethical content (present directly or indirectly) occurs in them. We obtain this information by determining the frequency of occurrence of terms describing various ethical problems.
2. The quantitative variant, which involves conducting a quantitative analysis of the presence of terms important for management ethics. Here we distinguish six groups of terms. The list of these terms is based on ideas that express expectations towards management ethics as formulated at the beginning of this article. The list has been divided into the following parts: 1. basic ethical terms; 2. general/basic values, humanist values; 3. social values; 4. utilitarian values; 5. stakeholders; 6. terms defining management models. This list expresses the (hypothetical) conviction that it is impossible to talk about the (possible) presence of ethical themes in management textbooks without the occurrence, in the text, of these groups of concepts. In the analyzed textbooks, we have examined the frequency of a term's occurrence, which allows us to determine a term's significance. Since textbooks vary in volume from one hundred to six hundred pages, it makes no sense to compare the frequency of occurrence of a term. Therefore, in order to be able to compare the frequency of occurrence, we introduce frequency indicators instead of absolute numbers. The indicator is created by dividing the number indicating the frequency of occurrence of a given term by the number of pages of a textbook. The larger the number, the more often the concept/term appears in the textbook. For example, number 1 indicates that the term appears on every page; any number larger than 1 indicates that the term occurs more than once on each page, and numbers lower than 1 that it occurs less frequently. Thus, for instance, the figure 3.000 means that a term (or terms) occurs (on average)

three times on every page of a given textbook, while the figure 0.333 indicates that the term occurs on average once every three pages.

In this study, we have used electronic versions of the textbooks.

We would like to note that this method of research is innovative due to the use of content analysis, involving quantitative analysis, in ethical research. This type of method, popular in various social sciences and humanities, has not yet been used in ethical research. We believe that – regardless of whether there is a separate chapter devoted to ethics in a management textbook – the frequency of occurrence of selected terms indicates the degree of the author's interest in ethical problems and reveals his or her state (and level) of ethical self-knowledge.

5. Qualitative analysis. Types of textbooks distinguished by the presence of sections devoted to ethics

We have distinguished three groups of textbooks. In group 1, there are separate sections (chapters) devoted to ethics. In group 2, there are no sections devoted to ethics, but there are passages which indirectly address ethical problems. In group 3, there is no discussion of ethical problems.

Textbooks with sections on ethics. Only in two textbooks are there chapters or sections devoted to ethics.

In the textbook [8] (Griffin, 2004)⁹, *Podstawy zarządzania organizacjami [Fundamentals of Management]*, there is an extensive chapter on ethics which discusses ethical problems in the context of the social environment of an organization. It treats of the following problems: individual ethics in organizations, social responsibility and organizations, state authorities and social responsibility, the managements of social responsibility. The book often uses the concept of social responsibility, which is understood as a set of obligations of an organization to protect and strengthen the social environment in which it operates (Griffin, 2004, p. 117). The textbook contains a subject index which includes ethical concepts (e.g., ethics and social responsibility).

In textbook [9] (Jemielniak, and Latusek, 2005), *Zarządzanie. Teoria i praktyka od podstaw. Ćwiczenia [Management. Theory and Practice from Scratch. Tasks]*, there is a several-pages-long chapter on ethics and social responsibility in management in which the reader will find introductory information about ethics, business ethics, and corporate social responsibility. It also includes a case study (a “mini-case”) about the activities of Greenpeace, to which are related questions, the intention being to facilitate revision. This chapter describes the characteristic features of ethics, business ethics and management ethics. The authors state

⁹ Numbers in square brackets next to the analyzed textbooks show the frequency of occurrence of the analyzed terms. The same method is used to mark the textbooks in the references.

that views on corporate social responsibility have changed with the development of management science. At the same time, they believe that, regarded “in socioeconomic terms, the social responsibility of management includes not only maximizing profit, but also acting to protect and improve the welfare of society” (Jemielniak, Latusek, 2005, p. 139).

Textbooks with sections that indirectly address ethical issues. This criterion is met by **two textbooks**.

In textbook [1] (Bogdanienko, 2010), *Organizacja i zarządzanie w zarysie* [*Organization and Management. An Outline*], there is no separate section on ethics/morality/values; nor is there a subject index. However, there is a chapter devoted to social aspects of management, which addresses the following problems: decision-making in organizations, the management of the social potential of the organization, the behavior of the organization’s participant, management and leadership, and the creation of organizational culture.

Textbook [2] (Klincewicz, 2016), *Zarządzanie, organizacje i organizowanie. Przegląd perspektyw teoretycznych* [*Management, Organization and the Organizing Process. An Overview of Theoretical Approaches*], contains no chapter directly addressing ethical issues; however, there are chapters and subchapters which address the following ethical problems: corporate social responsibility, organizations in the social system, man in the organization, including the humanist perspective, the Human Relations trend, the impact of criticism of capitalism on management theory, the challenges of the contemporary workplace, organizational culture, the importance of national cultures for management. An interesting table (Klincewicz, ed. 2016, p. 229) is included which presents the main philosophical foundations of corporate social responsibility as well as their origin and content. Among these foundations the authors include the golden rule of conduct, utilitarianism, the theory of justice, the ethics of virtues, and a model of moral development.

No sections devoted to ethics. There are **five textbooks** in this group.

Textbook [4] (Piątkowski, and Pawlak et al., 2012), *Organizacja i zarządzanie* [*Organization and Management*], has no section (chapter or sub-chapter) devoted to ethics and there is no subject index. There is a dictionary, which primarily explains the abbreviations used in the book but contains no entry about ethics, morality or values.

Textbook [5] (Czermiński, Grzybowski, Ficoń, 1999), *Podstawy organizacji i zarządzania* [*Basics of Organization and Management*] has no chapter directly or indirectly concerned with ethics. Only once, (Czermiński, Grzybowski, Ficoń, 1999, p. 8) in a perfunctory manner and with no further elaboration, is the term “management ethics” used. Here the authors promise to return to ethics in the third chapter of the book; however, they do not deliver on this promise.

In textbook [6] (Hopej, Kral, 2011), *Współczesne metody zarządzania w teorii i praktyce* [*Contemporary Management Methods in Theory and Practice*], there are no chapters or sections addressing, if only indirectly, ethical problems. The term “ethics” occurs only once, in the context of an assertion that ethics is (or ought to be) one of a manager’s competences. The phrase “social responsibility of business operations” occurs twice and so does “social

responsibility” (Hopej, Kral, 2011, pp. 186, 125, 146). The term “morality” does not occur even once.

Textbook [3] (Peszko, 2002), *Podstawy zarządzania organizacjami* [*Basics of Organization Management*], has no chapter dealing with ethics. As a matter of fact, there are no terms related to any ethical problems, either. The term “ethics” does not occur at all, while “morality” occurs only once. The term “morale” has been used twice.

Textbook [7] (Kozłowski, Piotrowski, 2007), *Zarządzanie. Teoria i praktyka* [*Management. Theory and Practice*], has no separate chapter or section devoted to ethics, even though there are chapters in which one could reasonably expect the authors to take up ethical themes. These are chapters devoted to motivation, leadership, organizational culture, the management of the social potential of an organization, and intercultural management. However, even in these chapters, terms that would indicate the presence of ethical problems are generally absent. There is a subject index, but it names few ethical concepts (e.g., organizational culture, morale, motivation, and value management).

As in this group of textbooks the terms related to ethical problems are not defined or explained, we may assume that the authors adopt a colloquial way of understanding them.

6. Quantitative analysis of key words indicating interest in ethical problems

We take into account six groups of key terms.

The occurrence of basic terms

The basic ethical terms which we have searched for in the textbooks include “ethics”, “morality”, “morale”, “ethos”, “social responsibility”, “human rights”, “norms”, “good”, “code of ethics”, “ethical program”, “ethics ombudsman” (or another institution responsible for the code of ethics in the organization), and “values”.

The average frequency index of basic terms is **0.5620**, which means that one of these terms occurs **every two** pages.

Among the basic terms, the most commonly occurring are “values” (indicator 0.3144 in the total of all pages) and, much less often, “norms” (indicator 0.0864) and “ethics” (indicator 0.0855). In the analyzed textbooks, “ethical program” and “code of ethics” do not occur, and “human rights” occurs only three times (out of 3505 pages of all the analyzed textbooks).

Terms denoting stakeholders

Among the terms related to “stakeholder” we find the following ones: “shareholder”, “owner”, “manager”, “employee”, “customer”, “supplier”, “natural environment”, “trade unions” and the term “stakeholder” itself when used in a generic sense.

The average frequency index of “stakeholder” is 2.0256.

Among the terms related to “stakeholder”, the most common are “employee” (indicator 0.7939), followed by “manager” (indicator 0.5977) and “customer” (indicator 0.4074). The least frequently occurring are: “natural environment” (indicator 0.0094) and “trade union” (indicator 0.0128). There is a visible disproportion between the frequency of the term “employee” and the term “trade union”, which suggests that for the authors of management textbooks, employees can be talked about and managed regardless of the existence of trade unions. To some extent, this reflects the typically hostile attitude of business owners and managers towards trade unions.

Terms denoting management models

The terms that characterize different management models include “management model”, “management concept”, “people management” (or “human resources management”), “management style”, “democratic/participatory management style”, and “autocratic management style”.

The terms related to management models are extremely rare. The average frequency index of terms related to management models scores 0.0313. In four of the textbooks, this indicator is higher than the average.

Among the most common terms for management models are “management/management of people/human resources” (indicator 0.0134), followed by “management/management styles” (indicator 0.0085) and “democratic/participatory style of management” (indicator 0.0045). The terms “management model” and “management concept” are the least common (only 8 times).

Terms denoting general humanist values

We have identified as such the following terms: “responsibility”, “security”, “dignity”, “humanity”, “subjectivity”, “respect”, “democracy”, “humanism”, “honesty”, “moral integrity”, “fairness”, “justice”, “health”, “happiness”, “freedom/liberty”, “equality”, “life”, “fair pay”.

The average frequency index of terms that denote general, basic, and humanist values is 0.2898.

Terms denoting social values

Social terms include the following: “competition”, “conflict”, “hierarchy”, “agreement”/“consent”/“compliant”, “cooperation”, “organizational culture”, “gratification”, “trust”, “pay/remuneration conditions”, “authority”, “loyalty”, “community”, “order” (as in “social order”), “penalty”, “partnership”, “working conditions”, “sustainable (development)”, “social goals”, “conflict of interest”, “social balance”, “corruption”/“cronyism”/“nepotism”, and “fair competition”. The average frequency index of terms that denote social values is 0.7215.

Terms denoting utilitarian values

Utilitarian terms include the following terms: “success”, “benefit”, “interest”, “profit”, “efficiency”, “effectiveness”. The average frequency index of terms denoting utilitarian values is 0.6271.

Frequency of occurrence of the terms in all the analyzed textbooks

In the analyzed textbooks, regardless of the presence or absence of chapters devoted to ethical problems, the searched groups of terms occur with varying frequency.

Table 1.
Frequency of use of all analysed terms in textbooks

No	Textbook	Numer of pages	Frequency of terms	Frequency index
1	<i>Współczesne metody zarządzania w teorii i praktyce</i> [6]	255	1641	6,4352
2	<i>Podstawy zarządzania organizacjami</i> [8]	801	4735	5,9113
3	<i>Zarządzanie, organizacje i organizowanie</i> [2]	518	2790	5,3667
4	<i>Organizacja i zarządzanie w zarysie</i> [1]	288	1290	4,4791
5	<i>Podstawy organizacji i zarządzania</i> [3]	212	750	3,5377
6	<i>Zarządzanie. Teoria i praktyka od podstaw</i> [9]	199	699	3,5125
7	<i>Zarządzanie. Teoria i praktyka</i> [7]	792	2673	3,3750
8	<i>Postawy zarządzania organizacjami</i> [5]	100	279	2,7900
9	<i>Organizacja i zarządzanie</i> [4]	340	168	0,4941
	Sum total	3505	15006	4,2813

Source: own research.

The average frequency index of the analyzed terms is 4.2813. Four textbooks score above this average, and five – below. Most often (in relation to the textbook’s page length) the searched terms are found in textbook [6], and the least often in textbook [4].

Ranking of the categories of the analyzed terms

Taking into account all the textbooks, we have observed considerable variations in the frequency of occurrence of the categories of the terms.

Table 2.
Ranking of the categories of the analysed terms

No	Groups of terms	Total numer of pages	Frequency of terms in textbooks	Frequency index
1	stakeholders	3505	7100	2,0256
2	social	3505	2529	0,7215
3	utilitarians	3505	2152	0,6139
4	basic	3505	1970	0,5620
5	general humanist	3505	1016	0,2898
6	management models	3505	120	0,0342

Source: own research.

In the analysed textbooks, the terms related to stakeholders are decidedly the most common, followed (but much less frequently) by social and utilitarian values. As can be seen, considerably less frequent is the occurrence of terms characterizing management models and general and humanist values.

7. Conclusions: what kind of ethics, if any at all

Our analysis of the contents of nine management textbooks allows us to draw the following conclusions:

1. In the textbooks, one can find ethical content, but this content is poorly exposed. Most often, ethical content appears in the form of a set of ethical terms used without theoretical background or explanation (textbook [8] being an exception).
2. Management ethics (in the context under scrutiny here) exists in the form of the ethos of managers (a set of norms and values preferred in this professional/business group). This kind of ethics is descriptive; alternatively, it has the rare form of a formulated requirement to apply socially accepted moral norms (the so-called universal ethics or morality) in the activities of the economic/managerial kind. (Thus, of the four distinguished approaches to business ethics, only the second and fourth are present, while the first and third are not).
3. If such textbooks are the basis for the education of managerial staff, it is hardly surprising that this group is oriented primarily towards economic and managerial values, while tending to ignore ethical and cultural ones.
4. In two (out of nine) management textbooks, there are chapters which address various concepts and problems related to management.
5. Three of the textbooks contain sections in which there are no separate passages on ethics, but which touch upon issues which are indirectly related to management ethics (e.g., sustainability).
6. In most of the textbooks (four), there are no sections on ethics or problems related to ethics.
7. All the textbooks contain terms that can be associated with some ethics (of management), but the intensity of this focus varies from book to book.
8. In the textbooks, the most commonly occurring terms are related to:
 - stakeholders (index 2.0256), the most frequently present being “employees”, “managers” and “customers”; rarely “the natural environment” and “trade unions”,
 - social values (index 0.7215),
 - utilitarian values (index 0.6139),
 - basic ethical terms (index 0.5620),
 - humanist values (index 0.2898),
 - management models (index (0.0342), which indicates a low level of self-knowledge about management models and a tendency to treat one’s own proposal as self-evidently superior to others.

9. Given the frequency of occurrence of the terms under scrutiny, the textbooks can be arranged into three groups. Above the average frequency are textbooks [6], [8], [2], [1]. The next group is below the average, and textbook [4] belongs to the third group, with a frequency index of the search terms below 0.5. The last-named result indicates that any of the dozens of the search terms occurs once every two pages of the textbook.
10. The results of our research indicate that in most cases ethical problems are treated as marginal by authors of management textbooks. Therefore, it is hardly surprising that opinion polls of managers, including students, point to a small role of ethical values in shaping their ideas about good management (which is confirmed by research conducted in 1994/1995 and 2013-2014) (Kopycińska, 1999, pp. 205-216; Herman, Oleksyn, Stańczyk, 2016).

To sum up. In the analyzed textbooks one can find an outline (perhaps “trace” would be a better word) of ethics understood as a set of moral norms and values recognized/preferred in the business environment (professional ethos) and as the requirement to abide by socially accepted moral norms (so-called ethics or general morality) in business activities. However, we will not find in these books ethics understood as a philosophical reflection on morality/ethos in the sense of a set of virtues and moral convictions that should condition the decisions and actions of business people (applied ethics related to group and individual economic activities, employing philosophical and axiological assumptions) or ethics understood as a discipline practiced at the interface of practical ethics and managerial activities related to the economy, trade, business activity, indicating moral the dimension of economic activity and a set of appropriate standards (beliefs, norms, values) of decision-making and conduct in business or business activity determined on the basis of what is morally good, and not solely on economic criteria (in other words, as professional ethics addressed, often in the form of codes of ethics, to people practicing professions related to business). An answer to the question about the diversity of textbook content depending on the place of publication (the university and the country) is not possible at this point, as it would require examining a much larger number of textbooks by Polish and foreign authors. One can only say that, among the nine textbooks we have examined, Ricky W. Griffin’s textbook [8] and Dariusz Jemielniak and Dominika Latusek’s set of practical class materials [9] stand out as notable exceptions.

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ALTERNATIVE TRANSPORT ROUTES FROM EUROPE TO ASIA AFTER THE OUTBREAK OF WAR

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Purpose: The aim of this paper is to identify possible transport routes leading from Europe to Asia that bypass the territory of the Russian Federation or go through Russia and don't violate the sanctions.

Design/methodology/approach: Comparative analysis, regional map analysis and case study are used. Map analysis allowed for the creation of various transport routes leading from Europe to Asia. The determining aspect affecting the course of a given route was access to transport infrastructure. The described case study shows the perspective of a small entrepreneur who wants to send his goods to Asia legally and in compliance with applicable sanctions. The comparative analysis made it possible to define new transport paths that largely coincide with the economic corridors of the New Silk Road.

Findings: Possible routes for transporting goods from Europe to China were presented, with a focus on land and intermodal routes that avoided Russian Federation territory and ran through Central Asian countries. The possibility of omitting sanctions in the transport of goods from Europe to Asia was also shown.

Research limitations/implications: Further research on this topic is suggested. A significant impediment in the creation of this article was the lack of access to numerical data from carriers performing the types of transport described in the article. Data worth analyzing concern the number of transports, the value and type of transported goods, transport costs, as well as qualitative data on the experience and good practices of carriers who carry out transport from Europe to China via Central Asia.

Originality/value: The article describes the logistical problems of a transport nature that arose as a result of the outbreak of the Russian-Ukrainian war, which, to the author's best knowledge, have never been described in detail before, nor have possible solutions to these problems been presented. The article is addressed to small entrepreneurs trading in Asian countries who cannot afford to use the services of intermediaries and are forced to organize transport on their own. The article also highlights the benefits for carriers by presenting alternative transportation routes that do not include Russia.

Keywords: transport, intermodal transport, Central Asia, Russo-Ukrainian War.

Category of the paper: Viewpoint, Case study.

1. Introduction

In the age of globalization, transportation is critical for connecting distant regions and economies. An example of such a connection was the former Silk Road, which connected Europe with China. The Belt and Road Initiative, initiated and being developed, aims to recreate the Silk Road and create a convenient transport connection between the old world and the Middle Kingdom (Mobley, 2019; Fang, 2015). important role in the smooth operation of various transport initiatives, in the case of land transport, are the transit countries through which the transport route passes, but they are neither the starting point nor the destination of this transport. In the discussed case, this role is played mainly by the countries of Central Asia, i.e. Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan. (Khasseanova-Kaliyeva et al., 2017). These countries, due to their location, are particularly important in the first stage of transport from China to Europe, because the goods, once in Central Asia, can be transported north through Russia, west through the Caspian Sea, or south-west through Iran to Europe (Kalyuzhnova, Holzacker, 2021).

In the current, highly volatile geopolitical environment, the decision to choose a mode of transportation is critical in terms of transport efficiency and safety. The aim of the article is to present the impact of the sanctions that were imposed on Russia and Belarus after the aggression against Ukraine on transport running through and ending in Central Asia and to show possible alternative routes and ways of performing this type of transport. The research methods used will be a comparative analysis and a case study of the transport of goods from a Polish company operating in the specialized entertainment industry to Kazakhstan.

2. Methods

In this article, the following were used: comparative analysis, case study and map analysis of individual regions. The case study is a method for condensing broad and often complex behaviors or phenomena that occur in a research subject into more easily developed research problems (Flyvbjerg, 2011; Heale, Twycross, 2018). As a case study in this article, the situation of a certain Krakow-based company operating in the specialized entertainment industry will be used.

Comparative analysis involves the analysis and compilation of empirical data to create an overall analysis and, potentially, provide a broader perspective (Roig-Tiemo et al., 2017). In this article, comparative analysis was used to analyze maps of the regions and their infrastructure and to create potential alternative transport routes.

3. Results

3.1. Transport routes from Europe to Asia

The Belt and Road Initiative assumes the creation and maintenance of transport and economic corridors, mainly leading from China to Europe. It is possible to distinguish six such corridors (Wen et al., 2019):

1. NELBEC New Eurasia Land Bridge Economic Corridor.
2. CMREC China-Mongolia-Russia Economic Corridor.
3. CIPEC China-Indochina Peninsula Economic Corridor.
4. CCAWAEC China-Central Asia-West Asia Economic Corridor.
5. CPEC China-Pakistan Economic Corridor.
6. BCIMEC Bangladesh-China-IndiaMyanmar Economic Corridor.

These corridors are shown in figure 1.

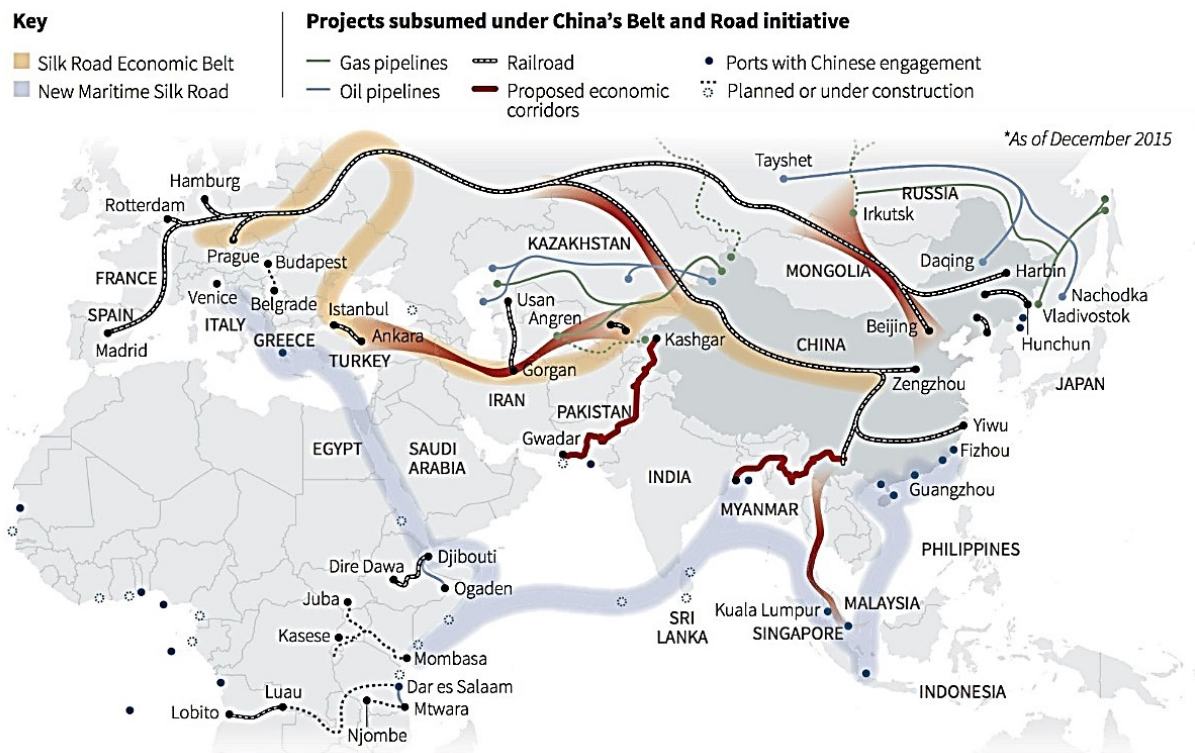


Figure 1. Belt and Road Initiative.

Source: Mercator Institute for China Studies. (C.Inton, 24/03/2017. Reuters).

Transport and economic corridors from the Belt and Road Initiative allow not only for more and more effective transport of goods, which is associated with both increasing the volume of transport and reducing its costs, but also for the development of the economies and infrastructure of the countries through which these corridors run (Lu et al., 2018). This project allows the transport of various types of goods using all modes of transport: road, rail, water, transmission and air, with the least emphasis on air transport. This proves the high intermodal

potential of transports carried out in the corridors of the Belt and Road Initiative. It is worth emphasizing that out of three land corridors, two run through Russia and two through Central Asia, which makes the countries of this region an important link in the organization of international transport in the economic corridors of the Belt and Road Initiative, especially if there is a need to bypass the Russian Federation in planned transport.

The countries of Central Asia, due to their location, are somehow forced to cooperate economically in order to optimize the transport services as much as possible, which results not only from the immediate geographical vicinity but also from the proximity of countries with huge economic potential (China, India, Russia). This cooperation, for many different reasons, can be described as turbulent (Kulipanova, 2012). However, the countries of Central Asia have undertaken and continue to undertake many initiatives aimed at stimulating the development of infrastructure and economies in the region. This is manifested by the extremely friendly approach of these countries to the entire Belt and Road Initiative project, which will allow for attracting new investors and, consequently, further development of the countries, including their infrastructure and economies (Taliga, 2021).

In the territory of the Central Asian countries, various international organizations operate, and there are many programs aimed at modernizing infrastructure, investing in improving its functioning, as well as controlling the quality and efficiency of transport. Among them, the following can be distinguished (Khassenova-Kaliyeva et al., 2017; Łacny, 2009):

- The International Road Transport Union IRU.
- Central Asia Regional Economic Cooperation Program CAREC.
- Transport Corridor Europe Caucasus Asia program TRACECA.
- Viking Train Railroad project.
- Belt and Road Initiative BRI.

The International Road Transport Union (IRU) was the initiator of the NELTI project, which began in the late 2000s. This project was aimed at streamlining procedures and checking the quality of transport infrastructure in Central Asia (Łacny, 2009).

In turn, the CAREC program, which is comprised of eleven regional countries and independent institutions, develops long-term transportation strategies for the region (including CAREC 2030). CAREC helps the countries participating in the program organize the money needed to carry out the investments. Under the CAREC program, Central Asian economic corridors, which are presented in figure 2, were created.



Figure 2. Economic corridors of CAREC program.

Source: (Khasseanova-Kaliyeva et al., 2017).

These corridors not only allow for faster, more efficient transport using various modes of transport, but also significantly affect the economic development of the region. In addition to transport, CAREC implements projects supporting, among others, the energy industry, trade and tourism, which is conducive to the development of the entire region.

TRACECA, on the other hand, is a European program aimed at connecting Central Asia and the Caucasus countries to Europe through efficient and reliable transportation links. Currently, the countries participating in this program are implementing development strategies for 2016-2026, and the effects of the implemented projects contribute to the development of the competitiveness and attractiveness of the TRACECA corridor in order to facilitate further trade liberalization and reduce barriers in the path of goods along the entire corridor. The map of corridors in the Central Asia region is presented in figure 3.

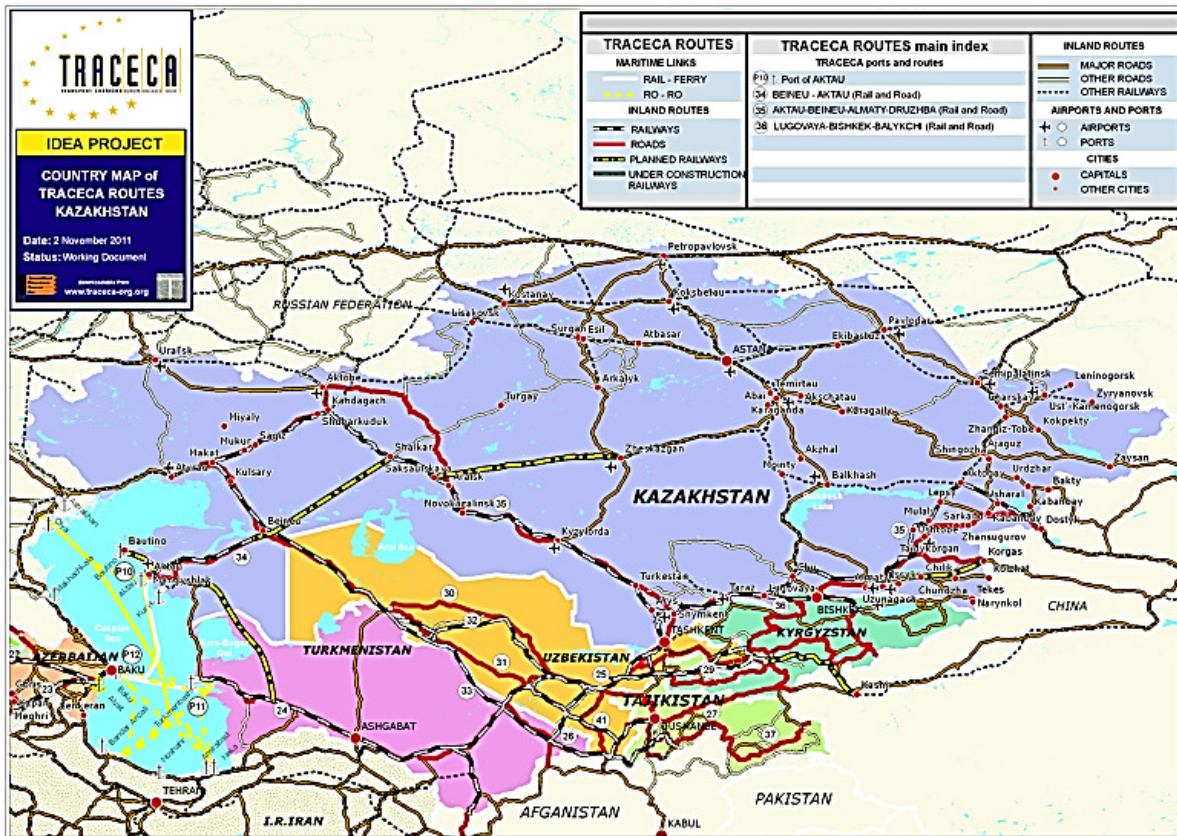


Figure 3. TRACECA map of Central Asia.

Source: (Khassenova-Kaliyeva et al., 2017).

The Viking Train Railroad project was an intermodal project connecting Lithuania with the countries of Central Asia by rail and sea. In the first months of 2021, over 31,000 people were transported under this project. TEU (RAILTARGET, 2021; Viking Train, 2022). Due to the fact that a significant part of the European part of the route ran through Belarus and Ukraine, the project was suspended after the Russian aggression against Ukraine, and the vikingtrain.com domain is up for sale as of December 2, 2022 (Project3seas, 2022).

The geographical location of the Central Asian countries makes them ideal transit countries in transport relations between Europe and China, and new investment projects in the transport industry make these countries more and more attractive to new investors and help optimize transport processes. In addition, there are many different transport routes that allow you to bypass selected countries in the transit of goods when necessary.

3.2. The impact of the war on transport to Central Asia

The Russian aggression against Ukraine, which took place on February 24, 2022, caused not only a significant political, humanitarian and epidemiological crisis (Choudhary et al., 2022), but also an economic one (TÁRIK, 2022). Warfare will prevent the effective performance of many activities, including transport, in countries where war is taking place. This involves the need to organize new routes and transport routes bypassing unstable regions

affected by military operations (Fan, 2022). This affects, among others, the countries of Central Asia, whose transport from Europe is significantly hindered by the need to bypass the territory of the Russian Federation.

As part of economic pressure aimed at ending the Russian-Ukrainian war as soon as possible, many countries imposed various types of sanctions on the Russian Federation. In terms of the operation of the transportation industry, the sanctions as of December 2, 2022 include: (Biznesgov, 2022; Europa.eu, 2022):

- a ban on the export of goods and technologies suitable for use in the aerospace industry,
- prohibition of providing insurance, reinsurance and maintenance services for goods and technologies suitable for use in the aerospace industry,
- prohibition on the provision of technical assistance and other related services, as well as financing and financial assistance in relation to goods and technologies suitable for use in the aerospace industry (the prohibition covers the entire CN code 88 (aircraft, spacecraft and parts thereof),
- ban on landing, taking off from and overflying the EU territory by Russian air carriers, aircraft registered in Russia and owned, chartered and controlled by Russian legal and natural persons,
- restrictions on the export of marine navigation goods and radiocommunication technology,
- complete ban on the entry of Russian and Belarusian road carriers operating in the European Union,
- a ban on the entry of Russian-flagged ships into EU ports,
- in justified and predetermined cases, derogations from these bans are possible, including for the completion of contracts concluded before a specific date, humanitarian purposes, counteracting threats to health and human safety and environment, medical purposes and cybersecurity.

The sanctions introduced by the Member States of the European Union were introduced in order to prevent all Russian vehicles and most Belarusian vehicles from entering the territory of the community, which is associated with the complete inability to carry out any transport activities by organizations from countries aggressing against Ukraine.

At the same time, "counter-sanctions" have been introduced by the parties covered by the sanctions, which basically prevent carriers from the European Union from carrying out transports in Russia and transiting (Transinfo, 2022; Logistykarp, 2022).

Both types of sanctions make transport, both road and rail, from Europe to Central Asia and China virtually impossible to carry out on the two shortest of the three land corridors of the Belt and Road Initiative. This situation puts most carriers that deal with transport to the east at a disadvantage, as it is impossible to carry out direct transports to Russia, and transports to Central Asia and the Far East using road transport generate relatively high costs and may entail certain risks regarding the feasibility of the transport itself or the durability of the goods.

3.3. Possibilities of transport to Central Asia after the Russian aggression against Ukraine

To avoid the sanctions imposed by Russia and Belarus on European carriers, they are forced to use one of the three Belt and Road Initiative transport corridors—the CCAWAEC corridor (China-Middle East, land) China-Central Asia-West Asia Economic Corridor. It will also be necessary to change its route because, in the European part, it will have to run through the southern part of the community—Hungary, Romania, Bulgaria or Greece.

Possible transport routes from the European Union to Central Asia and China are shown in figure 4. The TRACECA map, which contains all road and rail routes in the countries belonging to the project, was used to perform the route analysis. The planned routes assume a varied use of three modes of transport: road, rail and sea, both in separate cases and in integrated intermodal solutions. The assumed starting points of the routes are Romania or Bulgaria. These countries were chosen for the beginning of the route due to their membership in the TRACECA program and geographical location. Both countries are located on the Black Sea, through which alternative transport routes can run, and Bulgaria is adjacent to Turkey, through which all possible land transport routes not leading through Russian territory run. Due to the proposed Asian routes, the proposal of a route from further countries in the community does not fit into the purpose of this article. The end point is understood to be China; however, depending on the exact location of the end point, other transport routes will be proposed. At the same time, the proposed routes are relevant when the destination of the transported goods is in one of the transit or neighboring countries, but only if the neighboring country is not Russia.

The analyzed routes are marked with the following colors: blue, black, brown and green.

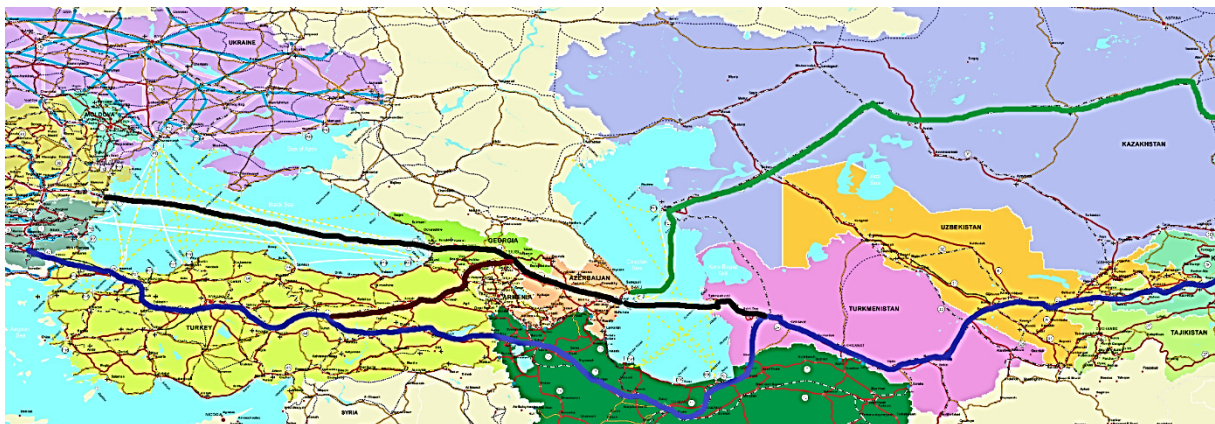


Figure 4. Favorable transport routes from Europe to the east, bypassing Russia.

Source: own study based on TRACECA map.

The blue (land) route passes through Bulgaria, Turkey, Iran, Turkmenistan, Uzbekistan and Kyrgyzstan. It was planned in such a way as to run simultaneously along the road and railway infrastructure, hence the slight extension of the route in Turkmenistan, north of Iran, that can be observed. Running the route further east in Iran would not involve the use of rail and only

road transport would be possible. In a situation where multimodal transport is not used or only road or rail transport is used, this is the most reasonable route from Europe to the East.

The black route (land and sea) starts in Romania or Bulgaria, then leads through the Black Sea basin to Georgia and Armenia, from where goods are transported through the Caspian Sea to Turkmenistan, where the final part of the route coincides with the blue route. From the point of view of the starting point, it is geographically the shortest route while at the same time being the most risky route. This risk results from the course of the route through the Black Sea basin, where military operations in the Russian-Ukrainian war are taking place. While ships not flying the flags of countries directly involved in the conflict should be safe in theory, the possibility of a ship being hit by a stray missile or an undetected naval mine, resulting in cargo and ship losses and potential crew losses, should always be kept in mind.

In the initial stage, the brown route (land and sea) runs the same as the blue route, and in the final stage, it runs with the black route. In Turkey, the route changes from the blue route and heads north towards Armenia, from where the goods are directed to the black route to the Caspian Sea. This route is relatively shorter than the blue route, due to the fact that it is not necessary to circumnavigate the Caspian Sea, but it does not necessarily take less time to cover this route. Due to the need to reload goods in two ports on the Caspian Sea and the sea transport processes themselves, the transport time may be significantly longer. In this case, as in the case of the black and green routes, it should be remembered that the infrastructure and fleet of the Caspian Sea ports significantly differ from European standards, and larger investments have only begun to be implemented in recent years.

The green (land and sea) route is similar to the brown and black routes. Differences emerge in Azerbaijan, from where goods are shipped to Kazakhstan instead of Turkmenistan. At the Kazakh port, the goods are transshipped onto a train or semi-trailer and, depending on the type of transport chosen, the goods move towards Mongolia or northern parts of China.

The routes described and presented in figure 4 do not include total sea transport from Europe to China, India, or Pakistan because the goal of this analysis was to propose routes that land carriers could use without engaging in long-distance sea transport. At the same time, the presented routes show the possibility of transporting goods from Europe to the East, completely avoiding transit through the territories of the Russian Federation, Belarus and Ukraine.

In addition to the indicated routes from Europe to the east, there is also the possibility of transporting goods from the territory of the community through the territory of Belarus and the Russian Federation. This alternative will be presented as a case study.

A company from Krakow (company K) operating in the specialized entertainment industry received a commercial inquiry from a company (company U) operating in the same industry located in Central Asia. The inquiry concerned the delivery of goods imported from Great Britain. Due to the fact that the manufacturer does not deliver its goods directly to Central Asia, the U company, in order to meet the demand and the basis of its activity, placed orders from

another company operating in this industry, which was located in Moscow. After the Russian aggression against Ukraine, the manufacturer ceased any deliveries to stores on Russian territory, which at the same time resulted in the inability to place an order by the U.

Company K expressed interest in a new market and sent the order to Company U. However, due to the relatively small scale of business, Company K does not have its own transport fleet or logistics department and all orders to customers are transported directly by external courier companies, so it was not possible to use one of the alternative transport routes proposed in the article. Also important in this case were the costs of order fulfillment, which should be as low as possible.

In order to carry out the transport of goods while meeting all the assumptions, the U company proposed its own road transport carried out by a Kazakh carrier. Due to the fact that the vehicle and the company of the Kazakh carrier are not registered in the European Union, Russia or Belarus, he was able to perform the agreed transport without major problems and breaking sanctions. The shipment from Krakow was transported to Lithuania by a courier company, from where it went to its destination via Belarus.

In the described case, it was also possible to use the services of a Russian or Belarusian carrier, as Russian and Belarusian sanctions prevent Community carriers from transporting into their territory, but it is possible to reload in a logistics center near the border, from which the goods can be collected by a native carrier for further transport.

4. Discussion

In the turbulent reality of globalization, war, even if it seems to have a local dimension, affects a place many kilometers away from the place of military operations. The countries of Central Asia, which in recent years have benefited from international investments and their presence at the center of global land trade routes, are suddenly indirectly affected by economic sanctions intended to weaken the economy of another country.

Simultaneously, specialized transport companies that deal with the transport of goods to Russia, Belarus, or the Far East are forced to seek alternatives in order to continue doing business.

Despite the presence of sanctions that are aimed at stopping transport beyond the eastern border of the community, this transport can still be carried out using loopholes in the law. Furthermore, alternative routes that do not pass through the territories of warring countries result in longer travel times, but they can also be a long-needed stimulus, stimulating investments in the infrastructure required for efficient logistics service of transportation.

It is recommended to conduct further research on the subject of the impact of the Russo-Ukrainian war on the transport of goods to Asia, excluding air and ocean transport. A significant obstacle in the development of more detailed studies based on economic calculations was the complete lack of willingness to cooperate with transport companies operating from Europe to Central and East Asia. Obtaining and processing numerical data on the quantity, costs and times of transport as well as qualitative data on the opinions of carriers would allow for a deeper research of the problem and a broader description of its effects, as well as finding solutions that could be implemented in practice.

5. Summary

This paper presents the economic corridors of the Belt and Road Initiative and the most important transport routes in Central Asia, along with the Central Asian economic cooperation corridors. The problem, faced by carriers providing transport services east of Europe, resulting from the outbreak of the Russian-Ukrainian war is also described. The issue of economic sanctions imposed on Russia and Belarus and how they affect the transport possibilities from the European Union to Central Asia and China were discussed.

Using a comparative map analysis, alternative transport paths leading from the southeastern borders of the European Union to Central Asia have been presented, with the possibility of further travel to China, which at the same time bypasses the Russian Federation. The presented paths show the possibility of transport using various modes of transport: road, rail, sea and multimodal, and are based on the analysis of maps and infrastructure of the countries through which they lead. The case study presents the situation of a Polish company that wants to sell its goods to the countries of Central Asia but faces the problem of organizing transport, which is caused by the current economic sanctions. The problem of organizing transport in this situation is solved by using the services of a Kazakh carrier, which can move freely through the territory of Russia, Belarus and the European Union because it is not subject to sanctions, thus making it possible to travel through said territories without violating the sanctions.

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INTERACTION OF SCHEMATA AND ROUTINES – THE MISSING LINK BETWEEN THEORY AND PRACTICE OF ORGANIZATIONAL DYNAMICS

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Purpose: identification of effective mechanisms of organizational adaptation under high uncertainty in light of the assumptions of the complexity theory.

Design/methodology/approach: The approach adopted involves literature review, including an interdisciplinary ground of complexity theory.

Findings: The content of the article includes the conceptualization of patterns as schemata at the level of an organization, recognition of the relationship between schemata and organizational routines as an area subject to shaping, and identification of the dynamics of routines depending on the degrees of uncertainty.

Research limitations/implications: The results of the study are presented in the form of theoretical framework enabling further testing.

Originality/value: Conceptualization of the contextual nature of routines depending on the degree of uncertainty as a mechanism of change and stability in the organization.

Keywords: uncertainty, schema, routines, complexity.

Category of the paper: Conceptual paper.

1. Introduction

The contemporary business environment characterized by uncertainty requires an organization to respond adaptively to threats and opportunities arising from extreme, discontinuous and thus unique phenomena. In such circumstances, strategies based on accurate foresight that consist in selecting the right position in a sector or even configuring the right resources fail. The reasons for meeting the necessary conditions for the strategies previously regarded as good are related precisely to the limitations in predicting the future. Foresight is not possible if the future is of undetermined, or open-ended, nature, that is when causes (actions) may lead to the infinite number of effects (results) (Stacey, 1996). Effective foresight is possible when events are in some sense a repetition of those from the past, rather than with regard to

completely new events. The purpose of foresight is to lay the groundwork for reigning over (controlling) the organization's development paths. Foreseeing events makes it possible to competently prepare for them, and even shape what is to happen. In the face of open-ended change (in case of indeterminate future), it is only possible to participate in emerging events and accept their results. Unpredictability, and therefore the lack of possibility of control, reaches intellectual aspects as well, limiting the possibility of rational behavior. Open-endedness naturally leads to anxiety, it touches emotional aspects and, in this sense, causes a lack of rationality (Bratnicki, 2020).

The crises experienced and the resulting uncertainty leads us to reflect on the possibilities of effective organizational adaptation, both in terms of management theory (in particular, strategic management) and business practice. In own studies, whose purpose was to identify effective mechanisms of organization's adaptation under high uncertainty, a relatively new approach in management was used, that is complexity theories.

One of the cognitively attractive aspects of the approach adopted in the author's own study is that it does not make existing knowledge outdated, but rather makes its boundaries explicit (Rokita, Dziubińska 2017; Morin, 2007). These boundaries concern also the carried-out considerations of adaptive mechanisms with regard to organizational dynamics in order and unordered situations. The former ones are based on the body of management literature in its mainstream, whereas the conceptualization of the latter uses the theoretical basis within complex adaptive systems (CAS). These ontologically different states require a fundamentally different approach towards diagnosing phenomena and interventions in the organization.

A significant term within CAS are so-called schemata that have also been used in own considerations of generative mechanisms responsible for organizational adaptation under high uncertainty. Schemas are knowledge structures that organize past and future experience needed to act in the present. It can be said "schemata act as data reduction devices enabling individuals to negotiate a complex and confusing world" (Balogun, Johnson, 2004, p. 525). The term "schemata" refers to the level of individual people, however, it is justified to talk about organizational schemas created when people forming an organization share individual schemata with one another (Bartunek, 1984). Organizational schemas can affect organizations' behavior since they are shared mental representations of what organizations mean in terms of beliefs, values, and attitudes (Harris, 1994; Wood, Stoltz, Van Ness, Taylor, 2018). Routines, which constitute part of the resource theory in management science (Orlikowski, 2000, Feldman, 2004), have been adopted as the manifestation of schemata in the organizational context. Organizational routines are understood here as repetitive, recognizable patterns of interdependent actions carried out by multiple actors (Feldman, Petland, 2003). Schemas and routines are related though not unambiguous concepts (Rerup, Feldman, 2011). Considering both categories makes it possible to obtain better theoretical coherence in the concept of the organization's response to the conditions of uncertainty, and to combine considerations at the theoretical level with specific empirical context.

2. Determinants of order and unordered systems as a context for decision-making

A relatively new and cognitively interesting perspective, especially for the study of phenomena associated with uncertainty, is a relatively new approach in management based on complexity science (Rokita, Dziubińska, 2016). The analysis of the phenomena in this perspective requires distinguishing three different ontologies, i.e., order, complex and chaotic (Axelrod, Cohen 1999; Gell-Mann, 2022). The state of the system referred to as order, refers to a situation in which the relationships between causes and effects are discoverable and empirically verifiable. Consequently, it is possible to create prescriptive and predictive models and to design interventions leading to the assumed purposes. Hence, it follows that understanding the causal relationships that existed in the past behavior of the system makes it possible to define so-called best practice for future behavior. Therefore, it is possible to identify the right or even perfect courses of action. It may also be that due to certain epistemological limitations, the relationships between causes and effects may not be obvious or self-evident. Thus, discovering them may require a more complicated procedure – collecting relevant data, subjecting them to expert analysis and, based on that, selecting measures in line with good practice with well-established experience.

The complex and chaotic state of the system can be referred to as unordered. However, it should be noted here that this does not mean a complete lack of order but rather order of a different nature (Morin 2007). Each attempt to learn about the system simultaneously means its change – each diagnosis is an intervention in which we shape or create patterns (Gell-Mann, 2002). To put it in a more precise way, complex adaptive systems are created by agents that remain in constant interaction. The nature of agents and the amount of interaction mean that the relationships between causes and effects, although they exist, cannot be clearly identified *ex ante* (consistent patterns can be identified retrospectively). The states of the system are not subject to prediction, but their anticipation is possible (McKelvey, Boisot, 2009). Learning about the system consists in sensing current and potential patterns. Intervention is necessary for orientation which patterns may lead to desired results (and which may not). It is an attempt to figure out which patterns are possible in the first place, and, among them, which will be sustainable in a certain time frame.

Even different conditions are created by the situation of chaos in which cause and effect relationships do not exist (in none of the conventional meanings of the notion). It should be noted that due to the natural proclivity towards self-organization, in social systems it is always a transitional period. There is always the potential for order in chaos, although it can be difficult to notice, and even if this potential is recognized, taking action to realize it most frequently entails a great deal of mental strain. However, under conditions of chaos, even a small intervention holds the potential to trigger commensurately large results. The transformation of

a system from a state of chaos to other states can occur in two ways, that is on the basis of an imposed order (a single-point attractor transfers the system into the order domain) or on the basis of conditions that make it possible for patterns to emerge (various possibilities emerge that coevolve to shift the system into a complex state).

With regard to systems created by humans, the basis for operation in the three ontologically different states is summarized by Snowden with the following heuristics (Kurtz, Snowden, 2003):

- order (visible/hidden): sense – categorize/analyze – respond,
- complex: probe – sense – respond,
- chaotic: act – sense – respond.

In order domain, the key issue is appropriate categorization/analysis, which makes it possible to select a proper (grounded in experience) scheme for the current situation – in this sense it can be said that “the model precedes the action” (Boist, McKelvey, 2009; Snowden, Rancati, 2021). In unorder (complex and chaotic) domains the acquisition of valid (in accordance with the adopted criterion) data precedes trial activities, or even taking action with no basis – the action serves as the basis for modification or even creation of new frameworks of reference. A significant boundary runs between the domains of order and unorder, making it possible to distinguish sense-making frameworks and categorization frameworks as a basis for decision-making under uncertainty (Kurtz, Snowden). The difference lies in the nature of the created representations of the system (Plotkin, 1993), or “schemata” understood as descriptions of perceived “regularities” that result in an “effectively complex,” adaptive response of “viable living entities” (Gell-Mann, p. 13).

3. Individual and organizational schemata

Definition of schemata

Schemata are an interdisciplinary category, addressed and studied by researchers from various disciplines. At the individual level, the issue was referred to as behavioral scripts, evaluative rules, decision-making or operating rules, or mental models (Baddeley, 1990). Schemata are also sometimes called (especially interchangeably with mental models) paradigms and cognitive maps (Kuhn, 2009; Huff, 1990). Schemata are, at their essence, complex structures of mental representations (Goldberg, 2011), either innate or acquired through experience and socialization (Zerubavel, 1997). Individuals’ world experiences are understood through them (DiMaggio, 1997; Hunzaker, Valentino, 2019), since they organize the knowledge about the world (Strauss, Quinn, 1997). Schemata (or mental models, evaluative rules, action theory, operational rules) can take a conscious form or be outside the level of

consciousness and be used automatically (either as a result of trained high competences or as highly defensive behavior). Most of these rules are outside the realm of consciousness, therefore conclusions about them are made on the basis of the behaviors observed by the observer.

The importance assigned to events, things and experiences refers to how an agent interprets them, attributing quality, and significance to experiencing them. The perceived sense in the form of patterns is always incomplete to a certain extent, specific examples of the same phenomena may differ from one another, but the agent reads into them sufficient similarity to consider them consistent with recognizable categories (Wittgenstein, 1958). By experiencing patterns, the agents “decide” themselves what they take into account and what they do not (Drew, Vo, Wolfe, 2013). The pattern is a result of own expectations and judgements about what is important (Gell-Mann, 2002) as well as motivation or intent (Dennett, 1996). To put it differently, “it seems that whatever we perceive is organized into patterns for which we the perceivers are largely responsible (...). As perceivers we select from all the stimuli falling on our senses only those which interest us, and our interests are governed by a pattern-making tendency, sometimes called schema. In a chaos of shifting impressions each of us constructs a stable world in which objects have recognizable shapes, are located in depth and have permanence (...). As time goes on and the experience builds up, we make greater investments in our systems of labels. So, a conservative bias is built in. It gives us confidence” (Douglas, 1966, as cited in Snowden, 2005, p. 6). In the broadest terms, schemata are the ways in which we make sense of the world that surrounds us, by interpreting and assigning sense to events and by selecting and evaluating information.

Schemata (behavioral scripts) are expressed in the form of decision making or operational rules, which in turn transform the sense extracted from information into actions. Therefore, agents’ schemas are composed of structures of rules that individuals refer to when making a choice. An agent can make two types of choice: evaluation, i.e., choice and information interpretation, and operation, i.e., acting on the basis of the sense of this information. Within the framework of the agent’s structure Stacey enumerates occurring simultaneously, although in opposition to each other (paradoxes), key features, such as inspiration and anxiety; conformity and individualism, leadership and followership; participating and observing (Stacey, 1996, pp. 34-35)¹. Agents’ schemas contain rules referring not only to what has already happened but also to what could have happened – formulation of expectations and making forecasts (Stacey, 1996, p. 32). Schemas responsible for operation include rules that are shared with other agents.

Schemata are embedded in individual cognitive structures, however, inside the organization collective processes of socialization and information exchange take place in which the sense is shared. Therefore, it is justified to talk about shared meaning schemas, since they

¹ Schemas can be individual (change through learning) and shared (evolve through interaction and dialogue); reactive and anticipatory (Stacey, 1996, p. 33).

simultaneously reside in individuals as a cognitive trait and the collective as reference frames (Wood et al., 2018). Collectively, the process of interaction between agents inevitably leads to interpretation to be shared, fostering the creation of systems of meaning. Each action undertaken by the agent impacts on other agents inducing them to respond and thus causing feedback effect on the agent. This process is both social, because it operates in groups, and cognitive and affective, occurring reflexively from the sense-making reality. Schemas can be shared in the form of bureaucracy rules or expressed as shared culture of the entire organization or a group being part of it. Valid and timely schemas economize on agent and organization scarce resources.

Organizational schemas: espoused and enacted

Organizational schemas have been mainly studied as cognitive ideas created to define reality and thus set a common ground for organization members to operate on. When studying the relationship between organizational schemas and routines, Rerup and Feldman (2011, p. 578) defined organizational schemata as shared assumptions (Balogun, Johnson, 2004), values (Gioia, Thomas, Clark, Chittipeddi, 1994), and frames of reference (Bartunek, 1984) that give meaning to everyday activities and guide how organization members think and act (Elsbach, Barr, Hargadon, 2005). As can be seen from this definition, two dimensions of schemata are distinguished, i.e., espoused and enacted. Although the dimensions remain in inseparable interaction the enacted schemata may coincide to varying degrees with the intents embedded in the espoused schemata (Mintzberg, Watres, 1985), what is more, changes in one do not have to translate into changes in the other. Other terms for espoused interpretative schema are “in-progress frame of reference (Isabella, 1990, p. 17), “initial schema” (Labianca, Grey, Barss, 2000, p. 240) and “new (expected)” schemata (Balogun, Johnson, 2004, p. 544). Schemata are articulated (revealed) by managers especially in problematic situations or in the face of challenges. Enacted schemas are expressed through observable actions and this “enacting” of events or structures (Weick, 2001) is their “bringing into existence and setting in motion” (Rerup, Feldman, 2011, p. 579). They constitute the transformation of intents into patterns of enacted cognition and actions. Enactment of schemas leads to their adaptation (Maitlis, Sonenshein, 2010), actions can also be conditioned by schemas and can lead to their revision. Hence, to date, the relationship between espoused and enacted schemata has been studied from two distinct perspectives. The first emerged from the problem of actions (Bartunek, 1984; Labianca et al., 2000), and the other from so-called sense-giving, i.e., “the process of attempting to influence the sensemaking and meaning construction of others toward a preferred redefinition of organizational reality” (Gioia, Chittipeddi, 1991, p. 442, as cited in Rerup, Feldman, 2011, p. 579).

4. Routines as observable manifestation of schemas in an organization

In the research on organizational dynamics organizational schemata were linked to routines (Balogun, Johnson, 2005; Rerup, Feldman, 2011). The introduction of the term organizational routines to the literature is attributed to Stene who regarded them as basic mechanisms for achieving organizational intents (Stene, 1940, p. 1129). Since then, the research on routines have resulted in various metaphors, such as individual habits; programs, heuristics or scripts, or genes of the organization (Feldman, Pentland, 2003). Cognitive effectiveness and complexity reduction were attributed to organizational routines (March, Simon, 1958; Simon, 1981; Cohen, Bacdayan, 1994). Routines were also defined as a result of organizational learning in the adaptation process of the organization and environment (Argote, 2013). Flexible use of routines is the core of improving organizational task execution (Canales, 2011; Howard-Grenville, 2005; Turner, Rindova, 2012), and their use is inherently grounded on action, surprise and creativity. Routines account for both organizational change and stability (Feldman, Pentland, 2003). They are recognizable patterns, but at the same time they constitute part of messy, unpredictable situated actions “for an established routine, the natural fluctuation of its surrounding environment guarantees that each performance is different, and yet, ... it is ‘the same’ (Cohen, 2007, p. 782).

Complex dynamics of routines results from a generative mechanism that consists in the interaction of two of their aspects, i.e., the ostensive and the performative (Feldman, Pentland, 2003; Pentland, Feldman 2005). The ostensive aspect is an abstract, generalized idea of routine. The ostensive aspect may take a codified form of standard procedure or exist as an unquestioned, taken for granted standard. The ostensive aspect may also contain a significant tacit component embedded in the procedural knowledge (Cohen, Bacdayan, 1994). However, it is worth noting that it also contains subjective understanding of various participants, which, as each social resource, is unequally available (Berger, Luckmann, 1996). Feldman and Pentland conceptualize it on the basis of the “ostensive definition,” according to which the said ostensive is constituted of specific instantiations that observers or participants experience as belonging together (Latour, 1984; Wittgenstein, 1958). The sense embedded in ostensive patterns is of emergent nature and depends on the point of view of those who experience/participate in action. Therefore, there are many ostensive aspects, they are diverse and none of the routines is a single entity (Pentland, Feldman, 2005, p. 797). The performative aspect consists of actions in the particular context of the people undertaking them, at a specific time and place. To describe the ways in which participants construct routines of potential opportunities, Pentland and Reuter (1994) use the term “effortful accomplishments”. Even in the case of thoughtless, habitual actions under highly constrictive conditions, participants perform self-evaluative reflection (Giddens, 1984). Then an interpretation of actions to make sense of what people are doing takes place and although choices about how to proceed may

seem automatic or thoughtless, there is always the possibility of resisting expectations and acting differently (Giddens, 1984; Orlikowski, 2000).

Taking into consideration these two dimensions of routines is not by its nature new and is, for example, analogous to the division between “know how” (ostensive part) and “know that” (performative part) (Ryle, 2000). The ostensive aspect in the language of the theory of practice (Giddens, 1984; Bourdieu, 1995) is the structure of routine, whereas agency lies in the performative dimension. Their interaction is a necessary internal condition for routine to exist, although routines are open systems and are also influenced by external tensions (MacIntyre, 2007), including crises (Gersick, Hackman, 1990). Taking into consideration both aspects of routines simultaneously (as opposed to obscuring one of them) helps to better understand the nature of dynamics - the transition of organizations between various states (ordered - complex - chaotic) - the play between stability and change.

5. Interaction between schemas and routines

Interactions Both organizational schemata and routines are referred to as abstract patterns of an emergent nature that arise through actions. There is constitutive feedback between the espoused and enacted aspects of a schema. As in the case of routines, the performative aspects create and recreate the ostensive aspects which then constrain and enable the performative aspects. These primary, generative mechanisms are open, which makes their (co)evolution possible. This openness also provides a link between schemas and routines. Rerup and Feldman set schemata and routines in the “realm of action” (Barley, 1986) and indicate how observable actions associate the ostensive aspects of routine with enacted organizational schemata (Rerup, Feldman, 2011) - figure 1. At the same time, the authors point out two basic differences between schemata and routines, which they locate at different levels of analysis. Ostensive patterns of routines are constituted by actions aimed at specific tasks, in relation to which the routine (or part of it) was constructed. On the other hand, enacted patterns of organizational schemas are formed by many different types of actions that take place in the organization, including those that form a pattern of routines (Rerup, Feldman, 2011, p. 580).

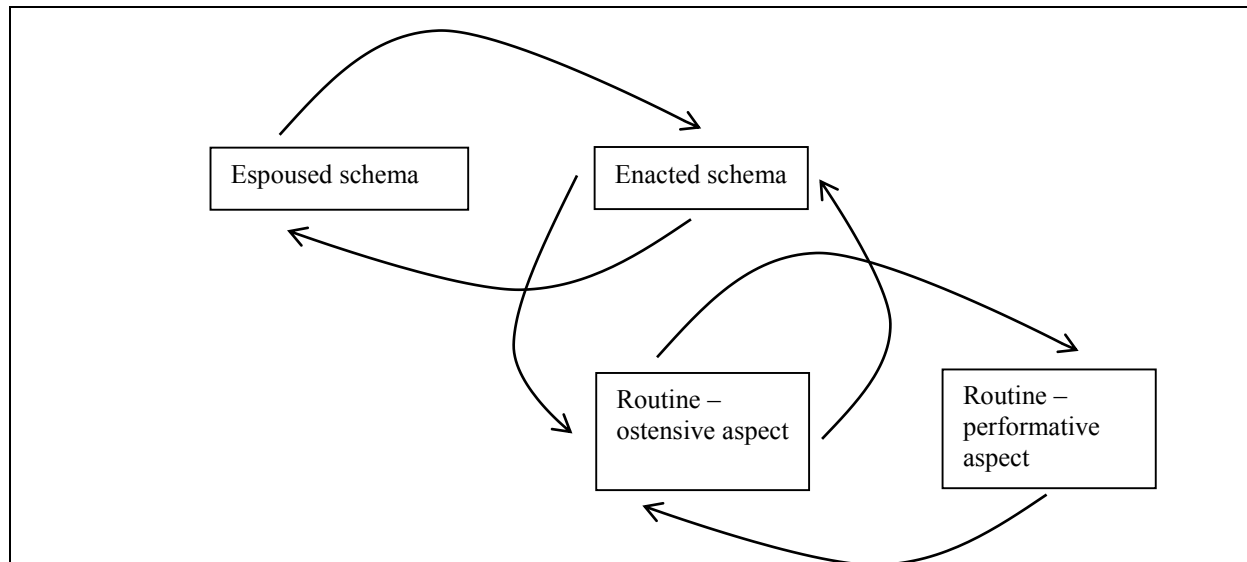


Figure 1. Relationship between endogenous generative mechanisms of organizational schemata and organizational routines.

Source: Own elaboration based on Rerup, Feldman, 2011.

To put it another way, ostensive patterns are formed through actions aimed at achieving specific tasks, therefore they operate at the level of routines. On the other hand, patterns of schemata are formed by all the actions undertaken by members of the organization (some actions are part of routines while others are not) - schemata operate at the level of the organization. It can be said that routines and schemata belong to orders of different degrees. It is worth noting that this is a different view from the concept of “metaroutines”, which served as the theoretical basis for the description of dynamic competences (Teece, Pisano, 1994). Schemas are of universal nature and can form relationships with diverse specialized routines.

Grasping the relationship between schemata and routines sets a theoretical bridge between the mechanisms of organizational learning from practical execution of day-to-day tasks and how strategic directions for organizational development are established. Understanding this relationship provides greater insight into how practical actions co-evolve with strategic intents, conditioning the trajectory of organizational development. It appears that the relationship should be “appropriately complex”. Too much independence of schemata and routines can lead to fantasies and, consequently, create unrealistic expectations. Too close relationship between schemas and routines can constrain abstract thinking, link too tightly to the current context and, consequently, lead to a lack of adaptive vision.

6. Plasticity of routines – the importance of context

There is always an element of uncertainty in routines. Schemata (rules) constitute resources for actions, but they never fully determine them (Giddens, 1984). Even with highly bureaucratic

generalized routines (Merton, 1940; Webber, 1947) an “open area” always remains to some extent so that the routine can be implemented. There are not enough rules to fully determine the behavior pattern, since interpretation of any rules (or any part of rules) requires further rules (Wittgenstein, 1958, as cited in Feldman, Pentland, 2003, p. 101). In this sense, the meaning attributed to routine, the ostensive aspect of routine, becomes definitive only when it is implemented in practical action. The performative dimension also always remains open to a certain extent. Practice by its very nature contains a component of improvisation (Bourdieu, 1977, 1990). Although practice is undertaken on the basis of a set of rules (schemas) and expectations, the specific course of action undertaken is always different to a certain extent. Some variation can be expected even if the procedures implemented are described in detail in the form of expected sequences of steps (Victor, Boynton, Stephens-Jahng, 2000; Nelson, Winter, 1982).

Referring to the posed objective of considerations, it should be noted that concentrating attention on the interaction mechanisms of the abstract and contextual dimensions of patterns (mutually constituting thinking and action processes) is crucial under high uncertainty, and this is where the key resources for organizational dynamics are found. When referring to routine derived from the theory of practice of a metaphor of co-creating structure and agency (Giddens, 1984; Bourdieu, 1995), Feldman and Pentland identify the abstract idea of routine with the structure, and their second part containing specific action in a specific context with agency (Feldman, Pentland, 2003, pp. 95, 98-99). Depending on the level of uncertainty, these dimensions play distinct roles. Ordinary conditions for the operation of organizations (ordered systems) justify reliance on past experience - it is possible to transfer patterns from the past to future situations (as opposed to complex systems when patterns become coherent only ex-post). Then the abstract dimension of routines (structural) has a stabilizing potential, whereas the performative (agentive) one is a source of potential differentiation, and thus is responsible for change (it drives evolution). This is the image of routines that is most frequently seen in the literature. Even if they were described as a component of organizational learning (Levitt, March, 1988; March, 1991), they served mainly as a repository of knowledge - organizational memory (Huber, 1991). Possible changes were rather caused by external pressure to improve performance (e.g., pressure from other units to improve quality), whilst more attention was paid to their structural dimension. In this view, routines were conceptualized as a source of stability, or even organizational rigidity (as responsible for inertia, mindlessness, demotivation, deskilling or competence traps), mainly due to parts of unconscious routine behavior (e.g., Hannan, Freeman, 1983; March, 1991). This stabilizing role of routines contributed to the development of an evolutionary metaphor where they were compared to genes or the DNA of an organization (e.g., Baum, Singh, 1994; Aldich, 1999; Durand, 2006).

More dynamic conditions make stable rules more unreliable in controlling (predicting behavior) the system and may even be counterproductive (intended actions result in unintended outcomes). Under complex conditions, the emphasis is shifted from the structural dimension to

agency (and subjectivity and power associated with it). Human as an agent is embedded simultaneously in three time dimensions - acting in the present remembers the past and can imagine the future (Emirbayers, Mische, 1998, p. 963). Acting within the framework of organizational routines is grounded on “reenacting the past, [but] the performance of routines can also involve adapting to context that require either idiosyncratic or ongoing changes and reflecting on the meaning of actions for future realities. Whole organizational routines are commonly portrayed as promoting cognitive efficiency, they also entail self-reflective and other-reflective behavior” (Feldman, Petland, 2003, p. 95). Under conditions of complexity (and therefore higher uncertainty) the abstract and performative dimensions of routines (structure and agency) enter a more dynamic and coevolutionary interaction.

In the situation of deep crisis (chaos) cause and effect relationships are invisible, hence there is no basis for relying on past experiences (coherent patterns are not discernible either ante or ex post). The way to discover sense is to act and only on that basis attempt to understand reality - act-sense-respond (as opposed to sense-analyze/categorize-respond and probe-sense-respond) - each action in search of a diagnosis is an intervention and each intervention is a diagnosis (Kurtz, Snowden 2003). The new order that emerges may require a major reconstruction of the structure (changing patterns). Therefore, it seems reasonable to believe that in an extraordinary situation (in relation to ordinary conditions) the role of the dimensions becomes reversed. Now it is in the performative dimension that the continuity potential lies. Changing the structural dimension (routine) makes it possible to preserve identity. It can be said that the change goes deeper and encompasses a second-order level, and thus organizational schemata.

Summing up, when under lower uncertainty, in which it is possible to base actions on accumulated experience, the ostensive dimension of routine acts as a source of organizational stability. Deviations from existing (best or good) practices lie in practice – in the performative dimension. Under uncertainty, basing on the accumulated experience in the above-mentioned manner is not possible. The greater the uncertainty, the more novelty the system’s response requires. The stabilizing role of dimensions of routine - ostensive and performative - is reversed. The above can be summed up in the following way:

Proposal: Under high uncertainty, maintaining the organization’s identity requires searching for new schemata that can provide an effective basis for action, hence the ostensive aspect of routine requires change, whereas the potential for continuity lies in the performative aspect of routine.

Survival of an organization under high uncertainty, most frequently associated with a crisis, requires searching for different, creative ways of executing activities. The preservation of continuity (the organization’s identity) lies in symbols, rituals adapted to the new conditions of action practice.

7. Summary

The article addresses the issue of adaptation mechanisms of organizations. In the subject literature, the issue has mainly been addressed in relation to organization operating under relatively stable conditions, because they make it possible to “transfer” patterns established on the basis of past experience into the future. The challenges arising from high uncertainty that have currently dominated the organization’s practice also lead to a critical reflection on the existing strategic management theory. A cognitively attractive perspective in this regard is provided by complexity theories. This is because one of principle properties of CAS is their unpredictability in the sense assumed on the grounds of classical science (Rokita, Dziubińska, 2017). This does not mean that these systems do not subject themselves to cognition, but that it requires a different approach. Referring to the key concept in the field of studies of CAS, i.e., patterns, made it possible to translate the interdisciplinary theory of CAS into the level of organizational management theory. In particular:

- conceptualization of patterns as schemata at the level of an organization,
- recognition of the (cause-and-effect) relationships between organizational schemata and routines as areas subject to shaping; and
- identification of paradoxical dynamics of routines depending on degrees of uncertainty formed a conception through which an attempt was made to successfully address the dilemma of searching for speculative ways to improve organizational performance and adherence to rigorous standards of scholarship (March, Sutton, 1997, p. 698). This postulate does not only apply to the domain of theory, since a better understanding of the mechanisms of organizational adaptation under high uncertainty is currently an equally urgent challenge for researchers and management practitioners.

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MANAGING RELATIONS WITH CUSTOMERS IN THE VIDEO GAME INDUSTRY

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Purpose: The main goal of the paper is to analyze customers relation between video game developers and the gaming community and their impact on the corporate image creation as well as gaining trust and good reputation by the company.

Design/methodology/approach: The approach applied in the paper is of descriptive-empirical nature. The research methods involved in this paper are: induction, deduction, literature studies, as well survey and data analysis. The method of critical and comparative analysis was used in relation to the views presented in the literature.

Findings: The paper ends with a brief presentation of research findings which correspond to the formulated research questions on building the relations with a client.

Research implications: Future research directions should focus on further, expanded research exploration in the area, taking into account various industries. Additional work is needed to disseminate research findings among managers and to implement them in public relations policies of the companies.

Practical implications: The results of the research discussed in the paper have a number of practical implications mainly for the managers in terms of use of customers relations tools and improvement of communication strategies.

Social implications: Building awareness of customer to business communication.

Originality/value The paper has a cognitive value for managers. Results have theoretical as well as practical implications in search of solutions to customers relations management.

Keywords: relations management, corporate identity, brand image.

Category of the paper: research paper.

1. Introduction

The paper constitutes theoretical and empirical study relating to selected aspects of customers relations in organizations on the example of selected companies. The paper was divided into two major parts: theoretical and empirical. The theoretical part completed the theoretical goal which was the review of the literature on corporate identity and brand image.

The second part of the paper is of empirical nature. In this part, the author performed the cognitive goal which was the identification and analysis of major factors which influence the customer to business communication and its impact on the perception of the company. For this goal the survey method was involved. It was carried out in two selected companies. The first company was CD Project Red and the other was Blizzard Entertainment.

The following research questions were formulated in the paper:

- How video game companies shape their public image and what are the results of that?
- What are the main differences between CD Projekt RED and Blizzard Entertainment and how their marketing decisions influence the relationships with fans?
- How PR crisis can change the perception of the firm?
- How consumers express their own opinion on video game companies using the internet and social media?
- How can video game developers improve their image and regain lost trust?

The paper attempts to find responses to the above questions.

2. Justifying the topic

The essential topic of the paper focuses on marketing and public relations in the video game industry which support shaping and maintaining complex relationship between a company and consumers and more specifically between a video game developer and the gaming community. Communication plays significant role for both parties and allows for constant growth of the brand as well as improvement of offered products. However the quality of communication depends on the public's perception of the company (Clavio, Kraft, Pedersen, 2009). The consumers often require an assurance that they can trust the developer and that their opinions matter. If they obtain that assurance they are more likely to actively engage with the fan community and become loyal customers (Costa-Sánchez, Fontela Baró, 2019). The corporate image of a video game developer is constructed through previous experiences with the company, released games, the firm's behaviour and actions as well as the controversies that took place in the past. These elements are very important for the average player and based on them. He or she decides if it is good to interact with the company, buy its games and participate in its community. For this reason the developers should be able to effectively manage marketing in order to create a certain image that is attractive for the consumers as well as public relations to maintain it.

The video game industry is very rapidly becoming one of the most important parts of the mainstream entertainment. At the moment it is bigger than the movie and sports industries combined (Williams, 2020). It is important to analyse it further and define its characteristics in order to properly navigate the environment and detect opportunities. Ability to create a strong

communication link with the gaming community is exceptionally important for new companies which want to stand out on the market. The developers have to be aware of the influence of social media and the internet on how they are perceived by the public. It can be particularly useful in case of a PR crisis.

In order to properly discuss and analyse the topic the author chose two video game developers namely CD Projekt RED and Blizzard Entertainment. The public image of both entities and their relationships with consumers are quite specific and worth observing. The conducted research allows to find certain similarities and differences between them as well as better explains the video game industry and indicates what should be taken into account when building a relationship with the customer.

3. Remarks on customers relations management

Maintaining a positive relationship with the client is exceedingly important for modern marketing. For this reason the customer relationship management is quickly becoming a business philosophy which is desirable or even essential in every company (Ehling, White, Grunig, 2013). It can be defined in many ways however Kotler and Armstrong characterize it as a comprehensive process of building and maintaining mutually beneficial relationship with the client (Kotler, Armstrong, 2013). The key to building lasting relationships with consumers is to generate for them value that is higher than others and ensure their satisfaction. If customers are satisfied it is more likely that they will be loyal and that they will want to make most of their purchases from the same company (Lambert, 2010). In modern times it can be objectively difficult to stand out from the competition because of the large selection of products. The customer buys from the company that offers the highest perceived value (i.e. the difference between all the benefits and the costs of the offer, compared to the offer of the competition). Most of the time clients also do not assess value and costs precisely. Their opinion is usually subjective. Additionally, people perceive value differently and can have different priorities when buying a product. An important element is also client satisfaction. It depends on how the customer perceives the usefulness or performance of the product in relation to his/her expectations. If the product does not meet the expectations in terms of usability the customer will be dissatisfied. If the expectations are met the customer will be satisfied. If the usefulness of the purchased product (or service) exceeds the customer's expectations, he/she will be delighted (Kumar, Reinartz, 2018).

Modern technologies allow for better communication with consumers and help create a platform for building closer relationships. They also provide customers with a power to find necessary information and control the situation themselves. This results in a “customer-managed relationship” which can be defined as a marketing relationship in which customers,

using modern digital technologies, interact with companies and other customers in order to shape a relationship with the brand (Mazurek, Tkaczyk, 2016). Marketing by intrusion no longer seems to work. Instead marketers need to find the way to attract the consumers and encourage them to interact of their own volition (Lin, 2010). A dialog with consumers through social media becomes a common practice (Burger-Helmchen, 2014). However it is not a simple task because of different factors such as cultural differences or an existence of internet culture (Ek, Sörhammar, 2022). A person who is responsible for social media in the company must be well informed in order to not offend anyone or be publicly ridiculed (Burger-Helmchen, 2014).

Kotler and Armstrong paid attention to the existence of consumer-generated marketing (CGM). They define it as a discussion on a given brand that is conducted by the consumers themselves. It takes place at the invitation of the company or on the initiative of the clients themselves (Kotler, Armstrong, 2013). Thus, they play an increasingly important role in creating their own brand experience and the experiences of other customers. Authors reach the conclusion that consumer-generated marketing has become a vital marketing power. Consumers now have the opportunity to influence the company and help in development of the brands. Their opinions also matter more and are more informed (Kotler, Armstrong, 2013).

Another concept which deserves some remarks here refers to corporate identity and brand image. In order to properly discuss and analyze the topic of corporate identity and brand image, it is vital to define an “image”, “identity”, and “reputation”. (Figure 1). Davis describes an ‘image’ as a complex intellectual or sensory interpretation, the way a person perceives someone or something; the product of the mind resulting from deduction based on available premises, both real and imagined, conditioned by impressions, beliefs, ideas and emotions (Davis, Dąbkowski, 2007). An image of the company differs from its identity because identity is a set of attributes and values presented by the firm. In other words, corporate identity depends on internal decisions of the company and corporate image is the way other people perceive the firm. Image and reputation are often confused with each other, however, the foundation of corporate reputation are experiences with the firm, whereas corporate image does not require them. These experiences can be direct (during the process of buying a product or service) and indirect (when others are sharing their own direct experiences).

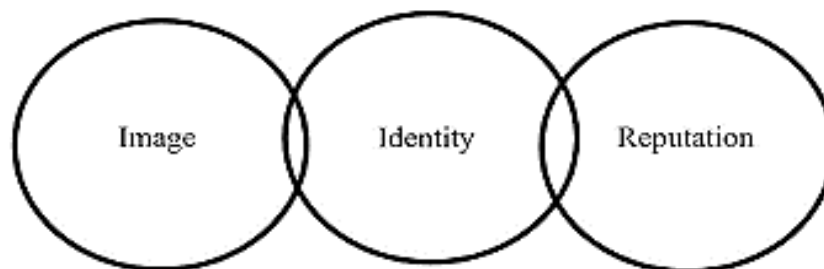


Figure 1. Image, identity and reputation relation.

Adapted from: Own study based on Davis A.E, Dąbkowski G. (2007). *Public relations*, Polskie Wydawnictwo Ekonomiczne, Warszawa, p. 52.

Corporate identity consists of three artifacts which build the system: linguistic (slogans, abbreviations, expressions understood only by members of the organization), behavioral (corporate celebrations, rituals, superstitions, etc.), and physical (logo, slogan, colors, vehicle markings, work clothes, etc.). These elements build the corporate identity and present some kind of vision to the consumers (Wood, Somerville, 2013). In the public relations process, the identity of the company is an element that connects internal and external PR. Its main purpose is to define the mission of a given institution, i.e. the goals and principles of its operation, the function it wants to perform in its environment, and the values on which it is based. For comparison, the reputation of any enterprise will always depend primarily on the quality of its operations and the products and services provided. A powerful brand with positive reputation, image, and strong identity is associated with high brand value (Black, 2013).

Cooperating with media is another aspect of the topic which is worth mentioning here. By cooperating with media, companies gain a powerful ally that can help in many situations and improve their image (Meech, 2006). As an example, they can be serviceable during a time of crisis when there is a need for an outlet to tell the firm's side of the story. Building a strong relationship with journalists can be essential, especially in some industries. The ability to provide information and commentary to a larger group of people is very important for companies and media can help with it. The development of digital media also opened many doors for public relations specialists (Wesley, Barczak, 2016). In modern times, they are able to build relationships not only with traditional journalists but also with bloggers, YouTubers, and other types of influencers and consequently, reach a younger audience and encourage them to take an interest in their products (Raab, Ajami, Goddard, 2016). Positive or neutral mentions about the company placed in popular and at the same time specialized blogs give the company's website a strong position in the search engine. They also expand the brand's audience with the community gathered around a given person (Goltz, Franks, Goltz, 2015). Social media also helps build personal relationships and allows to stay in touch – journalists keep their blogs or post on Twitter. Engaging in a conversation on these channels, as well as knowing about current texts or broadcasts produced by a given journalist helps to keep the relationship going (Mathews, Wearn, 2016).

Black argues that the trust of media representatives should be earned whenever possible (Black, 2013). Public relations should never create a barrier between the media and the institution; rather it should always try to be a bridge over which news and information can move freely in both directions. Working with media should be based on mutual respect as to not provide false information or slander anyone. Otherwise the reputation of the company and the journalist may deteriorate rapidly (Ruggill, McAllister, Nichols, Kaufman, 2016). The main requirement when working with media is to provide them with what they need in a convenient form and at the right time (Spaulding, 2016). The primary methods are still face-to-face contact, press releases, press conferences and the use of press agencies however it becomes increasingly popular that journalists directly address company representatives by e-mail or via social media. It all depends on how important and influential the information is (Theaker, 2020).

4. Marketing versus public relations

Despite the fact that many companies integrate public relations into marketing those two concepts are very different from each other and must be approached separately. The Chartered Institute of Marketing (CIM) defines marketing in the following way: “The management process responsible for identifying, anticipating and satisfying customer requirements profitably” (Chartered Institute of Public Relations, 2022). It is a discipline that focuses on discovering what are the customers’ wants and needs and properly advertising the products. This includes: following and analyzing the current trends, providing the right value to customers, promoting products, services, and company’s actions, maintaining a stable relationship with clients, as well as attracting new ones. The four main pillars of marketing (“Four Ps”) are product, price, place, and promotion (Wang, 2022). Strictly speaking, they cover what is sold, for how much, where and in what way, together with different means of promotion. These four elements must all be taken into account when formulating and implementing the company’s marketing strategies (Zackariasson, Wilson, 2012).

On the other hand Chartered Institute of Public Relations (CIPR) defines public relations as “the planned and sustained effort to establish and maintain goodwill and mutual understanding between an organization and its publics.” It manages the ways in which the information about the company is presented to the public and attempts to portray the firm in a certain way in order to improve its image. Public relations also means a close communication with customers which builds a lasting relationship (Zhang, 2011). In case of crisis public relations is responsible for informing the press and the public about the situation, as well as the damage control (Davis, Dąbkowski, 2007).

These two concepts indeed have certain common characteristics however they operate in a different way and have a different goal. In Public relations, Sam Black draws a clear distinction between the marketing and public relations and claims that the scope of public relations activities is much wider than the one of marketing as it includes parliamentary lobbying, internal relations with employees, contacts with local communities, crisis management, corporate social responsibility, dealing with environmental issues, and overall involvement in corporate strategy and planning (Vong, Wong, 2013). There is a fundamental difference between marketing and PR: marketing works only in the line function and public relations is irreplaceable in the staff function (advising), in other words: in a thriving enterprise marketing is a tactic, public relations is a strategy (Seitel, 2017). The basic difference between PR and marketing lies in the scope of responsibility and the possibilities of both specializations: marketing is sometimes identified with or relates primarily to human economic activity, while public relations has an impact and concerns all forms of his social life (Ehling, White, Grunig, 2013).

Despite the clear differences between the two concepts, there are also certain similarities. Black lists four steps in the process of exchange between institutions and customers. Both marketing and public relations play an important role in these processes (Black, 2013):

1. Attempting to understand the other party participating in the exchange.
2. Creating value as an element received by other parties.
3. Exchanging views on the value of products or services so that both sides agree on the value.
4. Provision of goods or services through an actual, physical transaction between parties.

Public relations also has been found to be the source of marketing benefits according to many entrepreneurs. There are certain arguments that confirm this claim (Theaker, 2020):

- the battle on the market is for perception, not for products,
- a good, clear image is conducive to recognizability and individualization of enterprises,
- image transfer and the halo effect are transferred to opinions about products and the entire company's offer,
- the indicative function is a quality criterion,
- better opinion about the company means trust in new products,
- PR can participate in the implementation of product marketing strategies,
- PR answers buyers' questions about who is behind the offered products,
- PR responds to the growing demands of consumers for in-depth information about goods,
- the behavior and attitude of consumers towards the enterprises and their products is largely influenced by the environment and the audience.

5. Selected survey results

5.1. Introduction

The survey was carried out on a research sample of 157 participants and its goal was to determine the intricacies of a relationship between video game companies and consumers. The presented survey is primarily focused on the complex relationship between video game developers and their fans, as well as the gaming community in general. Companies that are able to establish a strong connection between them and their customers and ensure favorable conditions for the creation of a large, productive fan community, often gain a powerful tool which can be used in marketing, advertising, public relations, etc. However the video game industry which is inextricably linked with entertainment is characterized by an exceptional importance and at the same time, fragility of public image. Most video game companies, especially those of considerable size and influence, had multiple experiences with

controversies, scandals, and other types of PR crisis. This, in turn, harms the relationship between the company and its community often irreversibly damaging its public image. The survey aims to discover in detail how this interdependence of a company and consumer in the video game industry operates and how gaming community perceives video game developers, in particular CD Projekt RED and Blizzard Entertainment. The set of questions regarding this topic was sent to different groups of people, most of which are interested in video games. It can be inferred from the following question: Indicate how much games are part of your life from 1 (I play rarely) – 5 (I play every day), which was presented in Figure 2.

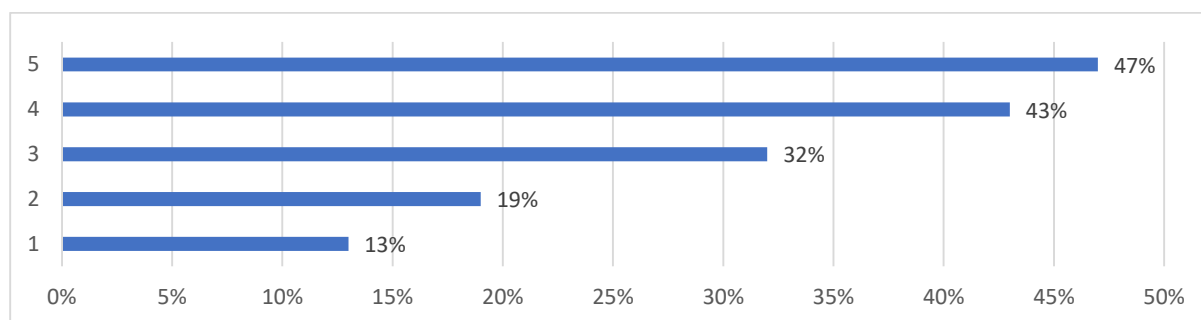


Figure 2. Importance of games in respondent's life.

Source: own study.

According to the demographic questions included in the survey, 57,8% of the respondents are male and 42,2% are female. The majority of people answering the questions (79%) were also in the age range 18-26.

The level of education among respondents varied with 57,1% of people with secondary education and 38,3% with higher education. It can be concluded from this data that a large part of respondents is quite young but mostly of age, probably before or in the process of obtaining an academic degree.

This unit has been divided into four sections. Section one includes the description and analysis of the relationship between video game developers and the gaming community. Section two examines the consumers' approach to PR crisis and responses of companies. The last two sections study the answers to the questions regarding the developers CD Projekt RED and Blizzard Entertainment and how people perceive them.

5.2. The relationship with the gaming community

The gaming community is characterized by the ability to create strong bonds between its members. Players are connected with each other through common hobby and become emotionally invested in their own fan groups. They create content which is tied to the certain video games. Eventually, they gain the ability to influence the smaller and bigger decisions made by video game developers and become important advisers and reviewers who constantly aim to ensure the best possible functioning of their favorite games. Usually, one of the most important goals for companies is to keep the community strong and engaged which can bring

many long-term benefits. The individual members can participate in different ways and bring their own worth. The conducted survey aimed to discover where people usually place themselves in the gaming community and if they are usually more active or passive. Respondents were asked a following question: To what extent are you involved in the gaming community? The responses are presented in Figure 3.

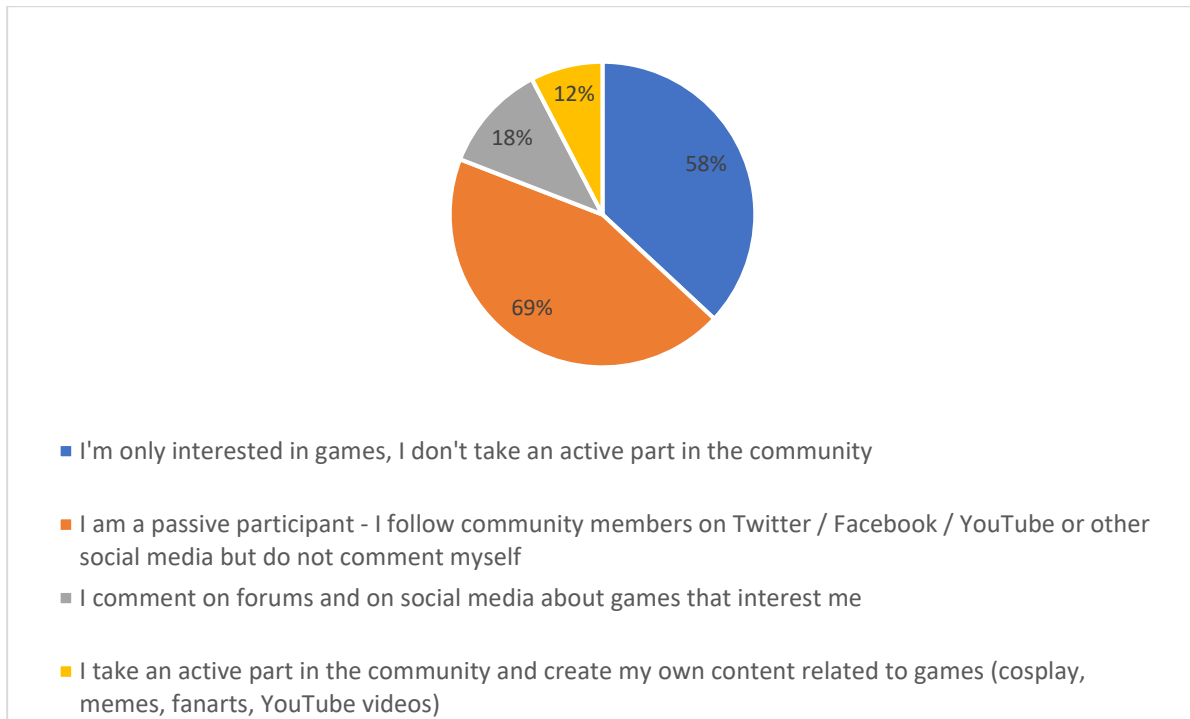


Figure 3. Involvement in gaming community.

Source: own study.

Despite the significant number of people not taking an active part in the community, there is a smaller group who speaks up and creates content. This percentage is the most influential as it is the most visible. The entire community is also judged based on their actions. Therefore, video game developers should maintain the closest relationship with this group and keep them as content as possible. However, the part of the community, the so-called silent majority, should not be ignored as they are the ones who can provide high sales.

Social media are a very important tool in marketing and public relations. They provide new ways to connect with consumers, build a fan/customer community, and attract more attention to the product. The public image of the company is also often dependent on their activity on the internet. According to the carried out survey, over than half of respondents (54%) follow the official social media of video game developers. Therefore, it can be concluded that a significant percentage of consumers wants to see the activity of companies on social media. Moreover, 32,9% of respondents declared that they pay attention to the individual/personal social media accounts of people working in the company. It means that not only main social media accounts of video game developers are important for their public image but also individual accounts of

employees. Improper behavior of one of the workers can negatively influence the perception of the entire firm as it is the company that is blamed for enabling and tolerating his or her actions.

There are multiple reasons for consumers following social media accounts of video game developers (Figure 4). The next question was: “For what purpose do you follow the social media of video game developers?” and respondents were able to choose multiple answers, answering in the following way:

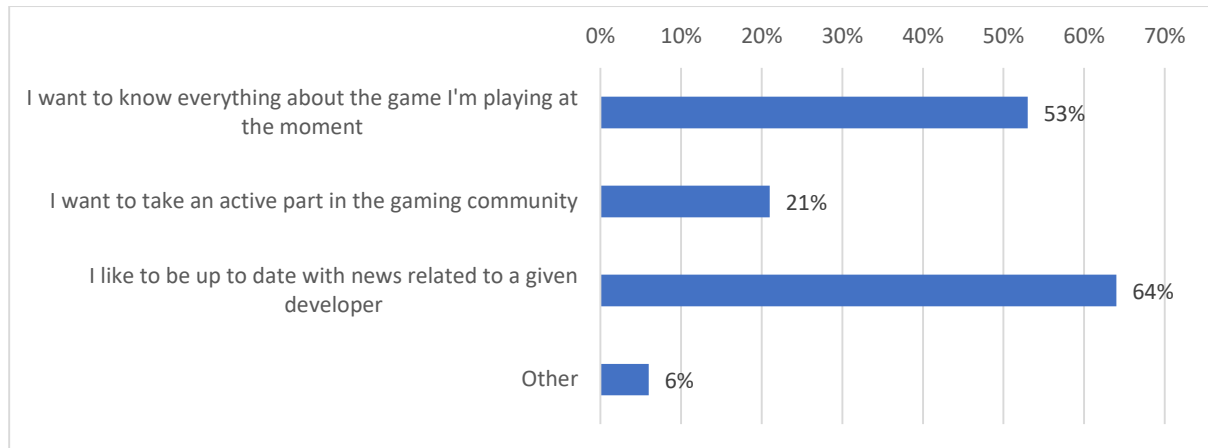


Figure 4. Purposes to follow social media of game developers.

Source: own study.

The respondents were also allowed to write their own answers for the question. Other reasons for following video game developers were: curiosity about how the creators' work looks outside the video game itself, waiting for continuation of a given video game series, general interest in the subject of games, and being a part of the team creating video games.

Because the video game developers aim to maintain a close relationship with their communities, they are often engaged on social issues that are starting to interest more and more people. Making the consumers feel like they are fighting together for the same cause creates a sense of solidarity. It also helps them feel welcome in the community where they can find like-minded people. The corporate social responsibility is becoming very popular and in certain industries such as video gaming and entertainment in general, it even seems to be obligatory. People often expect companies to be socially responsible and adjust to the new norms. According to the survey, the majority of respondents think the same way and answered the question: “Do you think video game developers should be socially responsible?” as follows (Figure 5).

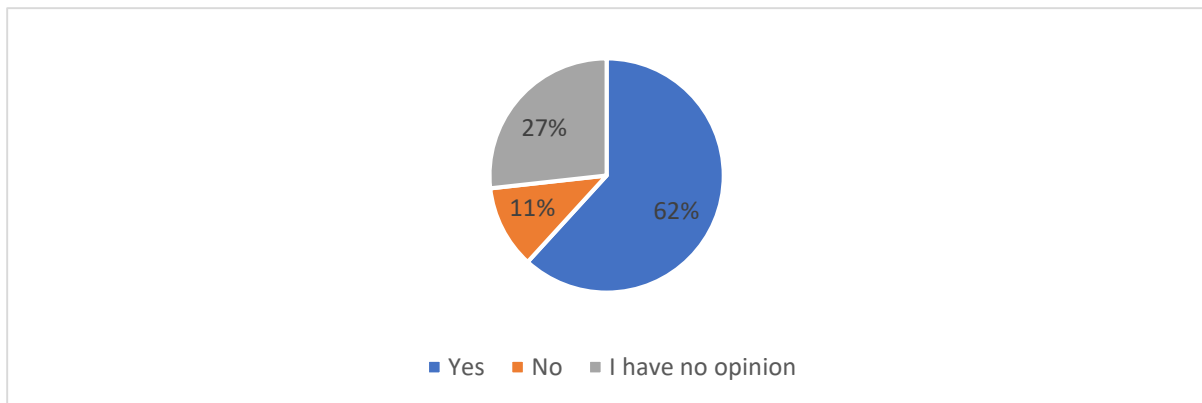


Figure 5. Expectations on social responsibility of game developers.

Source: own study.

The most popular topics that are brought up by video game companies right now are LGBT+ issues, racism, and women's rights such as developers Blizzard Entertainment and CD Projekt RED have already made statements on these matters in the past and publicly promoted inclusion and tolerance. Certain groups also advocate for further support of women and minorities through adding them more in video games as characters. However it can be a controversial topic as some people claim that they do not want to see forcefully included, shallow characters that only serve a purpose of supporting diversity. The respondents also seem to be unsure about this topic and only 22% supported the idea. The question was: "Do you think there should be more LGBT+ people of different races in computer games?" (Figure 6).

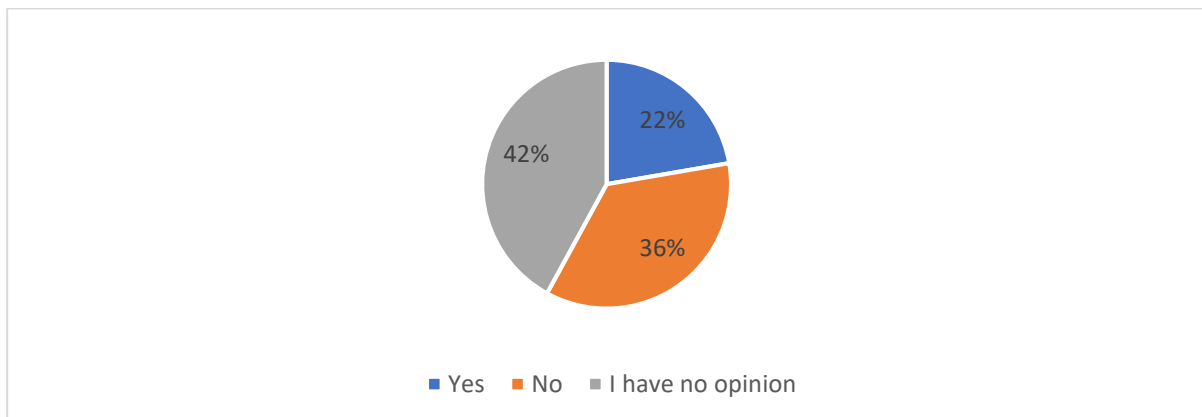


Figure 6. Supporting diversity in computer games.

Source: own study.

The reputation of the company is continuously formed through various consumer experiences. It is exceptionally important for the overall perception of the firm and further ability to form strong relationships with customers. The constant positive experiences allow to create a feeling of trust. However, building trust can be very difficult for a video game developer as people will have different expectations towards their products and towards services that they provide. The video game industry also has its unique characteristics and problems that result from them. According to the survey 52% of respondents declared that they were disappointed by a video game developer before. The prevailing opinion is that many companies lie or evade

the truth about their games which are still in development. Through promises and depictions, they create an image of the product that is highly idealized or even deceitful in order to create a feeling of “hype” and make more people interested in the purchase. Most video games can be preordered, that is paid for even before the premiere. The action of preordering is usually a clear sign of trust in the company and a way of showing support. However, in such situations, if the video game does not meet expectations, the disappointment can be much bigger than normal, especially if the developer promised certain features that are not present in the final product. Other consumer complaints include: misunderstanding of players' expectations, favoring certain groups of players, numerous bugs, unnecessary and intrusive micro transactions, exploitation of employees, lack of transparent and regular contact with the community, slow acting or rude technical support, launch delays, ignoring customers' requests and suggestions regarding the game, releasing unfinished games, unpleasant treatment of fans, offensive public comments, decrease in the quality of games, poor game optimization, and lack of regular updates. Such actions heavily influence the consumer's perception of a video game developer and can irreversibly damage its reputation. Numerous negative experiences with video game companies can even result in lack of trust in all developers in general and eventually harm the entire industry.

5.3. Reactions to controversies

When the company is faced with a PR crisis, it must act quickly and decisively as any errors can inflict serious damage on public image and, as a result, lower profits and the number of overall customers. In certain situations, however, the immediate reaction is not enough and a video game developer must take long-term actions aimed at repairing the relationships with fans. The most important factors that help in analyzing the problematic situation at hand and constructing a reaction plan are the circumstances of the case, as well as reasons for the occurrence of the crisis. Controversy can be created as a result of the company's actions or for reasons not related to the company's direct decisions. The former puts a bigger pressure as people tend to put the blame on the firm. When video game developers face a PR crisis they can approach it in many ways, usually via social media, or through video game journalists. Quick and direct communication link with consumers is extremely important in such cases as it provides unaltered, precise message to all interested persons. According to the survey, the majority of respondents are, to some extent, interested in controversies surrounding video game developers (Figure 7). The question was: "Do you pay attention to controversies in video game developers?"

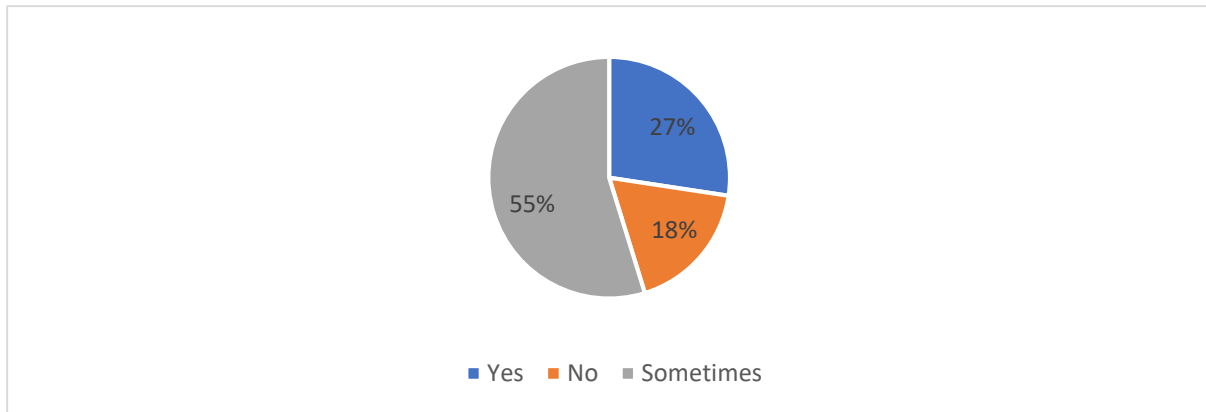


Figure 7. Reaction to controversies.

Source: own study.

At the same time, the respondents seemed divided whether they would allow the controversies surrounding video game developers affect their purchase of games. 55% of people who answered the question would not base their buying decision on past controversies. However, a high percentage of respondents (45%) claimed that they would take certain controversies under consideration when buying a video game. These controversies include: unfair or harmful treatment of employees (40 respondents out of 71), offensive comments on social media (34 respondents), lying to the fans (63 respondents), as well as implementing micro transactions, unfair business tactics, releasing unfinished products, buying reviews, openly propagating the developer's ideology/political views, violations of human rights, introducing pay-to-win elements in games, and improper treatment of fans.

One of the methods used by consumers to try to change companies' behavior and way of functioning is boycott. Usually, it requires a considerable amount of people participating in order to make a bigger impact and have a greater influence. Therefore, the consumers should be able to communicate with each other to efficiently carry it out. However, in modern times, it is becoming increasingly easy because of social media. This also results in a much bigger number of possible participants due to the fast spreading of information. The survey respondents were asked what do they think about boycotting companies and there was no dominant answer. A similar number of people chose options "I believe that boycotts are effective and necessary" and "I believe boycotts do not work". Therefore, it can be concluded that people are divided whether boycotts are a useful tool for interacting with video game developers or not (Figure 8). The answers to the question: "What do you think about boycotting companies?" are as follows:

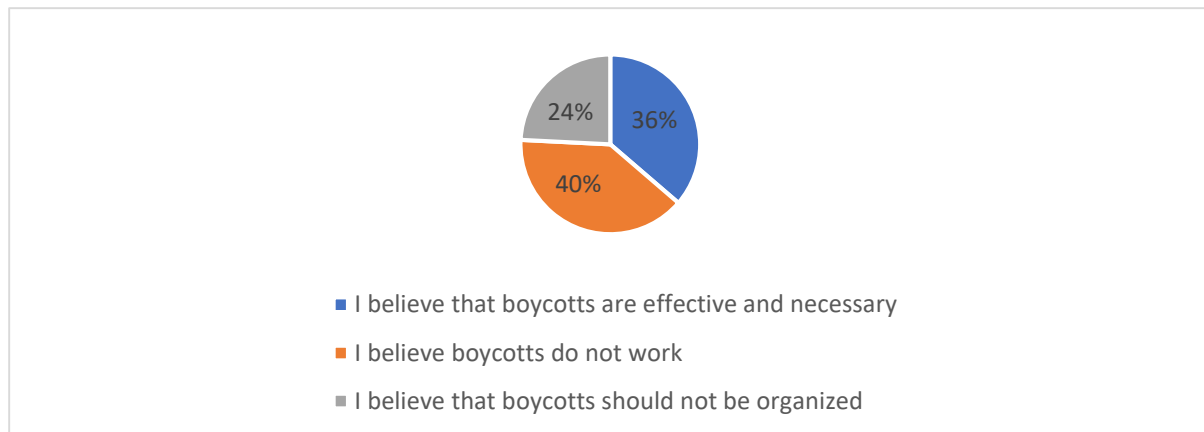


Figure 8. Boycotting companies.

Source: own study.

In order to fix the image of the company and appease the angry consumers, video game developers often publish apologies soon after a controversy takes place. The existence of social media makes this task easier and allows to monitor the direct responses of fans. However, the reactions can be different depending on the type of offence and how the apologies were expressed. Some people will even question the sincerity in the message. The respondents were asked what do they think about companies' official apologies to their fans in response to the controversy. Out of 157 answers, 72 people chose "It's just a marketing strategy and a way to avoid the consequences" and 3 answers were "It's a bad decision because most fans won't accept it anyway." Contrastingly, 67 people chose "It's a good decision that shows respect for the fans". Other respondents claimed that the situation depends on the developer's public image and previous behavior, as well as the way the apologies were expressed. For some, the apologies are necessary out of respect for the players. Multiple answers supported public apologies only if they are paired with real improvement and they introduce significant changes in the company. In conclusion, consumers will usually approach the apologies with skepticism, especially if the company had problems with public image even before the controversy took place. Apologies are often a good idea if expressed properly, however what fans expect the most are the real and direct changes which are able to repair previously caused damage.

5.4. Image of CD Projekt RED

Positive public image is very crucial in forming a strong, long-term relationship between a company and its customers. People who believe that a certain video game developer is honest, respectable, and principled are more likely to trust in the high quality of their games, recommend their products to others, or participate in fan communities. CD Projekt RED is a well-known studio, however, it became popular globally quite recently. Its breakthrough moment took place after the announcement of a new franchise and game *Cyberpunk 2077*. The general public was introduced to CD Projekt and its development studio through their previous video games, especially *The Witcher 3: Wild Hunt*. The high quality of the product,

attention to detail, good gameplay, praised soundtrack, and unique humor gave players a very good impression of the entire company. CD Projekt also took action to confirm and reinforce this positive, quite idealized image by continuously interacting with customers, forming relationships with numerous gaming journalists, establishing company's mission that puts video games first, and actively taking part in the gaming community. As a result, the public image of the firm was, at some point, immensely positive. A part of the survey was intended for discovering what is the current general opinion about CD Projekt RED and what are the positive and negative aspects of the studio. The question was: "What do you think about CD Projekt RED (The Witcher series, Cyberpunk 2077)?" (Figure 9).

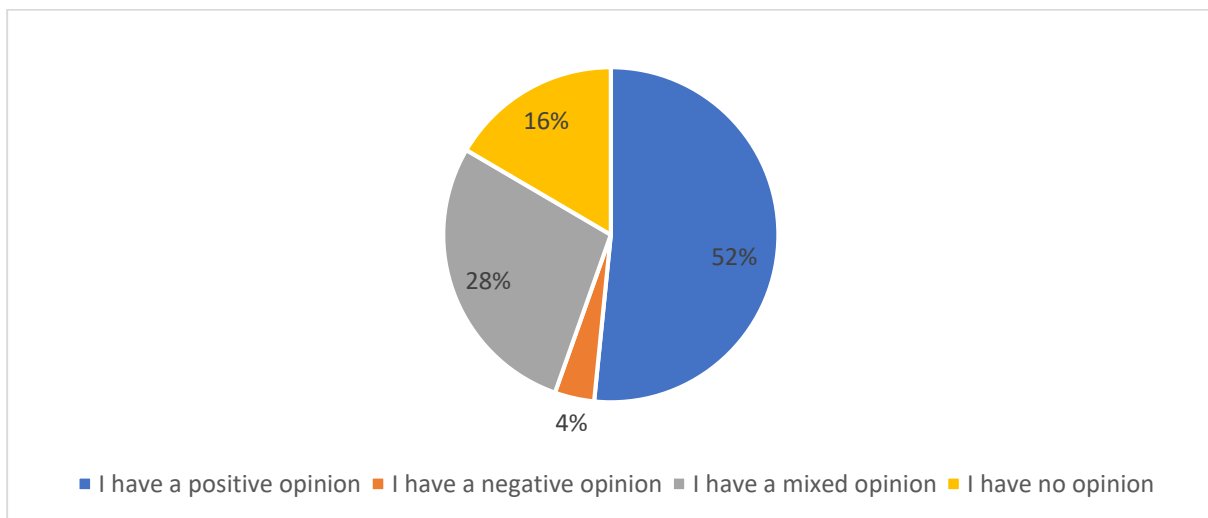


Figure 9. Opinions on CR Projekt Red.

Source: own study.

Over half of those surveyed reported that they have a positive opinion about the studio. However, it must be taken under consideration that all respondents are Polish speakers and/or are of Polish descent. The support for CD Projekt RED, therefore can be higher in their country of origin and the results may vary in other countries.

A great number of people who had something positive to say about the studio, commented on *The Witcher* video game series. Based on their own experiences, they unanimously praised the franchise for the very high quality of games, great storytelling, impressive length, good graphics, solid gameplay, interesting side quests, and attention to details. One respondent noticed that the studio seemed to greatly improve with each game from the series and other called the games innovative and advanced. The developers also later decided to come back to the first two productions, focus on them again, and release their "Enhanced Editions" that improved the graphics, fixed many bugs, and offered new content. Other people pointed out that CD Projekt RED released numerous DLCs and expansions to their games that not only were of high quality but were also offered for a reasonable price, some of them even for free. As a result, the developers were able to present an expanded, unique world with interesting, new characters that were shown in depth throughout the game. The studio did not introduce any micro transactions which earned the respect of the consumers.

Respondents also praised studio's open communication with fans and its ability to listen to criticism and advice. For example, this can be noticed in multiple surveys carried out by the company asking people for suggestions regarding the games and the overall functioning of the firm, as well as the almost instant changes and improvements after consumers express their dissatisfaction about certain actions made by the studio. Its respect towards customers is noticeable and appreciated by many players in the gaming community. In their view, CD Projekt RED does its best to satisfy as many fans as possible and admit the mistakes if something goes wrong. Others commended the studio's high standards and constant development. Certain fans expressed their pride in the success of a Polish company that is able to distinguish itself from others in the video game industry. One person wrote that she is not interested in what is happening with the firm and only focuses on the games which are very good in her opinion.

Negative opinions that are widely repeated by the general public can be especially harmful for the company and its public image. People who never heard of the firm before or are not particularly familiar with it can quickly form negative judgement about it if they hear this type of information first. It is also difficult to stop those opinions from spreading even if the firm was able to eliminate the problem. Video game companies are notably more vulnerable to them compared to most industries as the gaming community: utilizes social media more often, is more emotionally invested in products (video games) offered, communicates with one another to a greater extent, and considers itself more as a fan group of certain video game developers rather than customers. As a result, the companies in this industry should be more aware of their own public image and heavily invest in public relations in order to maintain the positive relationship with consumers.

When asked about the perception of CD Projekt RED, some respondents had negative opinions about the studio and criticized their certain behavior and actions. In response to the question, nearly all of those surveyed indicated that they see them in a different, more negative light after the premiere of *Cyberpunk 2077*. In their view, as well as the majority of the gaming community, the game was released too early and contained many bugs, especially on older generation consoles. Some people disapproved of the dishonest approach to consumers because the studio promised things that were not included or different in the final product. CD Projekt RED also seemed to present untrue state of the game in development. In reality, their project needed more time to be entirely completed. According to one respondent, their behavior results from the greed because they decided to release the game for older generation consoles despite them knowing that the game had too high system requirements to run properly. Multiple answers pointed out that the company started to behave "like a typical corporation" which in their view is a negative thing because right now they care more about earning money than creating video games.

Few respondents had negative opinions about the studio even before the premiere of *Cyberpunk 2077*, especially how they regularly postponed the game release and behaved in a way that could be considered transphobic on social media, as well as included offensive elements in their most recent game. Some also expressed concern about the reports commenting on their mistreatment of employees. Crunch has been found by them to be a harmful practice that exploits people and therefore is unacceptable.

A noticeable part of the respondents (28%) stated that they have mixed opinions about CD Projekt RED. These people have many positive things to say about the studio but cannot forget about its controversies and negative characteristics. However, they are still a very important group for the company as their trust can be rebuilt so that their opinion can be more and more positive. Firms must be able to convince consumers that their good features are much stronger and much more prevalent than the bad ones.

Few respondents pointed out the studio's mistakes such as the imperfect premiere of *Cyberpunk 2077*, however they also defended the developers and management claiming that their decision to release the game too early was made because they were under a pressure from impatient fans and shareholders. Eventually, they became overwhelmed due to too high expectations. Others criticized certain decisions made by the studio such as practicing political activism and implementing crunch, however the positive elements such as keeping promises, creating good games for affordable prices, and open communication with fans were enough for them to continue supporting the studio. Few people who took part in the survey chose different approach and declared that they do not like certain decisions made by CD Projekt RED but they also think that it does not deserve as much criticism as it got. In their view, the studio is working hard to repair the damage made and rebuild the trust of fans and it deserves the recognition for that.

Some claimed that they had a very positive opinion about CD Projekt RED but changed their mind after the premiere of *Cyberpunk 2077*. Regaining their trust can be particularly difficult for the studio as, in their mind, they were betrayed and lied to. By regularly updating and fixing the game as well as releasing other games of high quality, this trust is possible to be slowly rebuilt. However, some people will never support the developer again and this fact must also be accepted.

Certain respondents stated that CD Projekt RED undermined their trust but they are hopeful that the studio will be able to fix its mistakes. Working with people who think this way can be easier as they want to believe in improvement of the studio and still want to support it. Improving certain elements and continuing to release high quality products should be enough to gain their trust again.

The majority of those who responded felt that CD Projekt RED is a studio which is perfectly capable of developing high quality games as it proved this fact before. However, it is not without flaws which can and must be fixed in order for the entire company to grow and improve. Almost all answers had some positive comments but most of them also included a thoughtful

criticism about certain actions of the studio. In response to the question, most of those surveyed indicated that their main grievance is connected with the premiere of *Cyberpunk 2077* and, in some cases, with poor treatment of employees. It is important to notice that, before the announcement and release of the newest video game, CD Projekt RED had a very positive public image and a well-known, successful franchise. This fact heavily influenced the public's reaction after the controversy took place. For example, a great number of people tried to justify or explain studio's actions because before they had with it only positive experiences, and others criticized comments that were too harsh on the developers. The fondness for games from *The Witcher* series are the main reason that players still support CD Projekt RED and want to see it succeed and improve. However, this fondness that people had for the company also resulted in some of them feeling betrayed and cheated after *Cyberpunk 2077* release. The studio's priority at the moment should be regaining lost trust as fast as possible in order to maintain the high number of customers. This can be achieved through repairing caused damage (refunds, game updates), as well as constant and visible improvements within the entire studio.

5.5. Image of Blizzard Entertainment

Similarly to the questions regarding the studio CD Projekt RED, another part of the survey was intended for discovering what is the general opinion about the second analyzed company, Blizzard Entertainment. Based on the given answers, it can be said that more people than in the case of a Polish studio decided to choose the option "I have no opinion". The reason for this may be the possibility that the higher number of people that were surveyed was not familiar enough with the company to form an opinion. The question was: "What do you think of Blizzard Entertainment (World of Warcraft, StarCraft, Diablo, Overwatch)?" (Figure 10).

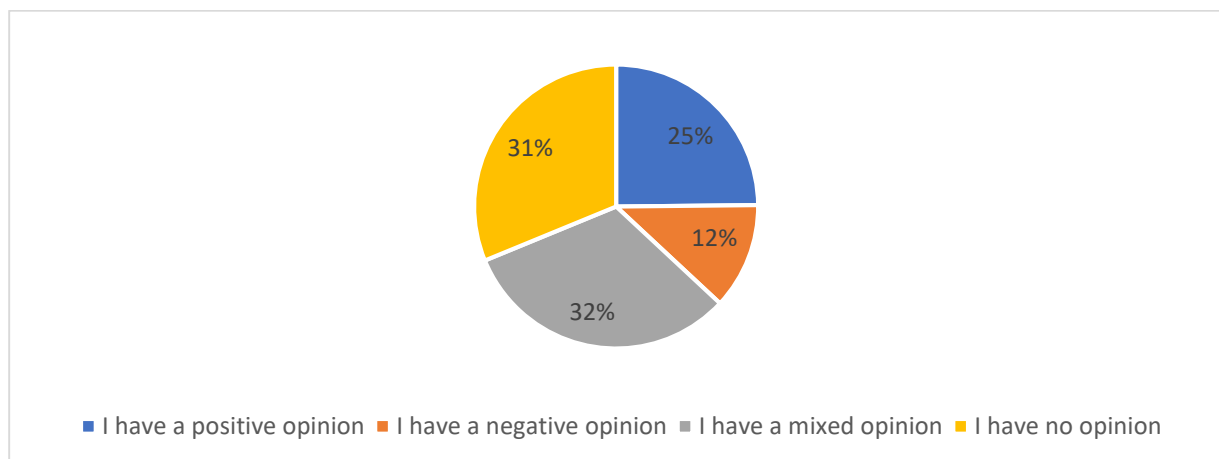


Figure 10. Opinions on Blizzard Entertainment.

Source: own study.

The positive comments praised Blizzard's "solid" and high quality games which are said to have an interesting design and well developed virtual worlds. Respondents also claimed that the company's creations are well known around the world and can be classified as classics in the gaming industry. They can be even sometimes considered as one of the best of their genre

and distinguish themselves from others with a high level of refinement. The mere ideas for these games are creative and unique as well. One answer emphasized that Blizzard has an unique approach to the announcements of new video games and prefers not to provide a set date in order to not put a pressure on employees, letting them finish the product without considerable rush. People claimed that the promises made by developers are also usually kept. The company's platform, Blizzard Battle.net was praised by the respondents as well. A high number of those surveyed focused in their answer on Blizzard Entertainment's many years of experience on the market which gives its certain kind of respect in the gaming industry.

Despite having a strong reputation as a creator of iconic games, Blizzard Entertainment is criticized for its certain actions and decisions, especially those that have been made in recent times. The survey respondents pointed out that the lack of regular updates to the games and lack of care towards certain franchises leads to deterioration in quality of products. Some new releases such as *Warcraft III: Reforged* (2020) have ended in failure after Blizzard broke its promises which resulted in the majority of customers very negatively reviewing the game. Respondents also mentioned in their answers the bigger controversies of the company: the BlizzCon 2018 *Diablo Immortal* fiasco, and Blitzchung controversy. Some were angry about the company getting involved in political affairs which, in their view, is negatively influencing the Blizzard's actions. The implementation of microtransactions and high price of games were highly criticized as well. Overall, people often complained about the lack of understanding and respect for the fans. The poor treatment of employees and mass layoffs were also mentioned and condemned by some of the respondents.

After the analysis of the survey results it can be said that many respondents seemed to have a mixed opinion about Blizzard Entertainment. Usually, the answers emphasized and appreciated the legacy of the company as well as its iconic games, however they were critical of the recent decisions and actions that have been made. One respondent tried to explain this change for worse by blaming the merger with Activision. The prevailing opinion is that Blizzard's games started to decline in quality, and that the franchises are no longer supported by the firm as much as they were before. Some people rated the company as average in terms of customer approach: not bad but not excellent either. Certain controversies have gradually changed the perception of the company for the worse and resulted in players losing trust in Blizzard. However, according to few survey answers, there are consumers that want to see the company return to its previous state and become universally loved by the gaming community again.

In case of Blizzard Entertainment, it is impossible to state precisely which controversy or misjudged decision was the main reason of the customers' loss of trust in the company. The deterioration of corporate image in this situation was rather a result of multiple different missteps that eventually accumulated in the consumers' minds. Few of the recent released games being lower quality than the usual standard also contributed to the changes in how Blizzard was perceived by the public. One of the most important problems that the company

has to face at present is the damaged relationship with fans. Inferring from the survey responses, many people who were answering the question felt like Blizzard did not respect their opinion or even pay attention to the gaming community in general. If customers do not feel appreciated it can be very difficult to earn their trust. The company must, in a sense, prove its worth again and show that it is able to change for the better, starting from its approach to consumers. Blizzard Entertainment's task, however, is much more problematic as it operates multiple franchises at the same time which all have different fan communities. As a result, creating strong communication links with all of them can be quite demanding and time-consuming.

6. Conclusions

Summarizing the above deliberations the following conclusions can be reached. Firstly, both analyzed developers exist in the same market, however, they differ in terms of their marketing decisions which shape their public image. The widespread access to the internet and social media as well as global cultural changes result in a situation where it is more difficult for firms to maintain a positive corporate image. Even small controversies can be dangerous and cause many problems. The company must therefore be constantly ready to react and take an appropriate action. Secondly, video game companies are especially vulnerable to negative changes in firm's public image because they heavily rely on creating a close community of devoted fans. They are also tightly connected with the internet culture which has both positive and negative consequences. Displeased consumers can voice their disappointment with games or company's decisions through different means such as boycott that aims to lower developer's income and number of fans and force the change. Thirdly, in the video game industry, consumers often wait for the desired product for years and develop very high expectations, however, too high expectations can distort the company's image in the long run.

These conclusions can be used practically in the video game industry as well as in the entertainment industry in general. Most of all, it is important to look at the company from different perspectives to determine how its public image will change over the years. As an example, employees are a very important element that can be vital in this process. All employees who interact with fans should be properly trained and educated on the internet culture. This step helps to avoid many mistakes and better introduce the company's philosophy to employees. However not all PR crises can be prevented. A good developer must be able to react accordingly to the situation at hand. The extensive knowledge about the gaming community is crucial and allows to create a strong relationship with customers. The consumers' trust in the company is exceedingly important and should be preserved. The process of regaining this trust can be very difficult, sometimes even impossible. For this reason, video game developers should approach their fans with as much respect and sincerity as possible in order to build a strong, faithful community that will support them in every situation.

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INDUSTRY 5.0 AS A NEW CONCEPT OF DEVELOPMENT WITHIN HIGH VOLATILITY ENVIRONMENT: ABOUT THE INDUSTRY 5.0 BASED ON POLITICAL AND SCIENTIFIC STUDIES

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Purpose: the aim of the paper is to present the frameworks of Industry 5.0 in a labile environment. Until the COVID-19 pandemic, the notion of a dynamic environment was used, due to the speed of the changes taking place in economies and society, which could be anticipated and proactive measures taken. The pandemic, whose impact was experienced worldwide, changed the environment, which took economies, societies and businesses by surprise. Such an unpredictable, unstable environment is called environmental volatility.

Design/methodology/approach: After COVID-19 instability has prevailed in many areas of human activities and societies, as well as in businesses and economies. The strongly popularised, for more than a decade, the concept of Industry 4.0 was transformed. In the new reality more important there were socio-economic and environmental problems. In the new concept called Industry 5.0 three aspects are important: human factors, resilience and sustainability. The above-mentioned aspects were included by the European Commission in the document: “Industry 5.0. Towards a sustainable, human-centric and resilient European Industry”. The document was published in January 2021. The idea of Industry 5.0 refers to the concept of Society 5.0 in the labile environment after the COVID-19.

The paper was realized based on the SLR method. The author used the bibliometrics of scientific publications about Industry 5.0 available in the scientific database Scopus.

Findings: This paper presents the policy assumptions of Industry 5.0 based on studies from the political documents and scientific papers. The first scientific publications on Industry 5.0 were registered in scientific databases in 2016.

Originality/value The presented frameworks of the Industry 5.0 based on literature review complemented (expanded) the understanding of the European development policy presented in the document: Industry 5.0. Towards a sustainable, human-centric and resilient European industry (European Commission, Brussels, Manuscript completed in January 2021).

Keywords: Industry 5.0, human factors, resilience, sustainability, environmental volatility.

Category of the paper: literature review/general review.

1. Introduction

Since 2020 up to now in many socio-economic areas a deep revision of development directions (principals) has been made. The changes were conditioned by the need to effectively confront the threat of SARS-CoV-2. The first cases of human infection with the virus were reported in late 2019 in the city of Wuhan in eastern China (Zhu et al., 2020). The world of politics, science and practice, with up-to-date knowledge and technologies, took action to safeguard the daily lives of people and the functions of societies, and set about tackling the causes of stunted economies, industries and business (Zaho, 2020). During the pandemic, radical restrictions were required in many areas of social life and economic activity in order to protect the lives and health of citizens in the first place, often at the expense of citizens' rights (civil liberties) and limiting the autonomy of business. In Poland, the beginning of radical restrictions began in March 2020. The final regulation of restrictions took place in the Document of the Council of Ministers of 26 November 2020 on the establishment of certain restrictions, orders and bans in connection with the occurrence of an epidemic state (Dz.U. 2020, poz. 2091). For many constraints, a large number of companies were on the verge of real bankruptcy, due to interruption of supply chains or lack of customers, among other reasons (OECD report, 2020). Currently, governments around the world have serious post-pandemic problems (energy crisis, high levels of inflation, falling real incomes, post-pandemic health problems and others). At various levels of government, policy agendas have begun to be revised and updated. The difficult situation in many levels of human activity after COVID-19, is named the post-pandemic crisis. The emergence of a pandemic on a global scale was the situation for which the world was not prepared. The pandemic was the 'black swan' of the modern world (Taleb, 2020).

After the pandemic, the notion of 'resilience' became increasingly important, not only in relation to the health status of societies, but also in relation to economies, industries and businesses (Silva et al., 2020). Professionals and scientists from a variety of backgrounds proceeded to revise the goals and assumptions made in previous plans, programmes, strategies and models (Verma, Gustafsson, 2020). According to M. Glenszczyk (2022), organisations have introduced into their value attributes, building stability by making business immune to economic, social, health shocks and any other 'black swan' event that could surprise business and show its helplessness.

The conception of resilience was noted by the European Commission (EC) in the document "Industry 5.0. Towards a sustainable, human-centric and resilient European Industry" published in January 2021. In the document, the European Commission, centrally placed human factor, sustainability and resilience of business in the labile environment. The Industry 5.0 is a new model of development after the COVID-19. Besides of the EC document, the term Industry 5.0 is used in scientific and popular publications. The first scientific paper about Industry 5.0 was

published in 2016. In 2017, the term 'Industry 5.0' appeared in studies on LinkedIn. Presented concept was about the return of the human touch to industry, by the collaboration between humans and intelligent technologies (Piątek, 2018). The most scientific publications about the Industry 5.0 concept in scientific databases were in 2022. The author of this study analysed publications registered in the Scopus database. The author of the paper used a systematic literature review. In the study the literature review is treated as an appropriate research method (Czakon, 2011). Papers about Industry 5.0 were analysed. Results of the literature review extended the findings taken from the European Commission's formal document on Industry 5.0.

The analysis performed made it possible to:

- diagnosing the potential for interest in the concept of Industry 5.0 in the area of science in the period from 2016, when the first publication on Industry 5.0 in topic was registered in the Scopus database, to the end of 2022,
- identifying and defining three areas of Industry 5.0 perceptions, in line with EC policy, and described by the adjectives: sustainable, human-centric, resilient,
- presenting a generic division of research areas within the Industry 5.0 concept, ordered according to orientation towards sustainability, placing the human being at the centre of technological transformations and ensuring stability by using the functions of the developed technologies of the fourth revolution,
- looking for differences and similarities between Industry 4.0 and Industry 5.0.

The study was performed in order to better understand the concept of Industry 5.0. The paper consists of three main parts (sections). Section 1 presents the results of the bibliometric analysis performed for the keyword: [Industry 5.0] included in the title of scientific publications registered in the Scopus database. Section 2 is divided according to the European Commission's directions for Industry 5.0. The focus was on the typology of research areas during the labile environment (from the outbreak of the COVID-19 pandemic to the present). The final section (Section 3) is a summary of the similarities and differences between Industry, 4.0 and Industry 5.0. The paper concludes with a synthesis of the final conclusions about the Industry 5.0.

2. Bibliometrics of scientific papers about Industry 5.0

The first publication that had Industry 5.0 in its title was registered in the Scopus database in 2016. It was the publication by Sachsenmeier, P., which dealt with bionics and synthetic biology, in terms of the structure and operating principles of organisms and their adaptation in technology and device construction (following the example of living organisms). The processes controlling the actions of organisms are used in automation, computer science, electronics, mechanics and construction (biomimetics). The second area concerned synthetic biology,

which has the potential to solve many human problems, from climate disaster prevention to medical breakthroughs. Both areas of research, the author placed in Industry 5.0. (Sachsenmeier, 2016). In 2017, no publication was registered in the Scopus database with Industry 5.0 in its title. The following year, 2018, 3 publications were registered in the Scopus database. The first one with the telling title: Birth of Industry 5.0: Making Sense of Big Data with Artificial Intelligence, "the Internet of Things" and Next-Generation Technology Policy, by authors: Özdemir, Hekim was recognised as the beginning of building scientific knowledge about Industry 5.0. The publication, in December 2022, had 179 citations. The second is a book by the author Salgues, B. entitled: Society 5.0: Industry of the future, technologies, methods and tools (275 pages). The third about nuclear energy (Energy 5.0) written by authors Wang, F.Y., Sun, Q., Jiang, G.J., (...), Dong, X.S., Wang, L. In the following years, the number of publications in the Scopus database increased. There were 11 scientific papers registered in 2019, 15 publications in 2020, 51 in 2021 and 126 publications in 2022. In the period called labile, i.e. from the outbreak of the COVID-19 pandemic to the present, the total number of publications about Industry 5.0 was 203. Figure 1 shows the dynamics of scientific publications about Industry 5.0 searched in the Scopus database for the keyword [Industry 5.0] used in the titles of papers.

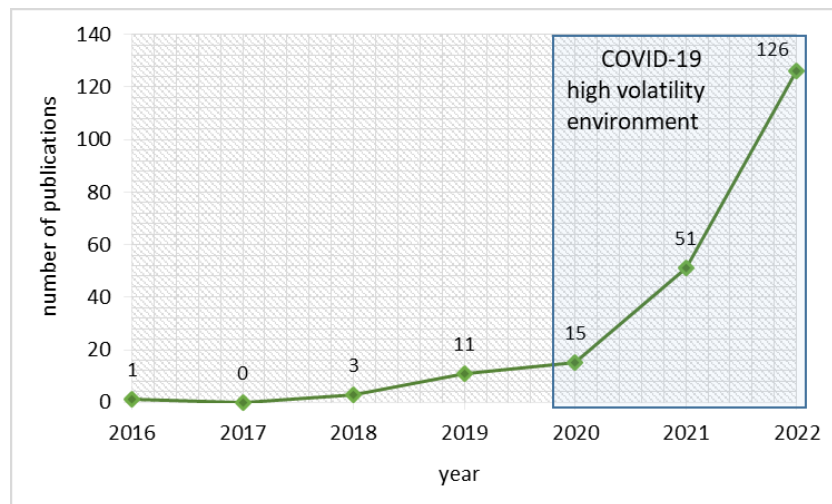


Figure 1. Publication dynamics of Industry 5.0.

Source: Data from the Scopus database.

Considering the subject area of the papers, engineering and computer science were in the lead with more than 100 indications (Figure 2). In Figure 2, topics that received a minimum of 10 indications are included.

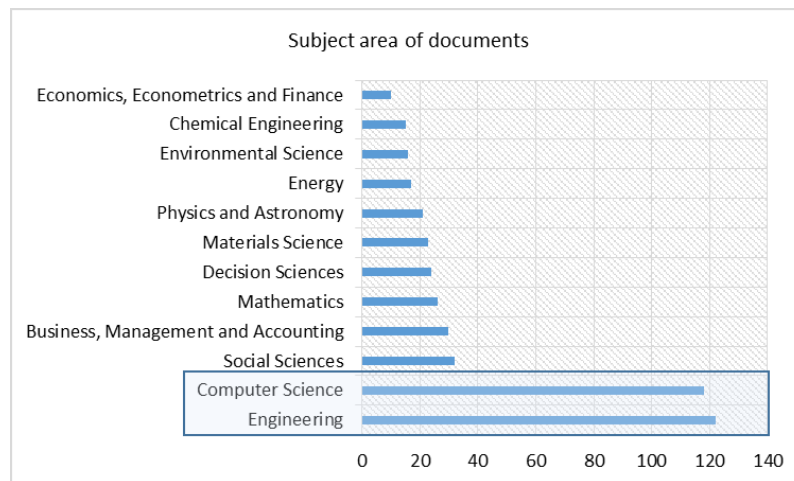


Figure 2. Subject areas of Industry 5.0.

Source: Data from the Scopus database.

The top countries from where the authors of the publications came from were India and China (Figure 3), countries that in many areas of industry (especially traditional industry) are at the top of the world rankings of producers, as well as countries where a significant proportion of the world's population resides. China and India, were countries where the COVID-19 pandemic emerged earlier than in European countries.

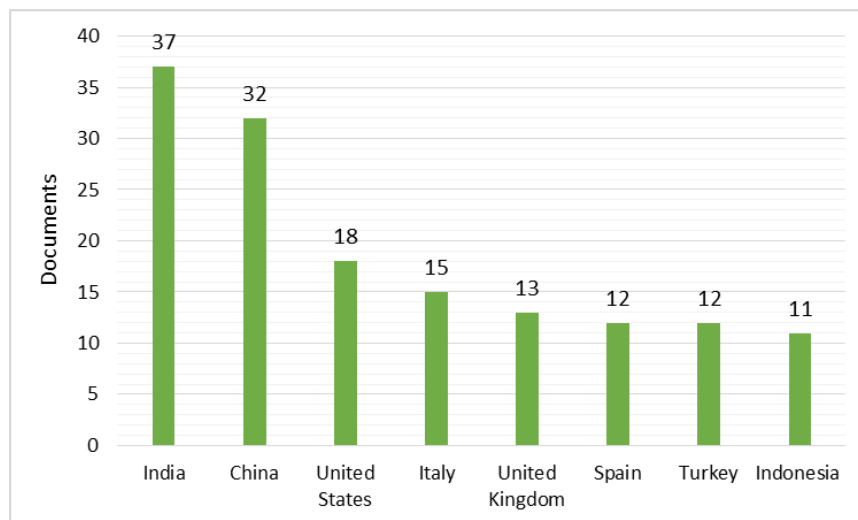


Figure 3. Countries where authors of publications on Industry 5.0 come from.

Source: Data from the Scopus database.

Ordering the keywords used in the publications, apart from the base key, which was Industry 5.0, the authors of the publications also used the key word: Industry 4.0. The transition to the topic of the concept of Industry 5.0, in many publications, was preceded by a reference to the pillars of Industry 4.0 and its history, which started in Germany with the provisions in the High Technology Strategy in 2011. The pillars of Industry 4.0 are artificial intelligence, augmented and virtual reality, IoT, Big Data, the cloud, incremental manufacturing, vertical and horizontal integration of systems and processes, computer simulation and the digital twin. The listed pillars appeared in the concept of Industry 4.0, at different times, e.g. digital twin as late as 2014

(Whitepaper: 'Digital Twin: Manufacturing Excellence through Virtual Factory Replication, by M. Grieves). The technologies mentioned (pillars of Industry 4.0) are achievements of the Fourth Industrial Revolution. Among the keywords used to describe Industry 5.0, in addition to AI and IoT, the key technologies of Industry 4.0, which can be considered as differentiators for Industry 4.0 technology directions, there are also areas typical of Industry 5.0 as descriptors (identifiers), and these are: Society 5.0, sustainable development, blockchain, sustainability of business and human-centric (human at the centre of technological changes).

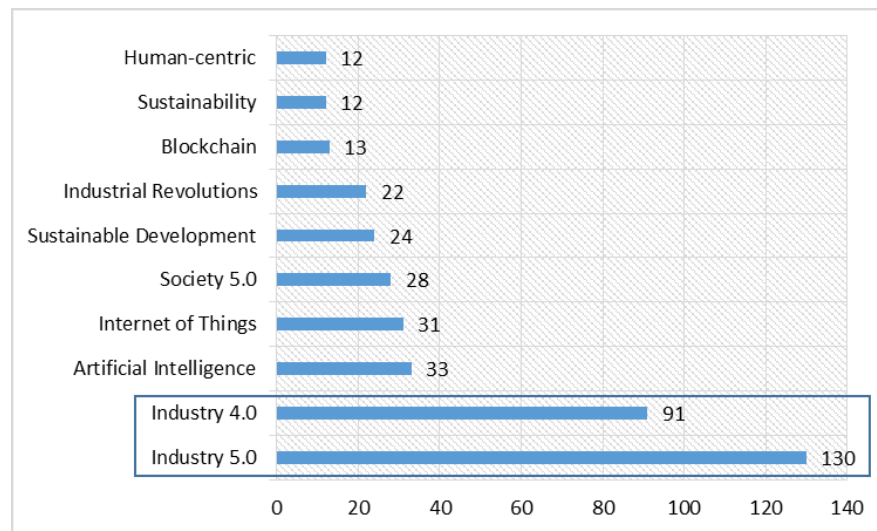


Figure 4. Keywords used in documents about Industry 5.0.

Source: Data from the Scopus database.

Concluding the overall bibliometric review, the publications with the highest number of citations were presented in Table 1.

Table 1.

Publications about Industry 5.0 with the highest number of citations (top 10)

Place	Subject	Author/authors	Year	Source	Citation
1.	Industry 5.0-a human-centric solution	Nahavandi, S.	2019	Sustainability (Switzerland) 11(16), 4371	244
2.	Birth of Industry 5.0: Making Sense of Big Data with Artificial Intelligence, "the Internet of Things" and Next-Generation Technology Policy	Özdemir, V., Hekim, N.	2018	OMICS A Journal of Integrative Biology 22(1), pp. 65-76	172
3.	Industry 5.0: A survey on enabling technologies and potential applications	Maddikunta, P.K.R., Pham, Q.-V., B, P., (...), Ruby, R., Liyanage, M.	2022	Journal of Industrial Information Integration 26, 100257	147
4.	Industry 5.0 and Human-Robot Co-working	Demir, K.A., Döven, G., Sezen, B.	2019	Procedia Computer Science 158, pp. 688-695	137
5.	Industry 4.0 and Industry 5.0-Inception, conception and perception	Xu, X., Lu, Y., Vogel-Heuser, B., Wang, L.	2021	Journal of Manufacturing Systems 61, pp. 530-535	124

Cont. table 1.

6.	Value-oriented and ethical technology engineering in industry 5.0: A human-centric perspective for the design of the factory of the future	Longo, F., Padovano, A., Umbrello, S.	2020	Applied Sciences (Switzerland) 10(12),4182, pp. 1-25	85
7.	Industry 5.0: Potential applications in covid-19	Javaid, M., Haleem, A., Singh, R.P., (...), Raina, A., Suman, R.	2020	Journal of Industrial Integration and Management 5(4), pp. 507-530	59
8/9	Critical components of industry 5.0 towards a successful adoption in the field of manufacturing	Javaid, M., Haleem, A.	2020	Journal of Industrial Integration and Management 5(3), pp. 327-348	52
8/9	Innovation in the era of IoT and industry 5.0: Absolute innovation management (AIM) framework	Aslam, F., Aimin, W., Li, M., Rehman, K.U.	2020	Information (Switzerland) 11(2), 124	52
10/11	Society 5.0: Industry of the future, technologies, methods and tools (book)	Salgues, B.	2018	<i>Society 5.0: Industry of the Future, Technologies, Methods and Tools</i> 1, pp. 1-275	47
10/11	Industry 5.0-The Relevance and Implications of Bionics and Synthetic Biology	Sachsenmeier, P.	2016	Engineering 2(2), pp. 225-229	47

Source: Scopus database.

The paper by the author Nahavandi, S. had the highest number of citation (244 citations). The paper was about the centrality of humans in Industry 5.0. The publication was published in 2019 (at the end of 2019 the COVID-19 pandemic broke out). The documents with the highest number of citations were published in the period 2016-2022.

3. Conception and frameworks of Industry 5.0

Between 2 and 9 July 2020, the concept of Industry 5.0 was the subject of a discussion organised by the Directorate 'Prosperity' of DG Research and Innovation EC. Research and technology organisations participated in the discussion. In its final document of January 2021, the European Commission set out the assumptions for a renewed European industry towards 'Industry 5.0'. In the document key directions of change are sustainable industry, resilient industry and supply chain and human centricity to technology. Smart technologies with the cognitive skills and critical thinking of humans are expected to ensure the success of Industry 5.0 (EC Document, January 2021) Based on an analysis of the European Commission's document, the key determinants of Industry 5.0 are presented in Table 2.

Table 2.
Key directions of Industry 5.0

Area	Direction	Examples
Ecology	<ul style="list-style-type: none"> • Sustainable: <ul style="list-style-type: none"> ▪ industry ▪ technologies ▪ production ▪ consumption 	<ul style="list-style-type: none"> • development of production systems based on renewable energy sources, • reduction carbon emissions of 55% by 2030. • reduction of negative environmental impacts: <ul style="list-style-type: none"> ▪ reuse and recycling of natural resources, ▪ closed loop economy, ▪ waste reduction, ▪ substitution of natural resources by others, • improve processes: new materials, reduce material losses, new technologies • sharing economy: not wasting purchased products, using reusable products, purchasing remanufactured products, handing over (renting, sharing) products to other users • analysis of the product life cycle (from project through manufacture and use to recycling)
Human factor	<ul style="list-style-type: none"> ▪ Human-centric 	<ul style="list-style-type: none"> • people at the centre of the production process - the message: instead of asking what we can do with modern technology, we should consider what technology can do for us - machines and people can work together in harmony, complementing each other, • the use of technology must not infringe on workers' fundamental rights, such as the right to privacy, autonomy and human dignity, • better working conditions and higher safety at work (intelligent robots do dangerous work) • development of the skills needed to operate and cooperate with new technologies (digital competences: basic and advanced with soft skills (creativity, openness, flexibility)), • H-CPS: human cyber-physical systems (human-technology cooperation).
volatility environment	<ul style="list-style-type: none"> ▪ Resilient 	<ul style="list-style-type: none"> • industry should be resilient to a variety of geopolitical turbulence and natural disasters as well as other unforeseen events, using the latest technological developments (predictive analytics can forecast upcoming problems and strengthen industry resilience, e.g. weather predictive analytics, maintenance predictive), • supply chains should be resilient to a variety of geopolitical turbulence and natural disasters, the latest technology should be used for this, e.g. maintenance predictive, predictive analytics for demand fluctuations, digital twins.

Source: own elaboration based on the document: Industry 5.0 Towards a sustainable, human centric and resilient European industry, European Commission, Brussels, Manuscript completed in January 2021.

The European Commission distinguishes six basic categories of technological solutions relevant to Industry 5.0:

- 1) Human-machine interaction.
- 2) Bio-inspired devices and smart materials.
- 3) Digital twins and simulation.
- 4) Transmission, storage and analysis.
- 5) Artificial intelligence (AI).
- 6) Energy efficiency, renewables, energy storage and independence from external supplies.

These are key solutions to help achieve the objectives of Industry 5.0, which are sustainability, human centricity to technology, resilience of industry and supply chains to a variety of local and supra-local events. Underpinning the development of the new concept are social and environmental needs. An expert team comprising members of the Faculty of Economics at Westfälische Wilhelms-Universität (WWU) Münster and Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen in Germany addressed this issue in a practical commentary on the European Commission report.

3.1. Sustainability in Industry 5.0

In the modern world, industry cannot survive without sustainability. Sustainability was and is a business paradigm. Sustainability is still a key business strategy, although it was less prominent in the concept of Industry 4.0. The concept of Industry 4.0 was (and still is) built primarily on advanced technologies that take over many of the activities performed by employees. What is important in the Industry 5.0 concept are the ways in which high technology can be used to solve societal problems and radicalise environmental actions.

According to the European Commission, the current development of Industry 4.0 is increasingly moving away from the original assumptions of social equality and sustainability and more towards digitalisation and artificial intelligence (AI) to increase the efficiency and flexibility of production. In the new European Union (EU) policy, the economic impact of the new technologies of the fourth industrial revolution on industrial development is not questioned. The environmental and social impact aspects of the technologies are more strongly exposed. Support is given to solutions in which the new technology contributes to a significant reduction in the consumption of natural resources, the introduction of new input materials into production, the reduction of energy intensity of technology (especially in industries that are energy intensive, e.g. the chemical industry, the steel industry), the decarbonisation of technology (reduction of carbon dioxide emissions), the reduction of energy obtained from coal (black energy) in favour of renewable energy (Green Energy).

Industry 5.0 is about greater energy efficiency and lower carbon intensity. With the world (especially EU countries) experiencing an energy crisis, manifested by high energy prices and energy shortages, an approach aimed at reducing energy intensity is very timely. Despite the energy crisis, EU policy is not changing course. More regulations are constantly being added to existing ones. The Fit for 55 package announced in 2021 aims to accelerate the decarbonisation of industry. Many industrial sectors use too much 'black energy' and much less 'green energy'. In order to achieve a decrease in energy consumption in industrial production, the EU is introducing ever more far-reaching regulations that industry considers harsh. These laws are mandatory. The aim in the 'Green Deal' is to make industry more environmentally friendly and to achieve carbon neutrality by 2050 at the latest.

A priority for Industry 5.0 is also to find solutions for resource consumption, primarily the development of a circular economy by increasing the quality and percentage of secondary raw materials (recycled goods). Optimising the recycling cycle starts with material and product design. The life cycle of products is tracked by IT-computer-based Product Life Cycle Management (PLM Product Life Cycle Management) systems. The new generation of PLM systems makes the entire product life cycle visible (RFID tags, QR codes). Forward and backward information can be viewed throughout the product life cycle. The systems analyse the various stages of a product's life cycle, support users in making appropriate decisions, especially decisions related to product development (Kiritsis, 2010; Kiritsis, 2009; Duda, Olszek, 2021). In Industry 4.0, the emphasis is on the customisation of the product and the participation of customer in its design. In Industry 5.0, this direction is still being pursued only that first, using at least the digital twin of the product and the digital twin of the process, (recycling efficiency must be traced). Technologies from the extended enterprise must enter supply chains as advanced chains throughout the product life cycle.

The issue of using smart technologies supported by the Internet of Things to improve the environmental performance of industry is a very broad topic. The problem of sustainability in Industry 5.0 is described by many academics and practitioners in addition to the policy community. Kasinathan P. et al. (2022) looked at how sustainability goals can be linked to technological opportunities in the development of Industry 5.0, Society 5.0 and smart cities and towns. The development of Industry 5.0 is equated with Society 5.0.

A number of published authors, including: Zengin et al. (2021), Salimova et al. (2019), link the concept of Industry 5.0 to Society 5.0. Society 5.0 is called an intelligent society because it uses information and computer technology to collect data, transfer information and build knowledge. Cyberspace facilitates society to update and share knowledge. New social and business chains are created in cyberspace. Society 5.0, compared to Society 4.0, which is referred to as the information society, has a greater capacity to integrate the real and digital (virtual) worlds. The strong connection between these two worlds is used for human development as well as for solving social and economic problems within cities and regions, in energy management, healthcare, agriculture and as well as logistics and services (Carayannis et al., 2021). Qahtan, S. and his team (2022) present the transport modelling. Sharma, R. and Arya, R. (2022) discuss the application of environmental monitoring system in smart cities with smart infrastructure. Authors who have undertaken to describe Industry 5.0 indicate and/or explore various areas of equivalence, e.g. human-machine, human-competence (Mazur, Walczyna, 2022; Johri et al., 2021; Margherita, Braccini, 2021).

There is no one-size-fits-all pathway for building sustainability in Industry 5.0. Each area of change may have a distinct pathway (roadmap) for building sustainable value (Ghobakhloo et al., 2022). Value in terms of sustainability can be understood as the concept of looking at the factors that support sustainability from a social, economic and technical perspective. Social, economic and environmental conditions strongly influence the development of Industry 4.0

(Gajdzik et al., 2021). The process of building sustainable value is continuous. In Industry 5.0, smart industry is being created, a process that was initiated by the concept of Industry 4.0 (Majernik et al., 2021) but, under conditions of a labile environment and strong environmental legislative restrictions, is acquiring characteristics that are described as "Green", e.g. "Green IoT", pointing in favour of using technology to build new aspects of sustainability, e.g. smart circular economy (Fraga-Lamas et al., 2021). The transformation process undertaken requires the refinement or even development of many regulations (Szpringer, 2021), e.g. for data management in blockchain (Leng et al., 2022), product lifecycle monitoring, taming AI (Mubarak, 2022), or securing privacy in blockchain (Singh et al., 2023).

In summary, the direction of building sustainability as a factor supporting technological progress should be considered hypothetical. Sustainability, despite being implemented in Industry 4.0, has been recognised in Industry 5.0 as a determinant (imperative) for building a smart environment.

3.2. Resilience in Industry 5.0

After the outbreak of the COVID-19 pandemic, the European Commission pointed out that the industry was vulnerable to various geopolitical upheavals and natural disasters and therefore introduced the principle of stability (resilient) (EC Document, Jan. 2021). In the last two decades of this century, the effects of a global crisis became apparent twice. The first time, in 2008, when there was a destabilisation of the real estate market in the United States, and the second, after the COVID-19 pandemic in 2020 and its associated consequences, e.g., the energy crisis that became apparent in 2022. The effect of the restrictions imposed, during the COVID-19 pandemic, on the world was to disrupt supply chains. The COVID-19 pandemic made companies (manufacturers) realise how vulnerable (not resilient) global supply chains are to disruption. In response, the European Commission created the 'Recovery and Resilience Instrument'. It serves to support EU Member States to reform and invest in green, digital and socially responsible solutions (Heredi-Szabo, 2022).

In Industry 5.0, activities that strengthen the resilience of supply chains against possible threats and crises are supported, as was the case with the coronavirus pandemic. The topic of technological improvement of blockchain is addressed in both the concept of Industry 4.0 and Industry 5.0. It is sometimes difficult to insert a boundary between activities related to the application of Industry 4.0 and Industry 5.0 or other technological solutions to the creation of blockchain, hence the entries in publications of the form 'Industry 4.0/5.0' (Kaur et al., 2022; Dhiman, Nagar, 2022). Industries have many tools at their disposal to respond to and even anticipate disruptions. Using Big Data and advanced data analysis methods, potential risks can be assessed in real time. Additionally, predictive maintenance in smart factories also supports the maintenance of supply chains. Blockchain technologies strongly linked to the Internet of Things are referred to as BCoT (Blockchain of Things) (Karmakar et al., 2022). Supply chains using smart technologies, are able to 'build resilience' already belonging to a new generation of

chains and are part of Industry 5.0 (Sriman et al., 2022). In these solutions, the blockchain user is placed at the centre (user-centric blockchain) (Yank et al., 2022).

3.3. Human-factor in Industry 5.0

The next important direction of Industry 5.0 is the human-centricity of technology. Prior to the European Commission document (Jan. 2021), which used the phrase 'human-centric', this statement had already appeared in studies by Romero et al. (2015), who used the term: human-automation symbiosis. In the following year (2016), Romero, et al. introduced "Operator 4.0" in "A Human-Centric Perspective on the Fourth Industrial Revolution Technologies".

In the Fourth Industrial Revolution, during the automation of production processes, even before the initiation of the concept of Industry 4.0, attention was paid to the integration of humans with automation (Sheridan, Parasuraman, 2006; Tzafestas, 2006; Lorentz et al., 2015). The cited authors emphasised that increasing automation cannot remove humans completely from workplaces.

The strongly popularised concept of Industry 4.0 called for more attention to the relationship: man and machine. Lorenz et al. (2015) asked: How will technological transformation change the industrial work environment by 2025? As technology advances, the view of the role of humans in production processes is changing. The introduction of new technologies must go hand-in-hand with a discussion of the importance and need for human labour (Daugherty, and Wilson, 2018). While each industrial revolution recognises the power of technology for the development of industry, the achievement of business goals must interact with the development of employees to preserve the human-machine relationship.

In a cyber-physical space, people operate and supervise technologies, teach machines to be intelligent, track processes through real-time data provided from machines and increasingly interact with machines. In the cyber-physical space being built, it should remember the basic principle that technologies that replace human labour must be combined with the capabilities of the people who introduced them (Romero et al., 2015). Industry 4.0 is the combination of key technologies, information and computer systems, processes with their visualisation, intelligent products as well as the competences of people into a single network that oversees itself increasing the efficiency of work execution. At the heart of factories are Cyber-Physical Production Systems (CPPS) (Lee et al., 2015; Lee, 2015; Liu et al., 2017). When a human is introduced into this system one gets an H-CPS (Human Cyber-Physical System) (Flores et al., 2020; Romero, 2016).

Technologies, referred to as enabling (Ruppert et al., 2018), require the involvement of fourth-generation operators: "Operator 4.0". Operator 4.0, due to the breadth of technological solutions employed, can be a device teacher, solution mentor, process controller, robot assistant, machine learning developer, manager for mobile robots, cyber-physical systems analyst, machine-to-machine liaison, artificial intelligence operator, design engineer, wireless computer

network operator, computer application operator, etc. (Rupper et al., 2018). This multiplicity of tasks is a result of and primarily due to the types of communication and communication technologies and systems (Ruppert, et. al., 2018; Romero, and Stahre et al., 2016; Romero et al., 2016). Ruppert et al. (2018), influenced by the study by Romero, et al. (2016), performed an analysis of the interaction of technologies and operators, identifying eight types of 'operators' that could play an important role in industrial production in the Fourth Industrial Revolution (Table 3).

Table 3.
Operator types in the Fourth Industrial Revolution

Original nomenclature	Simplified profile notation	Description of the operator profile
Super-strength operator	Operator + Exoskeleton = Super-Strength Operator	<ul style="list-style-type: none"> The operator with an exoskeleton can increase his physical strength.
Augmented operator	Operator + Augmented Reality = Augmented Operator	<ul style="list-style-type: none"> The operator uses augmented reality devices and he can be an augmented reality developer.
Healthy operator	Operator + Wearable Tracker = Healthy Operator	<ul style="list-style-type: none"> The operator uses the equipment to monitor his physical condition and measure psycho-sociological parameters.
Virtual operator	Operator + Virtual Reality = Virtual Operator	<ul style="list-style-type: none"> The operator uses the virtual world in his work.
Smarter operator	Operator + Intelligent Personal Assistant = Smarter Operator	<ul style="list-style-type: none"> The operator works with an intelligent personal assistant (artificial intelligence).
Collaborative operator	Operator + Collaborative Robot = Collaborative Operator	<ul style="list-style-type: none"> The operator has a collaborative robot to assist him.
Social operator	Operator + Social Networks = Social Operator	<ul style="list-style-type: none"> The work of the operator focuses on social networks. He can be a web designer (webmaster), a web traffic manager, a web architect or a website positioner.
Analytical operator	Operator + Big Data Analytics = Analytical Operator	<ul style="list-style-type: none"> The operator is responsible for the analysis of Big Data and can be a computer network analyst.

Adapted from: Ruppert et al., 2018.

In the Fourth Industrial Revolution and the Industry 4.0, the demand for employees with information technology (IT) and computer skills has increased. The new requirements for employees in the fourth industrial revolution are widely discussed among business practitioners and market analysts as well as in political arenas. Ongoing discussions in scientific circles have been the subject of publications by, among others: Botthof, and Hartmann (2015), Becker (2015), Böhle (2017), Windelband (2014). According to the Industry 4.0 nomenclature, an employee working with new technology is called an "Engineer 4.0" (Astor, 2017), and a manager of smart environments is called a "Manager 4.0" (Gracel, Makowiec, 2017). Companies and educational organisations aim to develop the tech-digital competencies and soft skills of current and future employees.

In the fourth industrial revolution, the focus is on a set of technical skills for building a collaborative environment between humans and intelligent machines (I2M). The acronym I2M (Intelligent Integrated Manufacturing) was introduced by a working group at ESTEP as a manufacturing delivery system that characterises the integrated process of monitoring, control and management of machines (definition from the European Commission's Blueprint study of May 2020). The aim of I2M is to optimise production processes and manage resources efficiently by increasing connectivity between sensor networks used at different stages of steel production. Knowledge of process (equipment) control and conversation methods appears to be a basic requirement for future employees. Employees in engineering and technical positions follow (using IT support technologies) manufacturing processes. Among the technical skills needed are operation of IT-computer systems, operation of intelligent technologies, management of networked distributed devices, etc. In addition to technical skills, analytical and conceptual skills as well as statistical knowledge are needed.

Due to the diversity of Fourth Industrial Revolution technologies, organisations are becoming more open to collaboration between IT teams and technologists in the development of computer systems and technology installations. Many decisions rest on small staff teams led by highly qualified engineers. Operator teams are located in control rooms where process operations are coordinated. Leading operator teams are characterised by technological expertise with knowledge of areas such as additive manufacturing, 3D modelling, data analysis, computer programming and machine learning (European Commission Document, EASME, May 2020, pp. 77-78).

In the European Commission's document, the premise of 'technologies that adapt to people' was proposed. Today the premise of Industry 5.0 is needed in a situation where there is a shortage of skilled workers. Enterprises must, on the one hand, use technologies that people, even without special skills, can handle and, on the other hand, encourage employees to develop technical and digital competencies. According to the Manual 4.0 study (Inspire Consulting), four stages of change can be distinguished from the employee's perspective in the process of adapting new technologies (quoted from: Manual 4.0 document of Inspire Consulting):

- pre-contemplation phase – The employee is not interested in technological changes. From his perspective they are unnecessary. He does not foresee any benefits from cooperation with intelligent technologies;
- contemplation phase – The employee considers action and declares readiness to cooperate with new technologies, but does not actively participate in the introduction of changes (postpones them);
- preparation phase – The employee shows a real readiness for technological change and takes action, e.g., plans to upgrade qualifications, develops new skills;
- action phase – The employee actively undertakes change-related activities by first learning about new systems, technologies, installations, programmes, applications, algorithms, etc., and then starting to work with the new technologies;

- consolidation phase – The employee has been functioning in the new way for some time, is strongly involved in work, working with intelligent technologies provides him/her with satisfaction, and quickly learns new skills, which come almost spontaneously.

The World Manufacturing Forum (Report..., 2019) prepared a list of the most important skills in the Fourth Industrial Revolution (Table 4).

Table 4.
Skills in the future of manufacturing

Skills	Description
Digital literacy as a holistic skill to interact with, understand, enable, and even develop new digital manufacturing systems, technologies, applications, and tools	The employee <ul style="list-style-type: none"> • has basic ability to work with digital systems, technologies, applications and tools. • understands information and computer systems, • operates production lines, • uses mobile devices, • understands process visualisation systems, • has manual skills and other psycho-physical qualities, e.g. speed, reflexes, attention span, etc.
Ability to use and design new AI and data analytics solutions while critically interpreting results	Refers to the use of artificial intelligence and data analytics and the critical interpretation of results. The employee has <ul style="list-style-type: none"> • analytical skills, • statistical knowledge (knows and applies standard quantitative and qualitative analysis tools for forecasting), • conceptual skills. The employee is able to analyse and interpret quantitative and qualitative data.
Creative problem solving in times of abundant data and technological opportunities in smart manufacturing systems	Refers to the use of big data and diverse technologies to find creative solutions. The employee is characterised by <ul style="list-style-type: none"> • creativity, critical thinking, perceptiveness., communication skills. The employee has <ul style="list-style-type: none"> • the ability to work in a team, • organisational skills which enable you to • realise design objectives • and undertaking professional activities. The employee is able to <ul style="list-style-type: none"> • accept and assign tasks in a team, • link cause and effect.
A strong entrepreneurial mindset including proactiveness and the ability to think outside the box	The employee is entrepreneurial. The employee has <ul style="list-style-type: none"> • basic knowledge of economic theory and the nature of the determinants and laws of the economic process, • knowledge of economic analysis. The employee knows <ul style="list-style-type: none"> • enterprise processes, • basic principles of rational management of human, natural and capital resources. • human, natural and capital resources. The employee has <ul style="list-style-type: none"> • the ability to think and reason rationally.

Cont. table 4.

Ability to work physically and psychologically safely and effectively with new technologies	Refers to coping with new technologies. The employee has <ul style="list-style-type: none"> • good physical and mental conditions (state of health, speed of reaction, rationality of thinking, etc.).
Inter-cultural and -disciplinary, inclusive, and diversity-oriented mindset to address new challenges arising from a more diverse manufacturing workforce	The employee has <ul style="list-style-type: none"> • the ability to adapt to technological and process changes (Flexibility Manufacturing), The employee is <ul style="list-style-type: none"> • flexible, • aware of the dynamics of change in the company and its environment. The employee is characterised by <ul style="list-style-type: none"> • knowledge compilation. The employee is able to <ul style="list-style-type: none"> • cooperate with different teams.
Cybersecurity, privacy, and data/information mindfulness to reflect the rapidly increasing digital footprint of the manufacturing value chain	Premise: larger volumes of data mean a larger digital footprint, which needs to be handled responsibly, so you need security systems and staff to handle them. The employee should be <ul style="list-style-type: none"> • aware of the need to protect the company's data and intellectual property.
Ability to handle increasing complexity of multiple requirements and simultaneous tasks	Premise: There are a variety of demands on employees to perform tasks in smart industry. The employee should <ul style="list-style-type: none"> • cope with increasingly complex working conditions. The employee should be characterised by <ul style="list-style-type: none"> • agility, flexibility, adaptability, etc.
Effective communication skills with humans, IT, and AI systems through different platforms and technologies	Necessity: in addition to communication with colleagues, business partners, etc., there is an increasing need to exchange with IT and AI systems on different platforms and using different technologies. The employee is familiar with: <ul style="list-style-type: none"> • principles of communication platforms and systems. The employee knows how to <ul style="list-style-type: none"> • interact with information technologies and operate computer and mobile devices, • work with AI
Open-mindedness towards constant change, and transformation skills that constantly question the status quo and initiate knowledge transfer from other domains	Transformation means being open to continuous change, resulting from technological progress and knowledge transfer from other fields. The employee should be characterised by <ul style="list-style-type: none"> • openness to innovation, • cognitive skills, • knowledge of cause and effect phenomena, • awareness of the interconnectedness of jobs in the production cycle, etc.

Adapted from: "Skills for the future of manufacturing" by The World Manufacturing Forum, 2019.

In a paper on Industry 5.0, published by the European Commission (Jan., 2021), it was pointed out that in reality only four of these skills are digital skills - the others are soft skills, based on creativity, openness and flexibility. The four digital ones include working with information and computer systems and technologies, handling the complexity of manufacturing technologies (technical and technological competences) together with process support information systems, as well as artificial intelligence algorithmic skills (intelligent competences) and analytical skills (Big Data). The competence structure is T-shaped and includes digital, technical and soft skills.

Digital (IT) skills belong to digital competences. The competences¹ can be divided into: basic, extended and advanced. The first group includes competences related to the daily (routine) operation of advanced technologies (automated production lines) together with knowledge of the use of information and computer process support systems. This group also includes the ability to use mobile devices and to use basic computer software. This group of competences is the base for building digital competence of employees. In an IT-dominated world, an employee must be able to use mobile devices and computers as well as operate in internal and external IT networks. Digital competences that are above basic or even advanced include, for example, AI algorithmisation, designing robotic systems, constructing virtual worlds, augmented reality, programming applications, creating data structures, creating interfaces according to user requirements, designing control systems for continuous and discrete control systems using numerical identification and optimisation methods, etc. Digital, or digital, skills need to be continuously transformed due to the rapid development of technology and increasing user requirements. The development of digital competences is supported by openness and flexibility of employees towards technological changes (Gajdzik, Wolniak, 2021; Biały et al., 2019).

In Industry 5.0, the emphasis is on technological support vis-à-vis employees who do not, for the moment, have the right competence. The handling of advanced technologies should be simple and free of human factor errors. This area also seeks to improve occupational safety. EU policy, recognises, justifiably, that industry still has a high accident rate. Human-centred cooperation between humans and machines is expected to contribute to a safer working environment. Robots can perform particularly strenuous and repetitive tasks that involve high physical effort. This has a positive effect on both the health of workers and a reduction in accidents. Work accidents that occur due to excessive physical exertion or health complaints can thus be largely prevented. Sensors detect all disturbing events in the operation of the equipment and inform the operator immediately. The operator does not have to accompany the equipment to its place of operation (he or she does not have to be on the production floor). Monitoring the operation of the equipment is possible from a distance. When a dangerous situation occurs, the machine suspends or slows down operation until the risk is eliminated. Smart cameras are also used to monitor equipment operation. The material collected in this way is sent in real time to a central control room, where the operation of the machines is managed (Gajdzik, 2021; Hancock et al., 2013). Such working conditions can be put: don't do what's dangerous, (the machine will do those things), don't work in conditions that are high risk to your health, (you have an intelligent robot). Changes in working conditions are followed by changes in work ergonomics. There is a need to analyse the relationship: human-technology, in order to parameterise it (Lee, Seppelt, 2012).

¹ Competences consists of skills, knowledge and experiences.

4. Industry 4.0 and Industry 5.0

When comparing Industry 5.0 with the previous concept, Industry 4.0, it is possible to find both common characteristics (similarities) and differentiating features (differences). The range of common features relates primarily to the applied key technologies of the fourth industrial revolution. Unlike previous industrial revolutions, the current transition is no longer accompanied by revolutionary changes. The technologies or pillars of Industry 4.0, such as the Internet of Things, artificial intelligence, Big Data, cloud computing, additive manufacturing processes, augmented reality and virtual world, are also applied in Industry 5.0. Industry 4.0 technologies are available and will continue to play a major role in the development of industries, economies, societies. In addition to the Internet of Things, artificial intelligence or additive manufacturing processes, of decisive importance, for the development of societies and economies, is the 5G network, which has long been part of the ongoing development and the expanded 6G (Dihman et al., 2022).

There is also some correspondence between the objectives of Industry 4.0 and Industry 5.0. Both concepts focus on sustainability and solutions to increase the resilience of supply chains, but in Industry 5.0 there is a greater industry focus on people, social and environmental issues, while in Industry 4.0 there was a greater focus on the development of Fourth Industrial Revolution technologies in symbiosis with the established, (Agenda) goals of industrial and supply chain sustainability.

An important difference between Industry 5.0 and Industry 4.0 is that Industry 4.0 exposes the achievements of the fourth industrial evolution, while Industry 5.0 points to the goals that technology development should provide. Industry 5.0 addresses socio-economic problems and tries to find possible solutions using the technologies of the fourth industrial revolution (Heredit-Szabo, 2022). Industry 5.0 points to key objectives on which the development of industries, societies and economies can - and above all should - be built. Economic and technical goals, e.g., productivity growth, technology intelligence, which were highlighted in Industry 4.0, are encapsulated in the next concept with objectives such as: improving the well-being of workers, protecting the environment and making supply chains more resilient to possible crises.

The Fourth Industrial Revolution and Industry 4.0 focused primarily on the digitalisation of processes and the application of artificial intelligence to improve productivity, and focused less on the role of workers in smart manufacturing or the transformation of supply chains. Industry 4.0 technologies equally impact the economy, the environment and society. Human orientation, sustainability and resilience are becoming increasingly important in Industry 5.0, and the development of digitalisation will be stronger than before. Industry 5.0 is neither a development nor, still less, an alternative to the concept of Industry 4.0. It can be seen as a kind of course correction of the sequence taken by Industry 4.0. There is a preponderance of similarities over differences between Industry 4.0 and Industry 5.0 (Table 5).

Table 5.*Similarities and differences between Industry 4.0 and Industry 5.0*

Directions	Industry 4.0	Industry 5.0
Technology	The technologies of the Fourth Industrial Revolution are the pillars of Industry 4.0: IoT, AI, additive manufacturing, Big Data, computer simulation, digital twin, ICT integration, VR, AR, visualisation.	Fourth technologies are still part of ongoing development but their usefulness for society, humans, ensuring sustainability and stability is emphasised.
Sustainability	Technological development in line with sustainable development of industry.	Highlighting the importance of technological development to achieve radical progress in sustainable development.
Supply chains	Improving supply chains through digitization and technologies of the Fourth Industrial Revolution.	Building the resilience of supply chains using advanced technologies and IoT to economic problems and global crises, as well as other events with global impact.
Human factor	Technology displaces humans, automation of production lines, robotisation of activities.	People at the centrality of technological change, improving working and safety conditions. Technology supports people.
Society	Society 5.0 with smart cities.	Society 5.0 with smart cities and towns.

Adapted from: Przemysł 5.0: Kolejny krok w rozwoju produkcji przemysłowej?, G. Heredi-Szabo, 28 maj 2022 [online] <https://knowhow.distrelec.com/pl/internet-rzeczy-iot/przemysl-5-0-kolejny-krok-w-rozwoju-produkcji-przemyslowej/>; Przemysł 5.0 - człowiek, technologia, stabilność, 04 kwi. 2022 [online] <https://www.mecalux.pl/blog/przemysl-5-00>.

Summary

Industry 5.0 can create opportunities for workers and entrepreneurs while helping the environment. Changing the current approach will not only increase production efficiency, but also make more rational use of available natural resources and provide better working conditions. The opportunities from applying technology to achieve significant improvements in productivity as well as in the sustainability of production and products are numerous. It is difficult to cover them all in one place (topic). It seems right that the EU draws attention to the use of innovative solutions to achieve sustainability and react to unpredictable situations such as: global pandemics, environmental and natural disasters. From the impact of the COVID-19 pandemic, the policy community and scientific bodies have drawn many lessons for the future. It is necessary to build the resilience of industries and economies so that they can better react to disruptions of the magnitude of global disasters. The volatile environment with the 'black swan' that was COVID-19 forced the search for new values in existing development. The Industry 5.0 should be human-centric, resilient, sustainable. Therefore Industry 5.0 is the next step in the industrial revolution process.

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KAIZEN IN SMART MANUFACTURING (SM) PROJECTS: FRAMEWORK AND EXAMPLES OF IMPROVEMENT AREAS

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Purpose: The fourth industrial revolution has a strong influence on changes in enterprises towards smart manufacturing. Technological progress and digital economies created new conditions for business. Currently producers aiming at digitalization of processes and smart manufacturing based on key technologies (pillars) of Industry 4.0. In transformation process, the question arises, from what to start the changes and which path to choose to smart manufacturing (SM). Apart from big projects of SM, changes need the concept of Kaizen based on small steps of changes on workstations towards smart production. The purpose of the paper is the presentation of links between Smart Manufacturing (SM) projects and Kaizen.

Design/methodology/approach: The paper was realized based on literature review and examples of SM projects.

Findings: The study found that Kaizen is evolving with the automation and digitisation of production. IC technologies facilitate Kaizen improvements. The automation of production processes provides insight into historical data through process monitoring. Fully autonomous equipment is equipped with systems for transferring data to a central decision-making system. The machine operator's job is to collaborate with robots and control machine operation in real time using simple data visualisation and warning systems.

Research limitations/implications: The work prepared is of a high degree of generality. Kaizen is implemented at workplaces and is concerned with practical improvements. These improvements are many, following the principle of small steps. The publication focuses on presenting the idea of Kaizen in SM projects.

Practical implications: The paper can have an impact on the practical application of Kaizen in SM projects as it presents examples of Kaizen improvements.

Originality/value The topic of adapting Kaizen to SM projects is a new area of research that will be strongly built upon due to the utility of Smart Kaizen.

Keywords: Smart Manufacturing (SM), Industry 4.0, Kaizen, Lean.

Category of the paper: general review.

1. Introduction

In a strong dynamic business environment, changes in companies are needed, including changes that can be implemented in small steps according to Kaizen.

The Japanese method of the continuous improvement of organisations. Masaaki Imai has spread Kaizen in Japan and beyond (Imai, 2015). Kaizen supports the Japanese concept of Lean Manufacturing as Lean Production (processes without muda) (Abdullah, 2003; Hobbs, 2004). Kaizen is the continuous improvement of processes through the involvement of every employee on the job who thinks lean (Womack, Jones, 1996a). Realized improvements in work lead to increased safety, efficiency and productivity and quality. According to Kaizen, every process can be improved (Womack, Jones, 1996b, 1997).

The concept of Kaizen together with the tools of TPS (Toyota Production System) (Abdullah, 2003) was strongly spread at the end of the last century. Companies around the world have been inspired by lean production, which is supposed to lead them to Lean Enterprise (Womack, Jones, 1994). Lean companies can be agile. Such companies can survive and develop in highly dynamic conditions, characterised by strong business cycles and emerging difficulties in predicting market changes (Bednarek, 2007, p. 33). Quick action, which is the essence of Lean, must be based on the strong activity of companies in the process of business improvement and the strong dynamics of companies' reactions to internal and external changes. In conditions of strong competition, changes must be innovative actions. An important contribution to the science of innovation was made by P. Drucker (1992), who formulated the definition of systematic innovation as a purposeful and organised effort of a company to change the value delivered to the customer. Innovations are new or improved products and services, new technologies, new manufacturing, etc. (Schumpeter, 1960, p. 131). Innovations are built in all phases of business from design, through manufacturing, to marketing activities and customer service (Eagar, Oene, Boulton et al., 2011). During the Fourth Industrial Revolution, innovations have been given new technological capabilities called "Industry 4.0" (I4.0). The term "Industrie 4.0" was first used at the Hanover Fair in 2011. In October 2012, a working group led by Siegfried Dais of Robert Bosch GmbH presented a set of recommended industrial changes to the German government - the final report entitled 'Industrie 4.0' was prepared on 8 April 2013. (Hermann et al., 2005). Industry 4.0 focuses on building cyber-physical systems (CPS) supported by Big Data, the Internet of Things (IoT) and the cloud (Schwab, 2016). The new concept of industrial development is based on economic and social trends, e.g. Society 5.0, digitalisation of business, and customisation of products (Gajdzik et al., 2021a).

E. Toyoda and T. Ohno introduced many new production principles that formed the Toyota Production System. This system is characterised by high flexibility with continuous flow and quality assurance principles. The creation of the key principles of the system (TPS) took more than 20 years (it is assumed that the basic structure of the system was built in 1973).

The concept of Industry 4.0 is based on the digitalisation of business and the development of the Internet. The key technologies (pillars) of Industry 4.0 such as cloud computing, the Internet of Things, Big Data, 3D printing, Artificial Intelligence (AI) with intelligent robots, Virtual and Augmented Reality, and networking with blockchain, etc. have created new opportunities for company development. In technical innovations, the emphasis is on smart manufacturing technologies with learning machines and intelligent robots. Technological innovations are linked to the organisation of work. Industry 4.0 challenges employees to improve quality, to eliminate non-value-adding activities based on the technological possibilities of the fourth industrial revolution. In Industry 4.0, existing Lean methods and techniques find new applications. Examples: at the smart product level, process mapping, and value stream mapping can be applied, at the smart machine level: Kanban cards, SMED, RFID, Andon, and TPM, at the planner level: virtual Kanban (Kolberg, Zühlk, 2015). The results of changes (innovations) should be agile, flexible and intelligent and smart manufacturing. Smart Manufacturing, often abbreviated SM in reference works and referred to as “intelligent manufacturing”, refers to a new global industrial method that relies heavily on the evolution of the latest technologies in terms of connected means of production during the manufacturing process. According to Kusiak, A. (2017) “Smart manufacturing integrates manufacturing assets of today and tomorrow with sensors, computing platforms, communication technology, data-intensive modelling, control, simulation and predictive engineering. Smart manufacturing utilises the concepts of the cyber-physical systems, Internet of Things (and everything), cloud computing, service-oriented computing, artificial intelligence and data science” (p. 509). The main implementers of SM are key technologies such as CPS, big data, cloud computing, IoT, AI, and human/staff education (Wang et al., 2021). In SM, the machines are connected, but also and above all to the Internet to ensure optimal and scalable control of production processes. In SM, the aim is to create new value for the customer using new manufacturing technologies. Lean Manufacturing is useful in building Smart Manufacturing. In the ongoing Fourth Industrial Revolution, a new concept is emerging called "Lean Industry 4.0" or "Lean Digital" or "Lean 4.0" (Powell et al., 2021). According to Powell et al. (2021) "Lean manufacturing that is based on participation and standardized practices can take advantage of the collaborative environment and structured data collection and analysis offered by Industrial Internet of Things (IIoT) and Cyber-Physical System (CPS) technologies. Lean Manufacturing is based on the new technologies of Industry 4.0, which enable companies to build cyber-physical production systems that are strongly linked to IIoT - the Industrial Internet of Things. Industry 4.0 enriches the Lean Manufacturing concept through the opportunities provided by information technology, artificial intelligence and machine-to-machine (M2M) collaboration (Gajdzik, Kowal, 2020). Sum up: on the one hand, it is impossible to develop Industry 4.0 without Lean tools, and on the other hand, Industry 4.0 increases the effectiveness of the Lean concept and creates new opportunities for its development and introduction of new or improved tools in digital business. But Lean does not

exist without Kaizen. New application possibilities have emerged for the Kaizen concept within the disruptive technologies or pillars of Industry 4.0. Example 1: Kaizen uses virtual space and digital twins. Simulation tools allow manufacturers to first test a project in the virtual world and then implement them in the physical world. Example 2: Computer technologies (IT) do easier Kaizen. Barcodes, Radio Frequency Identification (RFID) (Gladysz et al., 2017; Gladysz, Santarek, 2019) and mobile devices create new opportunities for the development of processes. Riezebos et al., (2009) state that IT complements Lean and improves Kaizen. Example 3: Wireless technologies are strong support for A3 cards, Andon, Heijunka, JiT, Kanban, Poka-Yoke, SPC/SQC, supermarket, TPM, TQM, VSM (Gladysz, Buczacki, 2017, 2019). At the stage of planning activities and developing projects of workstation digitalisation it is worth applying Kaizen, expecting bottom-up (employee) initiatives. Changes implemented at individual workplaces will in time create Smart Manufacturing. According to the idea of Industry 4.0 companies want to be smarter. The road to Smart Manufacturing, according to the idea of Kaizen, is implemented in small steps, from individual workstations through production lines to smart factories and entire supply chains.

This paper aims to provide a general understanding of Kaizen in Smart Manufacturing (SM) projects. The work is based on a literature study and SM projects realized step by step. The basic research question can be formulated as follows: Who Kaizen turns the processes into smart.

2. Kaizen framework for smart manufacturing (SM) projects

Smart Manufacturing (SM) projects include production technology modification projects and new machine investments, IT projects, operation visualisation projects, process monitoring projects, activity automation projects, machine data collection projects, etc. (IEC PAS 63088:2017). Modern technologies are based on the digital modelling of processes, which allows the production system to take the differing wishes of customers into account at each stage of production but smart products are determined by production costs (Aheleroff et al., 2017). The status (position) of a Lean company is achieved primarily through the comprehensive elimination of all kinds of waste (muda) (Walentynowicz, 2013). Industry 4.0 exposes smart changes that take place within companies and across entire supply chains (Kagermann et al., 2011). Both Lean Manufacturing and Smart Manufacturing aim at improving processes and work organisation. Lean focuses on lean manufacturing and smart focus on technology intelligence and process agility. According to Soder (2017), smart manufacturing is another form of manufacturing evolution. Soder outlined the evolution of manufacturing systems from conventional systems through flexible, computer-integrated systems to Lean Manufacturing and Industry 4.0 (Figure 1).

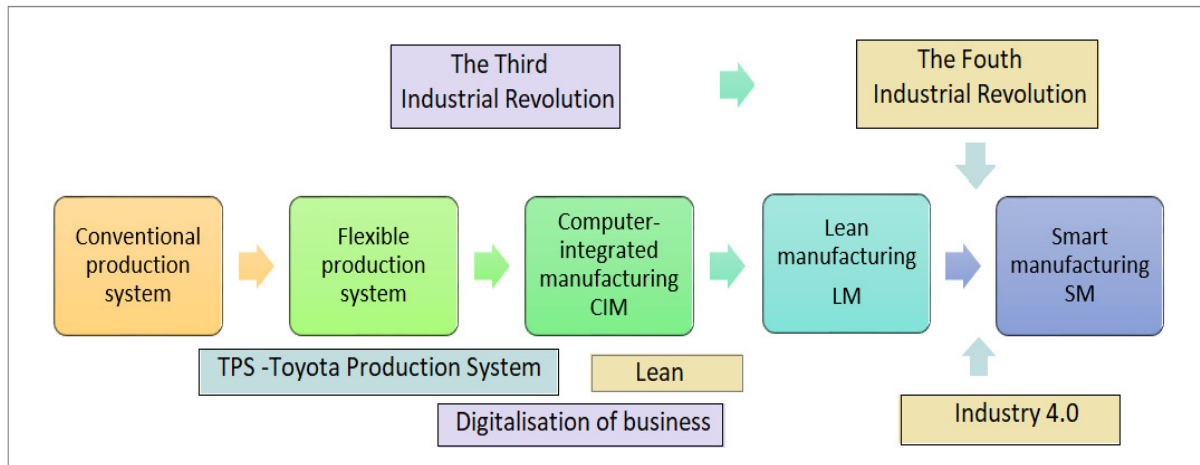


Figure 1. Evolution of production systems. Adapted from: „Von CIM über Lean Produktion zu Industrie 4.0“, by J. Soder, 2017 In T. Bauernhansl, B. ten Hompel, B. Vogel-Heuser (Eds), Handbuch Industrie 4.0, Band 1: Produktion, Springer, Wiesbaden.

The source of ideas for Lean Manufacturing is Kaizen, which starts with bottom-up initiatives (employee proposals for eliminating waste). The main assumption of the Kaizen philosophy is the continuous improvement of business processes. The beginning of changes (building smart workplaces) is Kaizen workshops and Kaizen idea boxes. The vast majority of enterprises start implementing Lean Manufacturing with the 5S method. The next tools are used at the stage of improving the efficiency of machine operation as part of TPM or reducing the changeover time of equipment - SMED. Over time, the number of projects is increasing and the Lean methods and techniques used are complemented by further tools, including those belonging to quality management, and Key Performance Indicators (KPIs) (Walentynowicz, 2013). For KPIs, from an extensive list, companies select the most useful indicators for their industry and business (SLMP report).

The main assumption of the Kaizen philosophy is the continuous improvement of business processes. Tools such as PDCA, 5Why, FMEA, Ishikawa diagram or Pareto-Lorenz diagram are used to detect the sources of the problem (Imai, 20016, p. 49). Lean methods when combined with quality building methods create new technical modules for process improvement and quality management systems, e.g. 6Sigma on Lean, FMEA in Lean, Quality Kaizen, 5S and Work Quality (Bicheno, Holweg, 2016). Kaizen allows employees to organise and improve their work. Employers encourage employees to propose changes and complete Kaizen requests. Subsequent ideas from employees contribute to improving processes and eliminating unnecessary activities and operations. The following forms of Kaizen are used in enterprises: Quick Kaizen (QKaizen), Standard Kaizen, Major Kaizen and Advanced Kaizen (AKaizen) (Piasecka-Głuszak, 2017). QKaizen is used to solve problems that can very easily be eliminated "on the spot" or in a short time (less than a week). The problem is eliminated by the machine operator or the work team leader. In contrast, AKaizen involves many people and addresses a difficult problem. AKaizen uses tools such as PPA, DOE, Six Sigma, etc. Among the mentioned forms, QKaizen is the basic form because it quickly empowers workstations

(Piasecka-Głuszak, 2017). The applied continuous improvement Kaizen in Industry 4.0 is called Digital or Intelligent Kaizen because of the use of digital technologies to detect losses in processes (Mohan et al., 2022). The IT market is helping companies build Smart Kaizen Systems as intelligent systems in smart manufacturing.

The way toward SM is an individual decision for each company (Gajdzik et al., 2021b).

Companies embarking on building a smart environment very often use, especially during the preparation of the first pilot projects, the help of external IT companies. Many IT companies provide off-the-shelf digital solutions and packages of smart technologies and services. The advice of specialised companies helps manufacturers to build cyber-physical production systems (CPS). External companies advise manufacturers during the selection of key IT technologies and during the performance evaluation phase to achieve a high return on investment (ROI). In addition to large projects with the support of external companies, companies can implement smaller projects initiated by employees according to Kaizen principles, which focus on workplace improvement by using digital technologies and mobile devices and process visualization.

Small Kaizen (SKaizen) is applied at the stage of developing smart manufacturing (SM) projects for specific workstations. Smart workplaces are created in stages based on the ideas (initiative) of the employees themselves (machine operators). The SKaizen method involves achieving Smart Manufacturing step by step, station by station, machine by machine, operation by operation, etc. In Japanese companies, the Kaizen method is strongly promoted in digital enterprise projects concerning individual machines, installations and workstations, so that over time the project develops into digital production lines and digital factories or entire supply chains. The first projects can be implemented in small steps while keeping investment costs at a moderate and acceptable level. In large investments and implementation of many projects, the planned costs are high and the expected results of production optimisation are delayed. Many Smart Manufacturing projects start with the manufacturing process and, over time, include processes centred around production and even supply chains (Gajdzik, 2022).

Technologies of Industry 4.0 create new opportunities for process improvement in enterprises by connecting smart devices on the shop floor through access gateways, combining digitalised operating procedures with cloud technology, sharing real-time process data, ongoing analysis of performance indicators (KPIs), and using 3D printing and other advanced technologies to manufacture more complex products at workstations (Gajdzik et al., 2021). Digital technologies and integrated computer systems together with process simulation and visualisation, data analytics enable both product creation and the definition of manufacturing and service processes in supply chains (Szozda, 2017). Digital process integration takes place through IoT platforms that connect business applications and IT-computer process support systems (ERP, CRM, PLM) with machines, products, materials and components. Individual business web applications connect to social media and users' end devices (laptops, computers, smartphones, tablets). The combination of the real and virtual worlds improves the functioning

of supply chains by equipping them with advanced technologies for production, transport, storage, and distribution (Christopher, Towill, 2000). In Industry 4.0, Kaizen acquired a new frame of reference, which is cyber-physical solutions, as coherent reference structures of the combined virtual and physical world of manufacturing, computer-aided manufacturing, communication and production control systems (Lee, 2008). The centre of the structure is formed by intelligent, networked machines independently performing repetitive tasks and exchanging information, and through learning algorithms, able to adapt to change (Castro et al., 2012). In the fourth industrial revolution, Kaizen refers to the level of influence and effectiveness of implementing Industry 4.0 solutions in companies. The concept of Kaizen is very useful to achieve process efficiency in small steps. The application of Kaizen helps many companies to implement intelligent technologies at individual workstations and individual installations (machines). By applying Kaizen, the operational team of employees outlines (suggests) the development paths of digitisation projects at workstations. Changes in small steps at workplaces are categorised as small Kaizen. The large ones use advanced computer process simulation and product prototyping systems based on digital twin models. With small Kaizen, many digital improvements in production can be implemented immediately, even at no or low cost. Large projects - huge investments (e.g. construction of a new hall fully equipped with intelligent machines) require many financial and economic analyses, as well as many very detailed analyses of optimisation of processes, the productivity of equipment, energy savings, the flexibility of supplies, availability of staff, staff reorganisation, levels of equipment cooperation, process innovations, quality of processes and products, customer expectations, as well as social and environmental analyses. In small projects, the quality of the work is assessed above all, which is continuously improved following the Kaizen concept. The bottom-up initiative of changes allows factory owners and production engineers to analyse the validity of implemented solutions at a specific work in the context of cost efficiency and directions of improvement. Employee projects take into account the ideas and suggestions of contractors (machine operators, process plant managers, facility managers) to improve their work. In modern Kaizen, it is not necessary to write down change proposals by hand, as computers and mobile devices streamline the transmission of proposals (image, video, etc.). Increased access to digital information shortens the execution of activities and provides the ability to use data (search for relevant data) to improve processes (Lee, 2015). The management of processes and, in particular, the prevention of equipment, failures is facilitated by the use of advanced analytical algorithms and machine learning techniques based on the vast amounts of data collected by individual sensors. Having the right data is not a guarantee of production improvement, data must be able to be analysed and, above all, understood. Data from multiple sensors must be filtered and processed to be useful for the content process optimisation task (Lee, 2015). Machine operators gain greater accessibility via the network to all relevant information from all processes in real-time. Production visualisation and mobile devices enable optimal data to emerge from the information flow at any time and according to different

evaluation criteria: cost, resources, quantity, quality, availability, time, productivity, etc. (Kiraga, 2016). New manufacturing technologies - additive technologies - 3D printing and others make it possible to produce complex-shaped products at the workstations without additional quality improvement operations. A similar effect is obtained by using multi-tasking machine tools, e.g. machining centres. Multi-tasking technologies contribute to the reduction of transport, storage, inter-station operations, etc. (Gładysz, Santarek, 2019, p. 944). As learning machines evolve, machine operators require more and more support during process improvement from IT teams (Gajdzik, 2021). Kaizen is applied at the each of stages of CPS development. Lee et al. (2015) identified five levels of CPS architecture within the collaboration of physical processes and digital space. The different levels of CPS correspond to the functions of technology in smart factories. The first, lowest level includes data collection and interpretation - the Connection level. The second level is the application of modern technology for analysing process performance - analytics capability - the Conversion level. The next level includes monitoring of work (processes) in real-time - real-time acquisition, and comparing monitoring - the Cyber level. The fourth level is called the Cognition level.

At this level, technologies strongly support humans in optimising processes. The fifth (highest) level is services, processes, and network configurations - the Configuration level. At this level, machines have cooperative learning and adaptive and executing algorithms. The participants in Kaizen are the operators of machines and process technology with the support of staff IT (Lorenz et al., 2015). Kaizen participants are operators of smart technologies, which Romero calls 'Operators 4.0'. D. Romero used the name to describe the role of humans in cyber-physical systems (Romero et al., 2016a). The cyber-physical system with human factors, abbreviated as H-CPS, is based on the cooperation of humans and machines in more and more intelligent processes (Sun et al., 2020). In the cooperation human with machines in cyber-physical production systems, the operators can take on various roles, such as virtual operator, using VR, smarter operator, being a personal assistant of this technology, operator cooperating with robots (collaborative operator), analytical operator and many others (Sun et al., 2020; Romero et al., 2016b; Rupper et al., 2018). The cooperation is supported by computer models and simulations that provide new techniques, e.g. in predictive maintenance. Plant operators and managers are using a wider range of mathematical and statistical techniques in product design and process improvement.

Widespread employee access to wireless technologies supports suction systems, e.g. e-channeling. Employees equipped with mobile devices collect and transmit data faster, e.g. within SPC, SQC, TPM systems, etc. (Gładysz, Buczacki, 2017, 2019; Gladysz, Santarek, 2019, p. 945). Kaizen participants use process mapping and evaluating their progress is easier in CPS. Information technology facilitates the synchronisation of process maps with information and computer systems, e.g. ERP. Value stream maps (VSMs) with extended MRP (Material Requirements Planning) system components are called SyVSM (synchro-MRP VSM) (Bertolini et al., 2013). Enhanced process visualisation systems make it easier for employees to

make adjustments during value creation (Rother, Shook, 1999). In cyber-physical production systems, the product takes on smart characteristics and a new framing of quality, which is called: smart quality (SmartQ). SmartQ consists of utilitarian and emotional values and most of all the degree of personalisation of the product. Kaizen is one of the promising alternative strategies for achieving continuous improvement of processes performance by identifying a company's value stream and then systematically removing all waste (Logu, 2021). Determinants of Kaizen are the following smart levels, i.e. smart product, smart machine, smart operator and smart planner. At the smart product level, operators use process mapping and value stream mapping. At the smart machine level, Kanban, SMED, RFID, Andon, and TPM with prediction are used. At the planner level, traditional and virtual Kanban are used (Mrugalska, Wyrwicka, 2017).

Wagner (2017) ranked the usability of Lean tools according to digital and smart data access and distinguished such levels: (1) data acquisition and processing, (2) machine-to-machine communication - M2M, (3) human-machine integration - HMI. The highest level of usability when it comes to the application of Lean tools in smart manufacturing is standardisation, the second position belongs to Kaizen, and the third to Just-in-time. The next positions are occupied by: Jidoka, Heijunka, teamwork, pull flow analysis, and time settings. The last place belongs to 5S (due to the replacement of manual activities by intelligent technologies). Lean Manufacturing with Kaizen is a base for Smart Manufacturing. In the evolution of production systems, the following features are exposed: importance, priority, key, flexibility, continuity, validity, agility, and personalisation. „Lean is one of the prevalent approaches in the present scenario because it uses several strategies to focus on the elimination of non-value-added activities along with resource utilization” (Beifert et al., 2018). Lean and Smart cause a considerable decrease in resources waste and increase productivity (Sanders et al., 2016). Lean and Smart principles focus on dynamic production variation and are seen as more efficient than traditional manufacturing (Beifert et al., 2018). The discussion shows that process simplification and improvement activities support the implementation of Industry 4.0 and vice versa (Figure 2). Lean production systems came before Smart Production Systems and now laid the foundation (base) for smart production.

To start smart manufacturing (SM) projects (abbreviated: smart project), the company performs a diagnosis of the technological state and the employee reflects on the quality of his work. The project team marks the current place where the company is before the implementation of the project (state diagnosis), as well as the place to which the company is aiming.

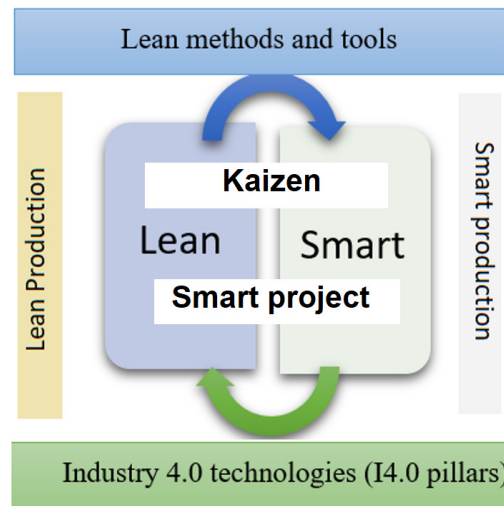


Figure 1. Kaizen in smart production.

Source: own elaboration.

The basis for many SM projects is the digitisation of workstations, therefore the company checks whether it electronically collects workstation data (data from machines, installations), if not then it begins this stage, if so, the data collected from machines must be visualised and the results from specific devices must be provided for analysis to managers and/or designers, who make decisions on the directions of process optimisation. The basis of new technological projects is the integration of information systems so that the introduced technologies do not perform many unnecessary activities, such as re-entering data. When introducing Kaizen at this stage, the employees (operators) look for problems related to the lack of data at particular stages of the process and the lack of possibility of the ongoing improvement of operations. The projects to eliminate the data gap are linked to projects to equip machines with intelligent sensors. Projects for the purchase of sensors and their installation on machines, together with the gradual modernisation of existing technology, are implemented in small steps from individual machines operated by operators. Even if it is assumed that ultimately the number of machine operators is to be reduced to a minimum or even to zero, some employees will remain. These will most likely be IT specialists and operators of intelligent equipment, who are currently lacking in the labour market. With gradual projects (implemented in stages), the company can train staff to operate the machines. It takes time for new staff to become familiar with the production profile, technologies and organisational principles. In addition, in the course of large investments, an additional social risk factor appears - in the form of employees' fear of losing their jobs when starting new investments in a fully intelligent factory, while the phasing of changes implemented during the small project of process modernization allows for reorganization of the human factor and preparation of employees to operate new functions of the equipment. Modern technologies are used at the stage of employee training, e.g. virtual reality. To assimilate Smart Kaizen principles, an employee needs to interact with virtual and augmented reality. Computer modelling and simulations help employees to

implement changes. Simulations support the design and evaluation of Lean Manufacturing systems. Employees also use simulation and modelling to verify Kaizen conclusions and forecast directions for process and product improvement. Once one station is optimised, operators (participants of Kaizen) can move on to the next one until they reach the entire production line. Of course, according to project management, at each stage of the project, you need to provide adequate resources and analyse the costs of investment (ROI) (Heagney, 2012).

Smart manufacturing projects are based on Key Performance Indicators (KPIs) in the fields of productivity, quality, maintenance etc. (Kumagai et al., 2017, ISO 22400-1:2014). No decisions should be made until a sound economic and financial assessment of the project has been completed. Each enterprise establishes its way of achieving smart manufacturing, and each of the ways differs from the others in terms of the scope of activities, the time required to implement changes, costs, ROI value, and additional investment costs. The aim of SM projects is significant operational improvements and measurable process optimisation. A mistake made during process digitalisation projects is to assume that the implementation must be fast and complete - as a result of extensive activities and large investments. Managers would like to build the new factory of Industry 4.0 within a few months. This cannot be done for several reasons. The first reason: large projects are difficult to justify economically. The second reason: the period of return on investment (ROI) may be longer than planned. The third reason: there are difficulties in estimating particular risk categories e.g. natural, technological, market, etc. Example of a large-scale investment: the construction of a new facility equipped with machines that meet all the criteria of the requirements of intelligent production in terms of data collection and transmission. Example of a small project: installation of sensors on machines and data collection and step-by-step replacement of machines with intelligent ones. Planning large investments requires more time and many more analyses of the legitimacy of the planned investments than smaller projects. The path of digital transformation of companies through Kaizen starts with small changes in workstations, where the costs are small or the changes are almost completely costless. In small projects, measuring the effects and learning lessons are done almost on an ongoing basis. After one project the next step is taken, from one machine to another, from one workstation to another, and from one line to another, until a smart factory is created. The method of small steps in Smart Manufacturing projects is realized by the Japanese company Mitsubishi Electric. On the corporation's website in the news section, you can find a lot of information about the project activities undertaken using the SMKL methodology - Smart Manufacturing Kaizen Level (IAF, 2020).

3. Examples of Kaizen in smart manufacturing (SM) projects

Project 1: Step-by-step automation of work (production). Initial state: activities were previously performed by humans, without much involvement of industrial automation systems. Activities: introduction of cobots to collaborate with humans. The project requires relatively little investment. Investment tasks: (Task 1) purchase of an IC system to enable contact with software to control and optimise work operations, (Task 2) purchase and installation of equipment for automated work, including cobots and, in the long term, intelligent robots. If these activities were previously performed by humans, automation can bring tangible benefits and at the same time initiate a transformation towards smart manufacturing.

Kaizen questions about automation of work operations: (Question 1) What work operations cause losses? (Q2) What work operations can be improved? (Q3) Which work operations are repeatable on the workstations? (Q4) What work operations create value for the customer? (Q5) What work operations are dangerous for workers? (Q6) In which work operations is there a high level of human error? (Q7) Which work operations are determinants of product quality? (Q8) What work operations can be done in less time? (Q9) What work operations produce the most waste?

Traditional industrial robots are often better suited to many applications in the field of fast and precise assembly, while cobots are indispensable for increasing the flexibility of the production line. They also make it possible to specifically support people - for example, when taking goods out of crates or putting them in, whereas conventional industrial robots tend to work independently rather than together with workers. Cobots are also better able to handle tasks involving pallet handling, machine maintenance and material handling. Other applications include machine loading, order picking, packaging and testing.

Kaizen questions about reasons for changes and work organization: (Q1) Why should cobots and robots be implemented? (Q2) Considering the process conditions, are cobots or fixed-mounted robots better? (Q3) Which tasks (operations) will be allocated to robots and which to cobots? (Q4) What is expected of robots and cobots? (Q5) Where will the cobots and robots be located in processes? (Q6) What movements should the robots make? (Q7) Should the robot be controlled by external experts or the machine operator? (Q8) What kind of part production and performance is needed? (Q9) Is repeatability or precision essential? (Q10) Is an integrated robot vision system or vision inspection system required? (Q11) Is it better to choose a fixed-mounted system or rather a flexible collaborative robot?

To operate industrial robots, workers must be qualified. Completion of training is essential. The worker must take part in theoretical and practical training. It is also important to learn health and safety principles to be able to follow them later during work. This is very important for worker safety. Questions about operator knowledge and skills: (Q1) Are workers able to quickly develop the knowledge needed to operate the robots? (Q2) What training is required to

operate robots? (Q3) Will the knowledge and skills of the operators be used at another stage of the production process?

Automated production systems operate on a physical product in a factory. They perform operations such as processing, assembly, quality control or material handling, in some cases carrying out more than one of these operations in the same system. Kaizen questions about the results of changes: (Q1) Does the automation of production operations increase productivity? (Q2) Do robots and cobots reduce labour costs? (Q3) By how much will the defect rate decrease? (Q4) Will production lead times to decrease? (Q5) Will stock levels fall? (Q6) Will storage costs be reduced?

Project 2: Implementation of the Poka Yoke system at the assembly station. Initial condition: the company relies on the knowledge and predisposition of its employees. Task: equip the assembly stand with electronic documentation of the process, preferably supplemented with 3D computer models, divide the production process into elementary activities, during which the worker uses individual assembly elements, subassemblies and tools, places the parts in lockable containers, sometimes additionally equipped with light signals. The course of operations: once the assembly of a new device has started, the worker is guided step by step through the system opening the containers with the elements to be used at a given moment. Similarly, manual or pneumatic (electric) tools are only unlocked at precise stages of the assembly cycle. The result: a lower risk of mistakes, an increase in the employee's efficiency, the plant receives objective information about the time of performing particular activities and the efficiency of the workplace (Adapted from: www.iautomatics.pl).

Kaizen question about work documents: (Q1) What documents are needed at the workplace? (Q2) What data is transmitted electronically? (Q3) What data is missing in the electronic documentation system? (Q4) How to simplify data transfer? (Q5) What forms of process data visualisation to use? (Q6) What kind of report to generate in the workplace?

An assembly line usually consists of a conveyor or set of conveyors, assembly stations, industrial robots and manipulators, and support equipment. An assembly line forms a transport line with a defined cycle of assembly stations (either universal or dedicated to each operation to be performed on it). The workstations are equipped with specially designed auxiliary equipment. Depending on the size of the space available to the client for setting up the line, and also taking into account the operating times of the individual workstations, assembly lines can be constructed as straight lines or L- or U-shaped lines. If there are also auxiliary operations, there may be stations or nests for component assembly in the vicinity of the line.

Kaizen questions about assembly stations: (Q1) What is the current work rate? (Q2) What are the working times at the workstations? (Q3) What is the coordination of the machines? (Q4) Is the transport line universal or dedicated? (Q5) What work movements does the worker carry out at the workplace? (Q6) What are the workstation types of equipment? (Q7) Are all work tools needed? (Q8) Are the employees able to keep the workstations tidy?

(Q9) How to improve the movement of manufactured product parts? (Q10) Are the workstations ergonomic? (Q11) How to achieve a better work sequence?

Project 3: Embedding sensors in machines. Initial state: check if the machine is collecting data. If not, plan an action: how to collect information from the machines, how to visualise and provide the results from a specific device for analysis to the managers making the decision. End state: predictive maintenance. Tasks: stage 1: production data is stored in an electrical database (production data and machine status), machine status is collected and stored in an electrical method, either automatically or by simple actions (example: scanner, code reader), status: electrical copy, daily report of machine operation, stage 2: data used to manage the production facility is indicated by an HMI device such as a monitor or PC display, but is not analysed (graphs and lists are automatically generated in real time based on the collected data from the machine), status: generation of graphs and lists using computer programs (graphs and lists contain real-time analytical data), stage 3: the system can analyze data, the system automatically warns operators when action variance correction is necessary, state: notification is automatically given to decision makers (operators), stage 4: automatic processing and application of algorithms using AI to recognise and perform improvement based on results - systems automatically perform feedback checks, state: use predictive maintenance based on digitised data to optimise production and maintenance plan (Adapted from: She et al., 2019).

Kaizen questions: (Q1) Is the machine collecting data? (Q2) How to collect data from the machine? (Q3) How to present machine data? (Q4) Where to store machine data? (Q5) What data is needed for predictive maintenance? (Q6) What data is needed to build a system to alert operators to equipment faults? (Q7) Which devices communicate with each other? (Q8) What solutions does the device's operating panel have?

4. Concussion

The general knowledge presented about the use of Kaizen in Smart Manufacturing projects can be useful at the stage of planning and developing changes that start at individual workstations or machines and in time end up in Smart Manufacturing. Each project is geared towards a specific goal. In line with Kaizen, it is worthwhile to involve employees at the stage of planning and improvement projects at workstations, and even to hand over the initiative for implementing changes to them, especially at the stage of improving the project at the control workstations. In Industry 4.0 Kaizen and Smart Production can coexist, especially at the beginning of the companies' journey towards smart factories. When the company has a high level of digitalisation, it can use smart Kaizen based on digital twins and other solutions of the Industry 4.0 technologies and pillars.

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CAPITAL STRUCTURE VS FINANCING RULES – THE VISEGRAD GROUP COUNTRIES

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Purpose: The purpose of this paper is to investigate whether the capital structure of stock exchange listed companies in individual countries of the Visegrad Group differs significantly, and whether these entities can be considered to be organizations implementing the principles of the golden and silver rules of accounting.

Design/methodology/approach: The research hypotheses assumed were verified using appropriate statistical tools. Calculations were performed using the Gretl software and MS Excel.

Findings: The basis for operating activity financing in the companies under examination mainly entailed equity. In practice, this means that most of the entities surveyed follow the silver, less frequently the golden (the more restrictive), rule of accounting. The results obtained for each country of the Visegrad Four differed significantly. The research conducted provides a basis for determining whether the golden and silver rules of accounting constitute factors affecting the decision-making regarding capital structure formation in companies listed in the Visegrad Group countries. The study covers companies listed in the four countries and provides a basis for further research in this area, with respect to both the sample size and the time series length.

Research limitations/implications: The paper takes into account only listed companies, so its results do not explain capital structure behavior of other companies. The research is a contribution to further analyses of the capital structure, which covers all types of enterprises.

Practical implications: The research conducted provides a basis for determining whether the golden and silver rules of accounting constitute factors affecting the decision-making regarding capital structure formation in companies listed in the Visegrad Group countries. The study covers companies listed in the four countries and provides a basis for further research in this area, with respect to both the sample size and the time series length.

Originality/value: The most important principle of financing is that firms should try to match the characteristics of the financing as closely as possible to the characteristics of the assets being financed. Unfortunately, only a few studies on this subject can be found, especially internationally. Our research aims to fill a gap in the literature on the subject. It made possible to identify financing rules characterizing capital structure of the companies operating in different economic conditions. The study may be addressed to analysts, investors and managers of companies as well as researchers conducting research in corporate finance area.

Keywords: equity capital, golden and silver rules of accounting, golden and silver rules of financing, V4.

Category of the paper: research paper.

1. Introduction

The primary source of operating activity financing for any business entity is equity, which constitutes a determinant of enterprise development potential. The amount of a business entity's equity capital thus determines its economic strength as well as its asset and capital standing. The relationships between the capital structure and the assets structure are determined by balance sheet rules. Asset and capital structure shaping in accordance with these rules enables any enterprise's financial balance to be maintained. This structure, however, is affected by various, both macro and microeconomic, conditions. One of such conditions entails the so-called 'country factor'. The varying degree of capital market development, under the differing economic conditions in individual countries, is one of the reasons behind the diversity in asset and capital structure. The Visegrad Group (V4) can serve as an example here. In the 14th century, during a congress held at the Visegrad Castle, the rulers of Poland, the Czechia, historically known as Bohemia, and Hungary undertook close cooperation on political and economic matters, which inspired the signing of a declaration, in the early 1990s, on cooperation on the path to European integration of Poland, Hungary and initially Czechoslovakia, later the Czechia and Slovakia. These countries were at a similar level of socio-economic development at the time. The four countries did not develop at the same pace thereafter, however. The differences became visible, inter alia, in the levels of capital market development. Moreover, V4's countries participation in the EU can be called difficult. However, the countries managed to advance in further integration into the EU while maintaining the heterogeneity of economic results within the Visegrad Group itself (Chetverikova, 2020). The article thus aims is to ex-amine whether the capital structure of stock exchange listed companies in the Visegrad Group countries is maintained at proportions accordant with the rules of accounting, and whether relations exist between the assets structure and these rules. If the company follows the golden balance rule, then the fixed assets are financed by equity. Many companies are not able to meet such a restrictive rule. In this case, companies apply a silver financing rule, which means that the fixed assets are financed by equity plus long-term debts. Therefore, it is worth checking whether the analyzed companies shape the capital structure according to the rules of financing, and if so, according to which of them. Thanks to this study, it will be possible to determine what dependencies are characteristic of the Visegrad Group companies and on this basis to determine their financial stability, which is reflected into the level of attractiveness of these entities for business partners and investors.

Implementation of a such formulated research objective involved verification of the following hypotheses:

1. The capital and asset structure of stock exchange listed companies in individual countries of the Visegrad Group differs significantly.
2. The stock exchange listed companies of the Visegrad Group strive to synchronize the maturity of their sources of financing with the period in which the assets financed via those sources are used.

The above hypotheses were verified by appropriate statistical tests. The calculations were carried out using the Gretl software.

The assets structure was expressed by the ratio of fixed assets to total assets. The golden balance rule was determined by the ratio of equity to fixed assets, and the silver rule by the ratio of fixed capital to fixed assets. The analysis covered 259 non-financial companies listed in the Visegrad Group countries between 1998 and 2020.

The article consists of an introduction, four parts and a conclusion. The second part is theoretical in nature and presents a description of the concept, importance and types of capital involved in business entity activity. The third part entails an overview of the existing research on the formation of the age structure of assets and the term structure of liabilities. The fourth part is methodological in nature and includes a description of the measures used in the study of the asset and capital structure and dataset. In the last section, the results of the research and discussion are presented, followed by a conclusion summarizing those results.

2. The essence, importance and types of capital in business activity

The concept of capital is most commonly understood as the financial or material (in-kind) contribution to the economic process. Along with labor and land, capital is the third factor of production imperative to undertaking and upholding business activity. Capital can be defined as the totality of the internal and external, own and debt, term and perpetual resources engaged in a business entity. This means that the category can be equated with the sources of asset financing, i.e., the balance sheet liabilities (Gabrusewicz, 2014). Capital can be subdivided based on the criterion of its ownership structure, by which the following can be distinguished:

- a) equity capital,
- b) debt capital.

The Polish Accounting Act does not define the concept of equity directly, but only specifies that, in value terms, equity is equal to net assets, i.e., it entails an entity's assets less debts, corresponding in value to equity (own funds). In the broadest sense, thus, equity corresponds to that part of assets, which is owned by the business entity. These assets can be covered by equity in a twofold manner: first, the company founders can contribute adequate funds to

finance these assets, and thereby create share (paid-in/initial) capital; second, equity capital can be accumulated from the net profit earned in previous years. Capital sourced in such manner is referred to as self-financing (internal financing) and constitutes the most important financing resource enabling further company growth. The key importance of equity capital is signified by the functions it performs in a business entity, which according Gabrusewicz (2014) entail: a founding function, a financing function, a revenue function, a warranty function, a protection function, a motivational function, a controlling function.

Undoubtedly, the most important of the above categories are the financing and the warrantee functions. In terms of the financial function, equity is identified as any financing vehicle that has a residual claim for the firm, does not create a tax advantage from its payments, has an infinite life, does not priority to bankruptcy, and provides management control to the owner (Damodaran, 2017).

The second of those categories (warrantee function), on the other hand, represents a liability repayment guarantee. Accordingly, it can be concluded that the amount of a company's equity reflects its value (Adamczyk, 2007).

Equity financing brings both benefits and costs. A high proportion of a company's equity capital increases the security of its investments. This type of capital is costly, however. The higher the value of equity, the lower its profitability, compared to enterprises with high proportions of interest-bearing debts in the structure of liabilities and the same rates of return on total assets (Pomykalska, Pomykalski, 2017). Different conclusions were drawn by Guliyev and Najafov (2019) who analyzed the impact of equity financing on firm efficiency. Their research shows that the strongest positive impact on firm efficiency is provided by equity financing.

The concept of debt capital, in turn, refers to a company's debts. Debt capital can be raised through borrowing, issuing bonds, using leases or financing via trade payables (Maćkowiak, 2009). All debts constituting the source of debt capital are of term nature. This means that these assets are granted to an enterprise for a specific period of time, after the expiration of which, they must be paid back to the creditor, with interest. With regard to the criterium of the length of the time after which these assets must be repaid, short-term liabilities (up to 1 year) and long-term debts (more than 1 year) are distinguished. Equity plus long-term debts is referred to as the so-called fixed capital.

Pederzini and Taniolo (2020) emphasize that lack of appropriate financing is a major issue for European small or medium-sized enterprises. They are highly dependent on bank lending for external funding, while there is a strong need for wider use of equity capital. In order to reduce this equity gap new mechanisms and financing methods are continuously created and implemented, such as: state and EU programs improving the access to private equity financing, alternative investment markets (AIM) dedicated to medium-sized companies or equity crowdfunding platforms. These initiatives have special importance for SMEs in the early stages of life cycle (Wieczorek-Kosmala, Błach, Trzysiok, 2020). Especially equity crowdfunding

seems to be a promising venue for financing entrepreneurs, democratizing demand and supply side of investments and contributing to economic growth (Yasar, 2021).

Equity financing is considered a particularly important and appropriate source of funding for innovative and growth-oriented firms. Moreover equity financing, which has higher risk tolerance, has a more positive impact on innovation than debt financing in terms of both economic uptrend and economic downtrend (Zhang, Zhang, Guo, 2019). According to research the innovating firms, export-oriented firms operating in niche markets, and firms with high levels of human capital have a greater probability of being equity financed (Power, J., Power, B., Ryan, 2022).

3. Overview of studies on the term structure of liabilities

The term structure of capital and reserves is an important aspect constituting the subject of corporate finance research and business practice. The average values of total debt ratio vary in different countries or regions of the world. The smallest share of debts in total asset financing was recorded in Japanese companies. The average value of this indicator across all sectors of the economy in Japan was slightly below 50%. In the United States, the ratio reached a value of slightly above 50%, while in the United Kingdom - about 60%. Globally, the most heavily indebted companies were those operating in the European Union (approx. 65%). The studies analyzed the food, pharmaceutical, retail and machinery sectors. The highest values of the total debt ratio were observed in the food sector, in the UK and the US in particular, where the value of this indicator reached as high as approximately 70% (Walsh, 2008).

P. Figura (2011) has proposed recommended values of the total debt and the fixed asset coverage by fixed capital ratios for individual sectors of the economy in Poland. The author additionally took three different overriding objectives of company operation into account in his study, namely: profit maximization, survival and value maximization. The recommended values of the two indicators are characterized by significant variation between both the overarching goals and the sectors of the economy. Considering the objective of value maximization, for instance, the recommended value of the indicator ranges between 0.35 and 0.6 in the construction industry and 0.2-0.4 in the chemical sector. For the objective of profit maximization, in turn, the ratio of fixed asset coverage by fixed capital ranges between 1.1 and 1.85 in the construction industry, whereas in the IT sector, this value ranges from 1.40 to as high as 2.85. It is worth noting here that the value of Polish enterprises' debt is affected by their size. As such, Polish micro and small enterprises show lower levels of both long-term and calculated-in-years debt, compared to medium and large-sized businesses.

The study of sectoral differentiation of equity ratios in business activity financing constituted the subject of a research conducted by Szczepaniak (2014), who determined that the highest share of equity in total assets prevailed in the following sectors: light industry, energy, pharmaceuticals, information technology and metals.

Wypych (2012), who analyzed 117 Warsaw Stock Exchange listed companies, obtained different results. The author states that the structure of assets should not be treated as a feature determining sector specificity. The study also shows that the golden rule of accounting serves as a useful tool for assessment of company's financial balance, as it is intended to align the structure of liabilities with the structure of assets, so that capital is no longer tied to the asset components, for a period not longer than the disposition thereof. It should be noted here that such conduct is independent of economic fluctuations and the related changes in the macro-economic conditions of business operation. The study has also exposed the relationship between the structure of assets and the manner of financing thereof. This means that the share of fixed assets in total assets is one of the factors determining the choice of enterprise financing strategy.

The research on the capital and asset structure of enterprises operating in Poland shows that equity capital constitutes the most important source of enterprise activity financing. Figura (2018) analyzed 97,471 financial statements of Polish enterprises. The conducted research proved that Polish small enterprises are characterized by lower level of tangible assets to long term debt ratio as well as higher level of equity or fixed capital to fixed assets ratio than medium and large enterprises. Marzec (2010) analyzed and assessed the mutual relations between the assets structure and the capital structure in Polish small and medium-sized enterprises. Her research shows that in Poland, the most important source of SME activity, including investments, is equity. Similar conclusions were drawn by Różański and Bogołębska (2022), Sierpińska (2021), Janus (2006), Lisińska (2012), Barburski (2014) and Wrońska-Bukalska (2014), who have pointed to equity as the primary source of financing in Polish enterprises. The conservative financing structure has been identified as a factor immunizing these entities to the risks associated with economic changes.

Studies on the formation of Polish enterprises' capital structure indicate that these entities follow the assumptions of the pecking order theory (Białek-Jaworska, Nehrebecka, 2016). This means that Polish companies prefer internal sources of financing. This aspect distinguishes Polish entities from German or Portuguese enterprises, which make much greater use of external, particularly debt capital, capital for asset financing. Similar regularities were observed in the Czechia in 2007-2011 (Konečný, 2013), where majority of the automotive companies financed their activity via debt capital, which constituted the main source of asset coverage. Kluzek and Schmidt-Jessa (2022) analyzed 8120 domestic and multinational enterprises operating in the Visegrad Group countries used data from 2012-2018. Among internal determinants of the capital structure in the case of all companies in all countries analyzed was sales profitability. Moreover, a negative relation was observed between this factor and the level of debt what is in line with pecking order theory. It means that V4's companies prefer internal

sources of financing. In the contrary, asset structure and the level of debt were positively related. This means that in companies with a large share of tangible assets in the asset structure were characterized by a higher level of debt. Similar conclusions were drawn by Fenyves et al. (2020). Their results show that more profitable V4's companies were less dependent on debt finance. In turn, Wieczorek-Kosmala et al. (2021) obtained slightly different results. As with previous studies their results support the inversed relationship for debt in total and long-term debt, which are consistent with the assumptions of the pecking order theory. However, for short-term debt, they have found a positive relationship, which confirms the assumptions of the trade-off theory of capital structure.

4. Data and methodology

The maturity structure of the sources of business activity financing is closely linked to the age structure of assets. For this reason, the maturity of individual categories making up liabilities must be synchronized with the useful life of the assets financed via those sources (Duliniec, 2011; Damodaran, 2017). The starting point in the study of asset and capital structure entails determination of the share of equity in the financing of a company's fixed assets:

$$EFA = \frac{\text{equity}}{\text{fixed assets}} \quad (1)$$

where EFA – the ratio of fixed assets coverage by equity.

If equity fully covers fixed asset components, then the so-called golden rule of accounting has been maintained. In accordance with the golden balance rule, a business entity's fixed assets should be financed by equity, as this part of assets and capital remains at the company's disposal over a long-term period (Sierpińska, Jachna, 2012). Fixed assets are more risky than current assets. It should therefore be financed to a greater extent through equity. This reduces the financial risk. That being the case, the equity to fixed assets ratio should be at a level of not less than 1:

$$\frac{\text{equity}}{\text{fixed assets}} \geq 1 \quad (2)$$

The golden rule of accounting corresponds to the golden rule of financing, according to which the value of total debt capital should not exceed the value of equity. Accordingly, it is assumed that the level of a company's indebtedness should not exceed the value of 50% (Skowronek-Mielczarek, Leszczyński, 2008). Many business entities, however, are not able to meet such a restrictive rule. They use debt capital to source the financing of long-term development. The value of the debt ratio in enterprises maintaining balance between the proportion of equity and external capital is should fall within the range of 0.57-0.67 (Sierpińska, Jachna, 2012; Gabrusewicz, 2014). Since long-term debts and equity are tied to a business entity over an extended period of time, it is permissible for fixed assets to be financed by equity

plus long-term debts (collectively referred to as fixed capital) (Bień, 2018), in which case, the silver rule of accounting is maintained.

As per the silver balance rule, the ratio of fixed capital to fixed assets should equal to minimum 1 (Korol, 2013):

$$\frac{\text{fixed capital}}{\text{fixed assets}} \geq 1 \quad (3)$$

When the above relation is maintained, the excess of fixed capital over the value of fixed assets can be used to finance a portion of current assets. This is conducive to financial stability. The portion of fixed capital covering current assets is referred to as net working capital or working assets. This category should be positive in value, i.e., it should exceed the value of current (short-term) debts, which helps maintain liquidity.

The subjects of the analysis entailed non-financial-sector companies listed in the years 1998 to 2020 on the main Stock Exchange Markets of the Visegrad Group countries, i.e., Poland, the Czech Republic, Slovakia and Hungary, as of November 19, 2021. The study encompassed 487 entities, out of which 259 companies (i.e., 53%) were qualified for the survey. The reasons for the removal of the companies from the research group of individual countries are explained below. Referring to previous studies (including those carried out by the already mentioned M. Wypych), the empirical analysis includes all companies in a given country together. Sectoral affiliation is not a determinant of the shaping of the capital structure.

The Warsaw Stock Exchange research sample included 415 listed companies. Financial sector entities (97 companies), as well as the companies which did not publish full financial statements during the period under investigation (15 companies), were excluded from the survey. Furthermore, since only companies listed on the Warsaw Stock Exchange for a period of at least 5 consecutive years were included in the study, 91 entities were additionally excluded. Ultimately, 212 companies, i.e., 51% of the initially selected entities, were qualified for the analysis.

Another stock exchange covered by the study was the Budapest Stock Exchange. Equities listed companies, i.e., 34 entities, were selected for the survey. Again, financial sector companies (6 entities) and companies listed for less than 5 consecutive years (4 entities) were excluded from the research. Ultimately, 24 entities, i.e., 70% of the initially selected companies, were qualified for the survey.

Out of the 16 companies listed on the Prime and Standard Markets of the Prague Stock Exchange, 9 companies, i.e., 56% of the total number of entities, were qualified for the survey. Companies listed for less than 5 consecutive years (1 entity), as well as financial sector companies (6 entities), were excluded from the sample.

The Bratislava Stock Exchange is the smallest stock exchange in the Visegrad Group. Out of the 22 entities included in the study, 8 financial sector companies were excluded from the survey. The sample ultimately included 14 entities, i.e., 64% of the total number of listed companies.

The conducted empirical analysis is closely related to the research hypotheses set out in the introduction, which assumed that:

1. In each of the countries of the Visegrad Group, companies shape their capital and as-sets structure in a different way.
2. Companies listed on the stock exchanges of the Visegrad Group countries try to synchronize the maturity periods of financing sources and assets financed with their help.

The first step of the analysis aims calculations of the fixed asset overage with equity ratio that represents the golden balance rule of accounting. Then the ratios of the fixed capital to fixed assets are found. Such relations represent the silver balance rule. Next the companies are grouped according to their value of ratios and country they operate. In the second step the Pearson correlation coefficients were calculated between asset structure and the golden and silver rules of financing.

5. Results and discussions

The values of the fixed asset coverage with equity ratio for the stock exchange listed companies operating in the Visegrad Group were characterized by significant variation, as evidenced by the standard deviation values of the indicator. The greatest variation in the coverage of fixed assets by equity was recorded for the Warsaw Stock Exchange listed companies (Table 1).

Table 1.

The fixed asset coverage by equity ratio for the Visegrad Group companies listed in 1998-2020

Country	Equity/Fixed Assets	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Czechia	Mean	1.04	1.31	1.38	1.43	1.28	1.21	1.22	1.07	0.94	0.84	0.84	0.88
	Median	0.71	0.73	0.85	0.94	0.96	0.91	0.98	1.04	0.93	0.79	0.60	0.91
	First quartile	0.63	0.61	0.72	0.69	0.82	0.81	0.60	0.60	0.37	0.46	0.42	0.35
	Third quartile	1.79	2.59	2.29	1.89	1.55	1.08	1.74	1.06	1.09	1.06	1.01	1.10
	Standard dev.	0.53	0.90	1.10	1.27	0.89	0.87	0.87	0.71	0.64	0.45	0.57	0.65
Slovakia*	Mean	-	-	-	-	-	-	-	2.03	0.73	0.78	1.53	1.45
	Median	-	-	-	-	-	-	-	1.21	0.68	0.67	0.82	0.95
	First quartile	-	-	-	-	-	-	-	1.08	0.22	0.42	0.39	0.58
	Third quartile	-	-	-	-	-	-	-	2.06	1.08	1.04	1.72	1.90
	Standard dev.	-	-	-	-	-	-	-	2.32	0.64	0.42	1.80	1.34
Hungary	Mean	1.42	1.54	1.19	1.07	1.19	1.23	1.03	1.02	0.88	0.84	1.56	1.03
	Median	1.48	1.35	0.92	0.85	1.18	0.92	0.81	0.83	0.78	0.77	1.02	0.75
	First quartile	0.92	0.77	0.65	0.60	0.77	0.58	0.46	0.55	0.52	0.44	0.71	0.60
	Third quartile	1.74	2.45	1.63	1.60	1.67	1.89	1.27	1.15	1.28	1.15	1.79	1.59
	Standard dev.	0.56	0.85	0.62	0.71	0.54	0.83	0.76	0.87	0.61	0.43	1.60	0.58
Poland	Mean	1.54	1.39	1.17	1.47	1.42	1.37	1.35	1.21	1.14	1.15	1.09	1.04
	Median	1.31	1.15	0.99	1.18	1.27	1.17	1.13	1.01	1.00	0.98	0.92	0.94
	First quartile	0.93	0.82	0.66	0.76	0.90	0.83	0.85	0.84	0.75	0.73	0.66	0.64
	Third quartile	1.86	1.73	1.54	1.71	1.72	1.66	1.49	1.42	1.26	1.24	1.33	1.30
	Standard dev.	0.91	1.02	0.97	1.21	0.87	1.13	0.87	0.87	0.79	0.94	1.04	1.17

* For Slovakia data from 2012 is available.

Source: Own calculation based on the data obtained from the Notoria and Reuters databases.

The lowest average values of the indicator analyzed were recorded in Czech companies. In 1998-2012, these values were slightly higher than 1, which indicates that the golden rule of accounting was satisfied in this period. Contrastingly, in 2014-2020, the indicator values were below unity, which means that the source of financing for a significant portion of these companies' assets entailed debts. What is more, the indicator values, particularly in relevance to the median, were lower than unity throughout the entire period under evaluation. This means that 50% of the companies under examination were financing their assets not only by equity, but via debt funds as well.

Different results were noted in the case of Slovakian, Hungarian and Polish companies. The golden rule of accounting was satisfied by all entities of the third quartile. In contrast, the first quartile companies were financing their fixed assets by equity to a small extent only, as evidenced by the values of the fixed asset coverage with equity ratio reaching levels lower than unity. The companies listed on the Bratislava and the Budapest stock exchange markets met the golden rule of financing in some years only during the period under examination. In the case of Slovak stock exchange listed entities, a single such instance was recorded, whereas in the case of Hungarian listed companies, a likewise situation transpired four times. This indicates that those entities mainly used debt funds to finance their fixed assets.

A different situation was noted with regard to the Warsaw Stock Exchange listed companies. In this case, the median values are mostly greater than unity. Only in the period covering the years 2002 and 2016-2020, the median of the fixed asset coverage with equity ratio was slightly lower, nevertheless, its value did not fall below 0.92. This result indicates that the Polish listed companies show the highest extent of respecting the golden rule of financing, pursuant to which the total value of debt capital should not exceed the value of equity. The above observations are in line with the studies referenced earlier, according to which equity constitutes the primary and preferred source of financing in Polish companies.

As mentioned already, the golden rule of accounting is very restrictive, given that it assumes full coverage of fixed assets by equity. This can be very difficult to realize, especially in entities characterized by high capital intensity, such as companies engaged in innovative activities with long operating cycles. In such cases, the equity resources held are usually insufficient to finance the fixed assets needed in the course of operation, which forces the companies to use long-term debt instruments, generally loans and bonds. In the set of the companies listed in the Visegrad Group countries, the values of the fixed asset coverage by equity ratio plus long-term debts, i.e., fixed capital, varied across the V4 countries (Table 2).

Table 2.

The fixed asset coverage by fixed capital ratio for the Visegrad Group companies listed in 1998-2020

Country	Fixed capital/ Fixed assets	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Czechia	Mean	1.20	1.46	1.45	1.48	1.33	1.23	1.39	1.25	1.17	1.10	1.12	1.15
	Median	1.00	0.94	0.93	0.96	0.97	1.04	1.03	1.07	1.02	1.05	1.02	1.04
	First quartile	0.81	0.85	0.88	0.82	0.91	0.94	0.98	0.95	0.92	0.87	0.82	0.79
	Third quartile	1.79	2.59	2.29	1.89	1.59	1.08	1.81	1.14	1.10	1.10	1.09	1.23
	Standard dev.	0.42	0.80	1.06	1.24	0.86	0.83	0.75	0.58	0.48	0.31	0.45	0.54
Slovakia*	Mean	-	-	-	-	-	-	-	2.06	1.04	0.85	1.62	1.60
	Median	-	-	-	-	-	-	-	1.25	0.68	0.83	0.89	0.98
	First quartile	-	-	-	-	-	-	-	1.14	0.31	0.48	0.68	0.72
	Third quartile	-	-	-	-	-	-	-	2.06	1.17	1.08	1.75	2.16
	Standard dev.	-	-	-	-	-	-	-	2.31	1.23	0.41	1.75	1.31
Hungary	Mean	1.58	1.64	1.25	1.15	1.29	1.46	1.28	1.21	1.11	1.08	1.70	1.36
	Median	1.54	1.34	1.05	1.03	1.20	1.21	1.11	0.96	1.03	1.08	1.20	1.15
	First quartile	1.19	1.09	0.73	0.81	0.91	0.94	0.88	0.89	0.76	0.80	0.90	0.97
	Third quartile	1.98	2.45	1.63	1.60	1.67	1.91	1.39	1.15	1.29	1.24	1.79	1.70
	Standard dev.	0.50	0.76	0.59	0.68	0.49	0.67	0.74	0.78	0.54	0.31	1.53	0.54
Poland	Mean	1.74	1.63	1.41	1.68	1.64	1.58	1.55	1.41	1.36	1.38	1.28	1.26
	Median	1.45	1.39	1.17	1.37	1.44	1.32	1.28	1.20	1.16	1.13	1.11	1.12
	First quartile	1.14	1.09	0.97	1.00	1.10	1.02	1.06	1.01	1.01	1.01	0.89	0.91
	Third quartile	1.92	1.86	1.61	1.87	1.79	1.89	1.68	1.54	1.45	1.43	1.44	1.49
	Standard dev.	0.92	0.99	0.92	1.19	0.88	1.12	0.90	0.84	0.76	0.86	1.02	1.17

* Certain data is not available for Slovakia.

Source: Own calculation based on the data obtained from the Notoria and Reuters databases.

Half of the Czech companies followed the silver rule of accounting in 1998 and between 2008 and 2020. In 2000-2006, however, these entities showed problems with maintaining financial balance. The values of the fixed assets to fixed capital ratio were below unity during this period. This means that the entities were using current debts, in addition to long-term debts, to finance their fixed assets during this period. In contrast, all Czech companies of the third quartile met the requirements of the silver balance rule.

The companies listed on the Budapest and the Bratislava stock exchanges showed correct capital and asset structure relations for the third quartile entities, throughout the period under examination. In the set of Hungarian companies, the median of the fixed asset coverage by fixed capital ratio was at a level above unity in most cases. The median of the fixed assets to fixed capital ratio in Slovakian companies, in turn, reached a value exceeding 1 only once, i.e., in 2012.

Polish companies should be rated the highest, since the fixed assets at their disposal were fully covered by fixed capital throughout the entire period under examination. One exception entails the companies for which the fixed assets to fixed capital ratio was below unity in the first quartile of 2002 and in 2018-2020.

Difficulties with financial sustainability tend to intensify during periods of downturn. The companies listed in the Visegrad Group countries were forced to operate under unfavorable economic conditions three times during the period under examination. First, in 2001-2003,

then for six consecutive years, i.e., from 2008 to 2013 (Central Statistical Office of Poland, 2016), and in 2020 due to the COVID-19 pandemic. In this respect, the study of the links between the structure of assets and the relationships describing the golden and silver rules of financing offers an opportunity for assessment of whether these entities have maintained financial balance. In the vast majority of the companies under examination, a negative correlation between the categories analyzed was observed in each of the Visegrad Group countries. This result indicates that an increase in the share of fixed assets in total assets results in a decrease in the ratio of fixed asset coverage by equity and fixed capital. In consequence, these types of capital covers current assets to a greater extent, which is quite favorable, taking liquidity into account (Table 3).

Table 3.

Dependencies between the asset structure and the relations expressing the golden and silver rules of financing in companies listed the Visegrad Group countries

Value of the correlation coefficient	Fixed Capital/Fixed Assets (silver rule)				Equity/Fixed Assets (golden rule)			
	Number of companies				Number of companies			
	Czechia	Slovakia	Hungary	Poland	Czechia	Slovakia	Hungary	Poland
From -1 to -0.75	3	6	11	106	4	5	7	95
From -0.75 to -0.5	3	3	7	55	1	5	7	59
From -0.5 to -0.25	-	1	3	23	-	2	4	23
From -0.25 to 0	-	1	1	12	1	1	3	18
From 0 to 0.25	1	-	1	7	-	-	1	8
From 0.25 to 0.5	-	2	1	7	1	1	2	4
From 0.5 to 0.75	2	1	-	1	-	-	-	4
From 0.75 to 1	-	-	-	1	2	-	-	1
sum	9	14	24	212	9	14	24	212

Source: Own calculations based on the data obtained from the Notoria and Reuters databases.

The vast majority of the companies listed in the Visegrad Group countries show relatively high values of the correlation coefficients. This applies to the coefficients between the structure of assets and the relations expressing both the golden and silver rules of financing. These results indicate that entities shape their capital and asset structure in a manner allowing the maturity of the financing sources to be matched with the useful life of the assets financed via those sources. Maintenance of such correlation ensures financial balance. Characteristics of the correlation indicators are provided in the appendix. Figures 1 and 2 show the correlations between the structure of assets and the silver and golden rules of financing in the companies operating in the countries under analysis. The vertical axis of individual figures shows the values of the correlation coefficients between the asset structure and the selected financing rule, while the horizontal axis is the company number of a given country. Each of the correlation coefficients was determined for the time series analyzed for it. Grouped values of the correlation coefficients, divided into appropriate quartiles, are presented in Table 3 above.

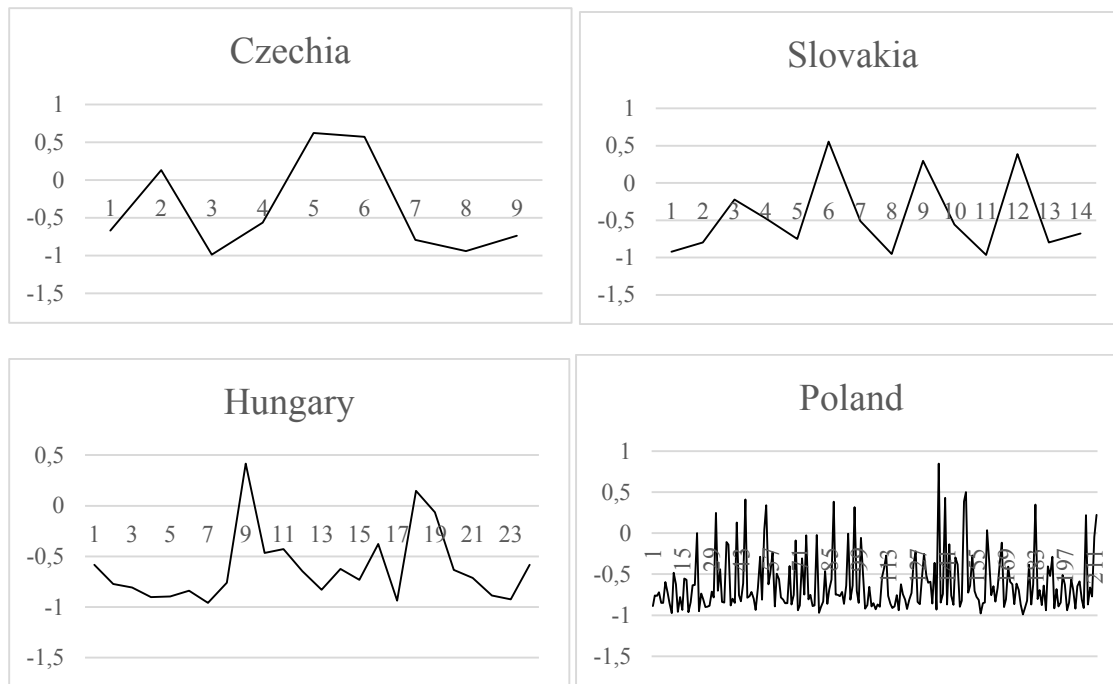


Figure 1. Values of correlation coefficients between the asset structure and the silver rule of financing.
Source: Own calculations based on the data obtained from the Notoria and Reuters databases.

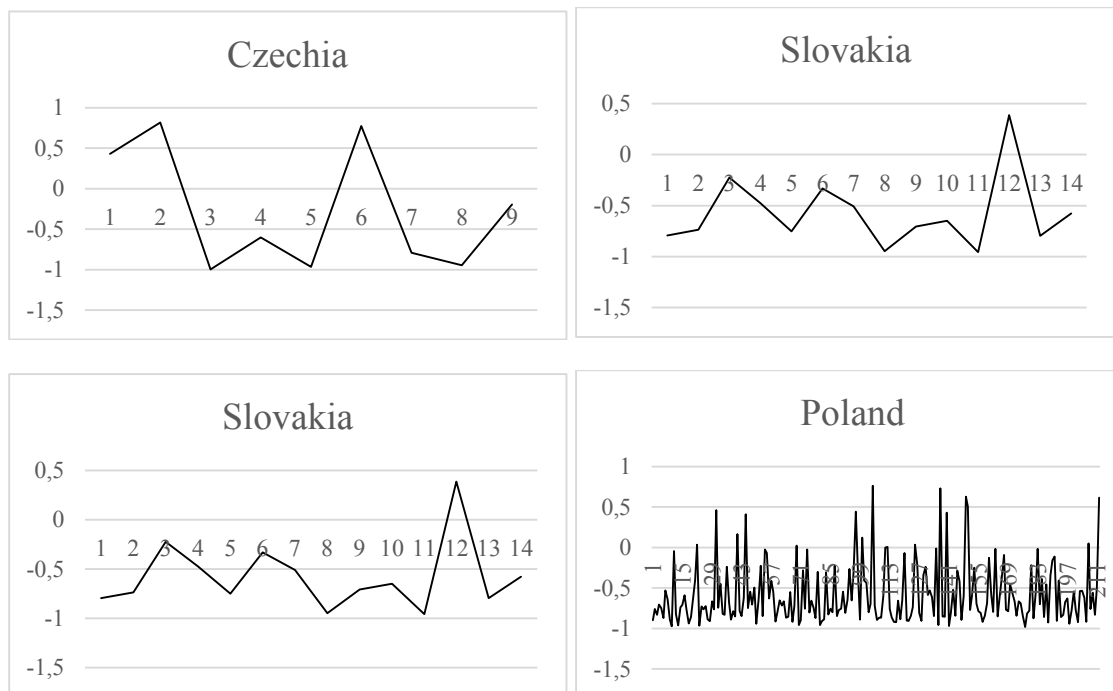


Figure 2. Values of correlation coefficients between the asset structure and the golden rule of financing.
Source: Own calculations based on the data obtained from the Notoria and Reuters databases.

The results obtained in the research generally confirm the earlier studies mentioned earlier. Referring to the research, for example, in Figura (2018), Sierpińska (2021), Rózański and Bogołębska (2022) Polish companies prefer internal sources of financing. Moreover, it points out the conservative way of financing activity. It can be assumed as a factor limiting the level

of financial risk. Similar research results were obtained for companies from other countries of the Visegrad Group (Kluzek, Schmidt-Jessa, 2022).

It should be remembered that it is difficult to relate the obtained results to other studies for other Visegrad Group countries except Poland. The limitation is the lack of such research available in the literature on the subject.

6. Summary

The research carried out allows a conclusion that the first hypothesis posed in the introduction, assuming that the capital and asset structure of stock exchange listed companies in individual countries of the Visegrad Group differs significantly, has been confirmed. This mainly results from the different values of the fixed asset coverage by equity or fixed capital ratios in the Visegrad Group companies analyzed. It should be noted that the sample sizes of the entities under examination were not equal (by far the largest number of companies came from Poland). This results from the number of the companies listed on individual V4 stock exchange markets, and any attempt of standardization would not provide representative results.

The second hypothesis, assuming that the listed companies examined strive to synchronize the maturity of the financing sources with the useful life of the assets financed via those sources, has been confirmed as well. This has been confirmed despite the volatile economic situation during the period under examination. All the Visegrad Group companies sought to shape their asset and capital structure in a manner enabling adequacy between the maturity of capital and the period of asset use. Despite the differences in the capital and asset structure, the analyzed companies from all V4 countries are characterized by a high share of equity in the financing structure. This means that these entities have a strong capital base. From the economic point of view, the stability of financing their activities is not threatened, which gives them the possibility of obtaining external funds for further development.

The originality of the research is based on the analysis of relatively long time series, taking into account the same research period for all countries (except Slovakia), which allowed for direct comparison of companies' results. The research of other authors mentioned earlier concerned companies analyzed in different periods of time. Moreover, it is also original to determine the relationship between the asset structure and the golden and silver financing rules with a quartile approach. This is because such an approach allows for the identification of companies for which these dependencies have extreme values.

Thanks to the analysis covering a relatively long period of time, it was also possible to determine long-term trends in the scope of changes in the capital and asset structure of the analyzed entities in the context of changes in the business cycle. The research shows that despite

the deterioration of the asset and capital situation during the economic slowdown and recession, the analyzed companies from all countries were able to maintain financial liquidity. This means that these entities can be recommended, first of all, as desirable business partners. Secondly, this recommendation may also be addressed to investors looking for attractive capital investments.

It can be therefore concluded that both the golden and the silver rules of financing company operations constitute important determinants of decision-making regarding the structure of capital.

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Appendix

Characteristics of the correlation coefficients for the silver and golden rules of financing

Charact.	Fixed Capital/Fixed Assets (silver rule)				Equity/Fixed Assets (golden rule)			
	Indicator values				Indicator values			
	Czechia	Slovakia	Hungary	Poland	Czechia	Slovakia	Hungary	Poland
Q1	-0.8670	-0.8295	-0.8761	-0.8571	-0.9564	-0.7949	-0.8049	-0.8485
Q2=Me	-0.6697	-0.6187	-0.7214	-0.7503	-0.6027	-0.6781	-0.5340	-0.7128
Q3	0.3498	-0.0943	-0.4965	-0.5133	0.6022	-0.4393	-0.1232	-0.4398
Mean	-0.3745	-0.4568	-0.6171	-0.6193	-0.2754	-0.5762	-0.4714	-0.5876
min	-0.9498	-0.9646	-0.9595	-0.9904	-0.9978	-0.9570	-0.9743	-0.9823
max	0.6201	0.5546	0.4156	0.8464	0.8155	0.3872	0.4126	0.7596
Standard dev.	0.6018	0.4969	0.3426	0.3479	0.7163	0.3365	0.3986	0.3638

Source: Own calculations based on the data obtained from the Notoria and Reuters databases.

SELF-EMERGENT SUPPLY CHAIN RESILIENCE? A CASE OF INDUSTRIAL STRATEGY IN CRITICAL TIMES

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Purpose: the aim of the article is to evaluate supply chain resilience strategies adopted by an industrial cluster to cope with the lack of critical materials originated from the Ukraine crisis

Design/methodology/approach: the study analyzes historical time series between the 2014 and 2022 Ukrainian crisis and assess import concentration adapting the HHI Index methodology to evaluate critical supply chains.

Findings: despite a lack of a coherent supply chain resilience strategy, empirical data imply the self-emergence of adaptive behaviors within a prototypical industrial cluster.

Originality/value: These results could suggest the intrinsic value in terms of supply chain resilience of strong socio-economic networks and addresses new research scenarios.

Keywords: supply chain resilience, Ukraine crisis, risk management, adaptability.

Category of the paper: research paper.

1. Introduction: Risk management and supply chain resilience

The military-political crisis in Ukraine, subsequent the COVID-19 pandemics, have caused massive disruption in the global supply chains: vertical industries have been hit by a sudden lack of raw materials sourced in the countries involved in the war.

These events have stressed the need to analyze the concepts of risk management and supply chain resilience (SCRes) under the light of multiple crisis. The COVID-19 pandemic, as an all-compassing calamity concerning all facets of social and economic life, has tested the resilience of global ecosystems and their ability to regenerate themselves in short timeframes.

Companies, organizations, institutions, and individuals have been forced to abruptly rethink their modus operandi to become more resilient and face unpredicted external threats.

The resilience concept, while dating back to the nineties (Horne III, 1997) was theoretically defined after the first economic shock of the XXI century: the 2008 financial crisis.

Although resilience was still a relatively undefined concept in the disciplines of risk management and supply chain management (Ponomarov et al., 2009), a plurality of definitions arose. Some focused on damage control features like survivability, adaptability and recovery in face of disruptive events or disturbances (Pettit et al., 2010; Gaonkar et al., 2007; Ponomarov et al., 2009), others included the proactive capability to predict and prevent threats at organizational level (Datta et al., 2007).

In order to face an ever changing external environment, supply chain resilience strategies, had to mold into multi-dimensional and multidisciplinary task (Datta et al., 2007; Ponomarov, Holcomb, 2009), therefore embracing also organizational resilience.

The COVID-19 outbreak has put organizational resilience at the forefront of social sciences analysis. A variety of sectors have been explored through these lenses such as the public health system (Kuzior et al., 2022), public administration (Vasylieva et al., 2020, 2021) and the digital revolution (Xie et al., 2022, Kuzior et al., 2022).

Unknown risks can be presented in a variety of forms along the supply chain: inconsistent supply and demand behaviors, natural phenomena or shifts in the geopolitical framework.

If the global supply chains were only temporarily engulfed during the peak of COVID-19 pandemics due to sanitary measures and logistics bottlenecks, the 2022 conflict in Ukraine threatens to permanently sever any supply ties between political blocks.

Russia and Ukraine lead in the extraction and first transformation process of critical raw materials such as nickel, copper, iron, neon, titanium, palladium and platinum, which are key components for advanced industries like aerospace and electronics (Ngoc et al., 2022).

Based on an impact evaluation model elaborated to assess the economical shock on Germany (Bachmann et al., 2022), the Italian central bank carried out a quantitative assessment outlining that, in case of energy disruption, Italy would have been the most damaged economy among the largest European manufacturers (Borin et al., 2022).

Several quarters of the Italian manufactory have been severely affected by the downstream ripples effect of rising commodity prices and sudden scarcity. Russia and Ukraine not only hold a significant production share in hard commodities but also soft commodities like corn, wheat, fertilizing by-products, lumber and other items serving as basic commodities for transformation industries like food processing, petrochemical, furniture manufacturing, ceramics, machinery, steelmaking, automotive.

However, it is frequently hard to properly assess the damages caused by the war or the general economic situation, since these abovementioned industries handle complex global value chains (GVC) in which inefficiencies or logistical delays are amplified by the vast amount of intermediary players dispersed in several links of the supply chain.

Anyway, if risk management literature suggests that the strength of a supply chain corresponds to the strength of its weakest process, in 2022 it can be identified as the raw material sourcing process (Bevilacqua et al., 2018).

Therefore, in order to define the boundaries of our research hypothesis and reduce the complexity, the early studies on the Ukraine's war effects choose the explanatory single-case or single-sector study as methodology to assess the industrial SCRes. (Nabhani et al., 2018).

2. Raw material imports and the case of the Italian ceramic district

The Italian tile-making industry exemplifies a supply system with high geopolitical risk and high natural resource consumption, since only a few players interact in the GVC.

This industry has been studied over the decades since it enjoys distinctive features that make it a good “laboratory” to analyze the socio-economic framework of the paradigmatic SME (Small-medium enterprise) Italian manufacturing model, due to its large size (in 2020, the overall turnover was 6.166 million euro per 435 mln m² tiles produced¹), geographical concentration and exemplarity as cluster (Schmitz, Nadvi, 1999).

Although limited ceramic activities scattered all over the country exist, in 2021 regional data referring to Ateco class 2007 "Ceramic floor and wall tiles" point out that, on a national scale, 93,9% export market share come from the Emilia Romagna region, where the Sassuolo ceramic district is located. (ISTAT, 2022).

Pioneering studies on tile-making industry date back to the post-war period, noting that its early success was caused by a combination of socio-economic factors and the availability of raw materials fit for ceramic tiles in the local mountains' quarries (Prodi, 1966).

A seminal survey on local economies (Porter, 1990) identified the ceramics district in Emilia Romagna region as one of the 18 “clusters”, defined as geographic concentrations of interconnected companies (Porter, 2000), constituting the core of Italy's manufactory.

These local networks of small-medium companies are characterized by strong inter-company bonds, leading to multiple layers of cooperation, from knowledge transfer to shared procurement, which allow them to develop as a whole (Pyke et al., 1990).

By the new millennia the tile-making industrial district located between Modena and Reggio Emilia provinces counted the highest concentration of tile making plants in the world, accounting for approximately one-sixth of the global production. However, while local clays constituted the sole mineral source for most of its economic history, by 2000s already dropped to 40% of the demand. This trend has been mainly related with the significant commercial success of the new manufacturing process taking place in the eighties, when fast single firing and wet grinding were introduced allowing new types of tiles (Dondi, 1999).

¹ Confindustria Ceramica, 2020 National Statistical Survey on Italian Ceramic Tile Industry.

Supply diversification started in the 1990s (the same process happened in the Castellón ceramic cluster in Spain) because the clay minerals locally mined were particularly rich in iron oxide, thus giving a characteristically red hue. The growing international market requested tiles with a clear body rather than a red one, as a result the need to import clay minerals with low iron concentration became a strategic issue (Fernández-Miguel, 2022).

Sourcing new materials led to typological modifications of the final products, creating a feedback loop between the availability of raw material with specific characteristics and the emergence of new batch designs via process innovation (Dondi et al., 2021).

As a result of increased market demand the tile-making industry gradually transitioned from purely local value chains to global supply chain (GVC), a transformation that balanced higher raw material availability with mounting dependence on imports from extra-EU sources.

Further relying on imports is still a technical need since possible substitutes coming from recycled secondary raw materials still have to face technological bottlenecks in order to become enough competitive to be suited for the mass market usage (Mugoni et al., 2020).

Physical inputs from imported sources into the tile-making process are industrial minerals like clays and fluxes. Most of the Italian production consists of porcelain tiles, which requires clay as basic raw material. Porcelain products need three raw materials to make up their bodies:

1. Illitic-kaolinitic clays (ball clays), which provide the plasticity required for tile forming. Clay materials can be classified into red-firing clay, white-firing clay (ball clay) and kaolin with various degrees of chemical and mineralogical purity, depending on the industrial use (Dondi et al., 2014). In the ceramics sector they are mostly composed of the kaolinite group dioctahedral 1:1 phyllosilicates $Al_4[(OH)_8Si_4O_{10}]$, with negligible amounts of other minerals (e.g., illite) and impurities (quartz, feldspars) (Pruett, Pickering, 2006).
2. Kaolinitic clays (kaolinite 75-85%; Fe_2O_3 and $TiO_2 < 0.9\%$) are primarily used as a ceramic raw material to produce floor tiles, tableware, glazes and sanitaryware production (Murray, 2006; Dondi et al., 2014). Other main applications are in the paper, fiberglass and cement industry, as well as catalysts, although they are not relevant for this study.
3. Sodic, potassium, or sodium-potassium feldspars, which melt during the firing process to form a glassy phase with an enough viscosity for total sintering of the product (Dondi et al., 2014).

Quartz sand offers a framework function, contrasting deformations during drying and firing processes and therefore is an indispensable constituent of silicate ceramics (Dino et al., 2021).

Nevertheless, imported materials from different countries and sources are not interchangeable: a recent study involving an expert panel consisting of twenty-one top and middle-management position within the Italian ceramic industry determined that on a scale of 1 to 5 ((1) extremely low, (2) low, (3) medium, (4) high, and (5) very high), only the Ukrainian

ball clays were pointed to have a very high (5) level of criticality, due to their high-plasticity (Fernández-Miguel et al., 2022).

The main alternative to Ukrainian imports are the German medium-plasticity ball clay and the Turkish sodium feldspar clays. Furthermore since the technical features are different, the manufacturing process has to be adapted too.

German clays are not as plastic as the Ukrainian type, impacting the final product quality. Alternative extraction of low-plasticity kaolinitic clay from Italian quarries would pose even greater manufacturing issues (Fernández-Miguel et al., 2022).

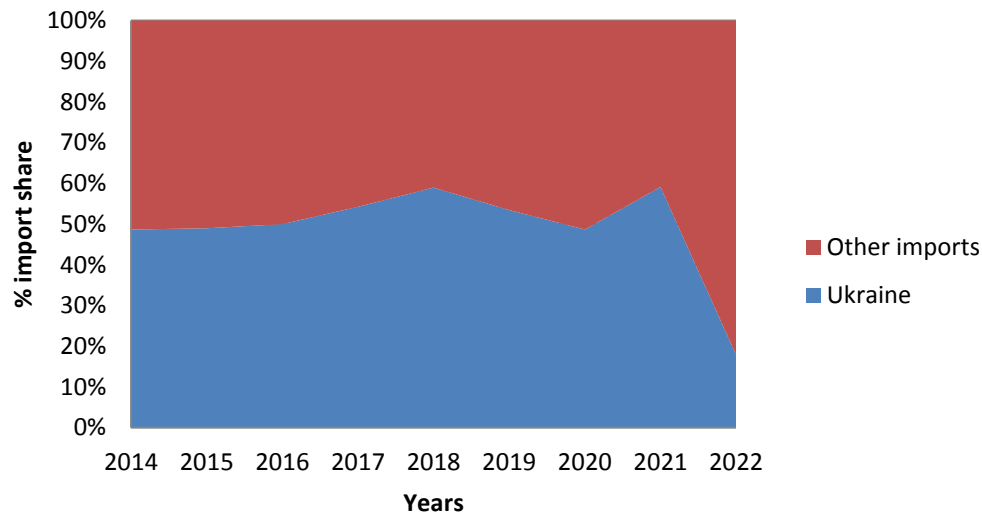


Figure 1. Historical data on import share % Ukraine vs. other import countries.

Source: Italian Institute of Statistics SH4 2508.

The industry has historically been depending on a singular critical source, the Ukrainian quarries, as shown in the figure 1, producing around half of the Italian imports.

In such energy and commodity-intensive manufacturing business, any supply disruption can severely endanger the stability of the industrial production, thus supply chain resilience plans are posed to have paramount importance in production management.

Risks are potentially predictable based on historical information. Multiple commodity price shock and geopolitical crisis have contributed to the heightened awareness that dependence on limited sources located in unstable regions is critical (Fahimnia et al., 2015).

Following the war hostilities in Eastern Ukraine the clay and feldspars supply extracted from quarries in the Donbass region were suddenly broken down in the first half of 2022.

The customary logistic route looked as follows: extraction in Donbass quarries, shipping from the port of Mariupol in south-eastern Ukraine to the Ravenna port in north-east Italy and transfer by truck to the ceramic district around Sassuolo, Emilia Romagna.

The conflict in Ukraine in 2022 can hardly be considered a “black swan” (Taleb, 2009) phenomenon from a risk management perspective, since the crisis dates back to 2014.

However, the geopolitical risks has not been considered and recent qualitative survey (Fernández-Miguel et al., 2022) assessed that any coherent plan was adopted to mitigate the risks of a sudden supply disruption. The intent of this work is verify these assumptions and the level of supply chain resilience in this critical time.

3. Database & methodology

In spite of its significance for the ceramic tile industry risk management, there is not an raw material database available, due to the complex structure of the European ceramic industry determining that the data ownership belongs to individual companies (Dondi et al., 2021).

To surmount these barriers, the data have to be extracted by the monthly reports on Foreign Trade section (COEWEB) of the Italian Statistical Institute (ISTAT) related to inter-country trade between Italy and the world, namely on the specific database “Volume trade by product area and country: SH4 2508 [Clays, andalusite, kyanite, sillimanite, whether or not calcined; mullite, chamotte or dinas earths (excluding kaolin and other kaolinic clays)] – January-September 2022” which encompasses most of clay materials imported into Italy.

Since there is no statistical indicator available in literature, which clearly define the supply chain diversification, the author considered repurposing the Herfindahl–Hirschman Index (HHI) to measure import diversification, based on previous literature about the effects of export concentration on developing countries’ economies during economic crisis (Camanho da Costa Neto, Romeu, 2011).

HHI is a method for measuring market concentration which is widely used by public regulators in competition law to measure the single company market share in order to evaluate M&A acquisition from an antitrust standpoint.

The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases.

It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. If there is only one firm in the market it means 100% market share. In this case the HHI would equal 10 000, indicative of a monopoly.

To measure the production concentration of a critical commodity the authoritative report World Mining transpose the firm HHI, although states that there is not a global consensus at which level concentration becomes critical (World Mining Data, 2022).

In the United States, between 1000 and 1800 points is considered to be acceptably concentrated, data in which the HHI is in excess of 1800 points are considered to be concentrated, while the threshold for concentrated markets in the European Union is 2000.

The repurposing of the HHI for this paper focus on the share of imports of the critical materials significantly exported by Ukraine or the Russian Federation and used a particular industry, as defined by the HS4 code in the international classification of goods.

The concentration of producer countries is calculated by the HHI similarly to the firms index. To avoid misunderstandings with the “classical” HHI, the countries concentration index is named as HHI(ct). Hence this index essentially measures the inequality between the shares of imports.

The HHI is defined as: subscript n in equation:

$$HHI(ct) = \sum_{n=1}^N s_n^2$$

where:

n indicates the trading partner,

N indicates the total number of trading partners,

s_n is the imports value share sourced from the n th trading partner.

$$s_n = (s_{1,2,3 \dots} * 100) / \sum S_n$$

A higher value of the HHI indicate a lower import diversification, tending to cause supply chain bottlenecks, and vice versa a lower value of the HHI is a sign of higher import diversification. The dataset is limited to countries who have exported the selected goods to Italy in the 2022 survey. Values less than 1% of overall import on a year by year basis are deemed irrelevant and not considered in the statistics.

4. Supply chain disruption and adaptation

As a first step the study should assess if a general disruption in the overall flow of clays from imported sources, which constitutes the bulk of raw materials used by tile-makers in the industrial districts as assessed in section 2, has taken place.

Following this consideration, an hypothesis where the sharp decline of Ukrainian production in 2022 as the main global import source (see figure 1) has impacted the global import trend in 2020-2022 can be formulated.

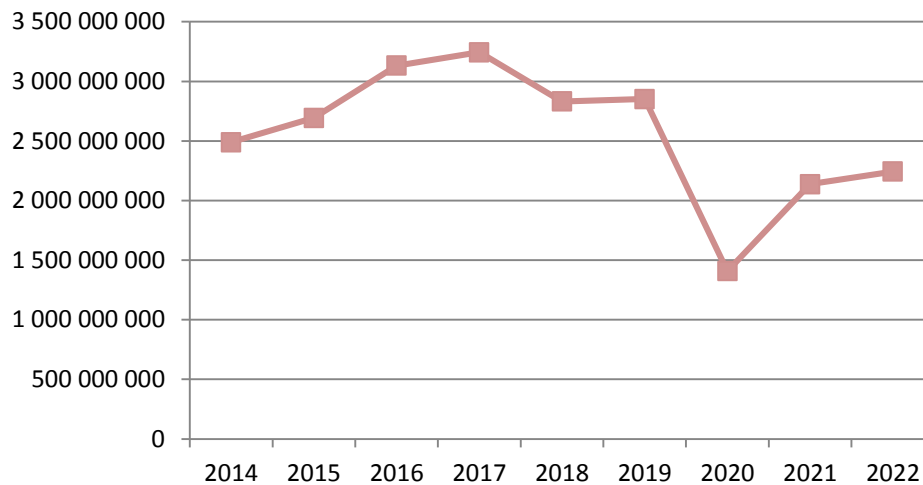


Figure 2. Global clay import in Italy in kg.

Source: Italian Institute of Statistics SH4 2508.

On the contrary, such an hypothesis is not backed by data yet. In fact, Figure 2 shows that the 2020-2022 timeframe has seen a bounce back in imported clays, whose figures have not reached the pre COVID situation, but the overall import trend is increased imports, although the curve is flattening and reaching a stabilizing point at just over 2 mln kg.

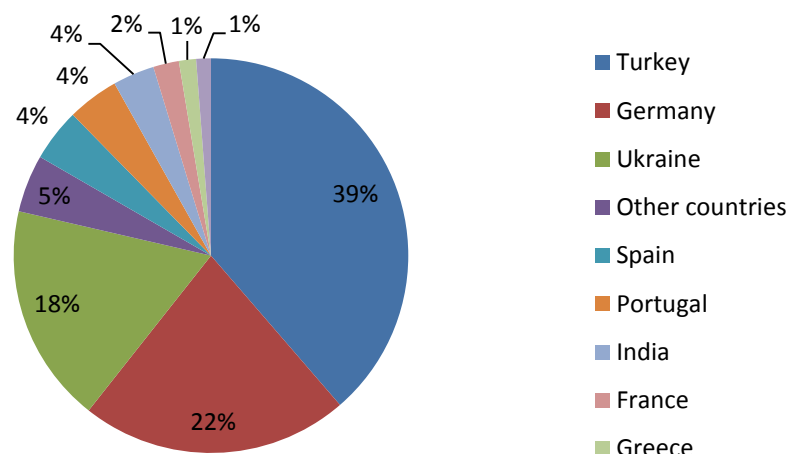


Figure 3. Global import suppliers' share 2022.

Source: Italian Institute of Statistics SH4 2508.

Thereby the 2022 clay supply scenario is displayed in figure 3. Turkey has become the primary import source, followed by Ukraine and Germany, while minor exporters provide around 22% import share. In order to evaluate the industry supply resilience, these data should be put into historical perspective, comparing statistical time series from 2014, when the first Ukraine crisis occurred up until 2022, when the Russo-Ukrainian war broke out.

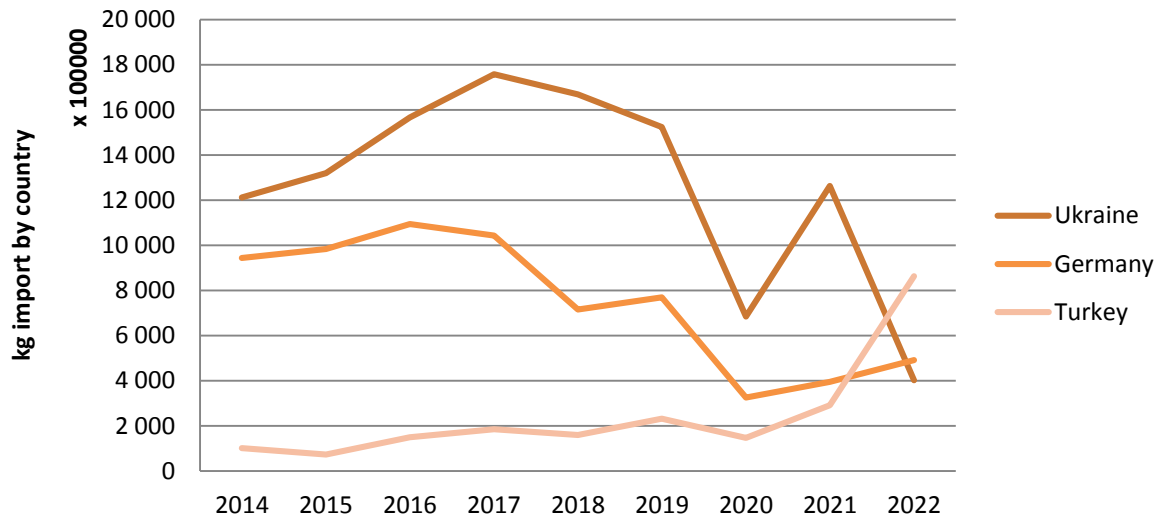


Figure 4. First-tier clay suppliers to Italy 2014-2022 years.

Source: Italian Institute of Statistics SH4 2508.

First-tier suppliers of the Italian industry are regrouped in figure 4: Ukraine, Germany and Turkey. While Germany has been consistently the second clay supplier, Turkey took over its position in 2021. Notwithstanding the military crisis in Donbass started in 2014, imports from Ukraine peaked in 2017, followed by a consistent import declined (with exception in 2021).

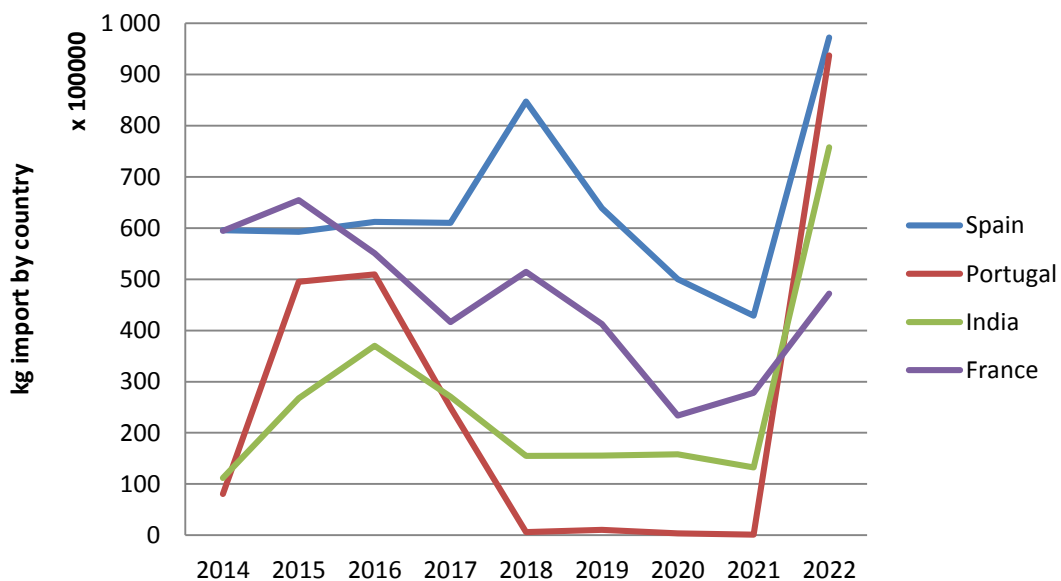


Figure 5. Second-tier clay suppliers to Italy 2014-2022.

Source: Italian institute of statistics SH4 2508.

Second-tier suppliers (between the 1 mln kg and 400 thousand kg) can be grouped into two different categories: stable suppliers and late-coming suppliers. Spain and France belong to the first category as stable import source, reaching a peak in 2018 and then declined.

India and Portugal have been introduced in the supply mix only after the 2014 crisis in Donbass and afterwards reduced their market share. However, both suppliers drastically increased the export to the Italian manufacturers in 2022 after the war in Ukraine broke out.

While previous analysis stated a strategic dependence solely on Turkish imports (Dondi et al., 2021), this statement is only partially confirmed, since it is reduced by the sudden surge of imports from previously second-tier sources such as Portugal, India, France and Spain.

Even though any coherent SCRes strategy has been laid out, data substantiate a swift and effective import substitution policy of Ukrainian production in 2022 combined with a path towards diversification by activating low-volume import channels.

In order to validate this assessment figure 6 visualize the yearly HHI import concentration index which has been calculated, with a linear regression showing a consistent trend in place.

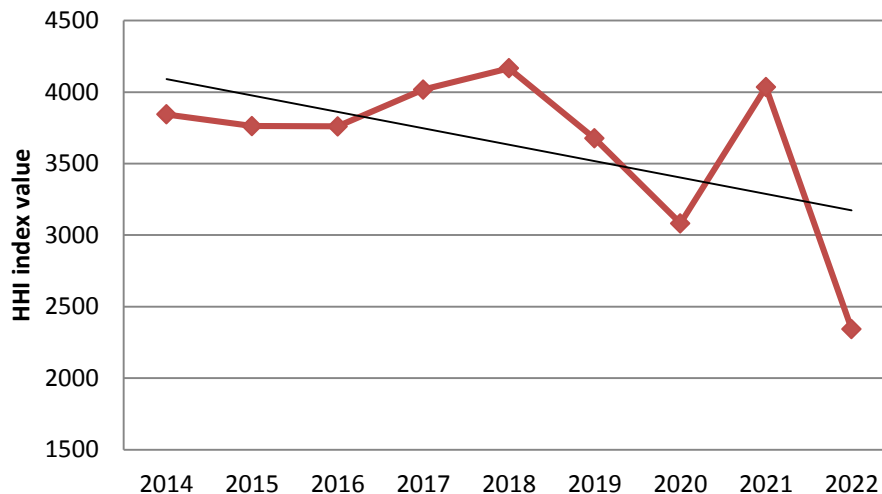


Figure 6. HHI index value 2014-2022.

Source: author's own study based upon Italian institute of statistics SH4 2508.

The HHI index lowers from a peak of 4166 in year 2018 to 2342 in year 2022, getting closer to the European Union threshold for competitive market.

Except of 2021, which can be considered an outlier since it was heavily influenced by logistical struggles during the COVID-19 pandemics, a pattern towards reduced dependence take place from 2018 onwards, as can be seen in the linear regression.

5. Conclusion

Supply chain and risk management best practices suggest to take an integrated approach with the goal of controlling risk exposure and reducing its negative impact on SC performance. (Heckmann et al. 2015), but in real life situations organizational issues often hamper the elaboration and, most importantly, the execution of SCRes strategies.

This occurrence might happen, from a sociological viewpoint, because social groups, companies or individuals develop different risk acceptability levels in different risk situations, as well as reactions to each of these circumstances.

In real world context these risk evaluations are guided by socio-economic factors, informal networking and cross-corporate culture, rather than a scientific probability estimation based on business intelligence. Thus, the objective risk analysis can be altered by the different risk perception among different decision-makers (Gordy, 2016).

Given the enduring flux of commodities from Ukraine after the conflict outbreak, reaching a peak in 2017, might have provoked excessive confidence in the industry decision-makers about the middle-term stability of this supply stream. This optimism bias could have been enhanced by the cognitive and economic costs to find a viable alternative solution to Ukrainian clay, which should have been considered higher expenses and lowered quality.

Thus, the social network binding Italian tile-making companies allows to formulate an hypothesis of informal cross-company information exchange that could have driven the progressive source diversification since 2018 and ease the swift supply adjustment in 2022.

Although the recognition of outside threats requires an organized supply chain resilience plan to enforce pre-emptive actions, the study's findings may suggest that the capacity to adjust to disruptive scenarios can be enhanced by a strong social interconnection.

In January 2023, many statistical data upon the consequences of the Ukrainian war are not yet available, further qualitative investigation should be carried out on the field to verify if the patterns emerging in data were part of a coordinated plan or they were self-emerging.

Theoretical tools like the Complex Adaptive Systems (CAS) theory, which has been proposed as a framework to study SCRes (Tukamuhabwa, 2015), might be interesting to implement to analyze the style and the features of the decision-making leading to generate, strategically or spontaneously, the reaction to external shocks. The collective social behavior of economic clusters feature typical CAS characteristics like adaptability, self-organization and emergence and it could suggest a future research direction.

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BARRIERS AND DETERMINANTS OF RESTRUCTURING EMPLOYMENT IN THE MINING INDUSTRY UNDER THE JUST TRANSFORMATION MECHANISM. INTERVIEWS RESULTS

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Purpose: The purpose of using the method is to obtain information on the social perception of the employment restructuring process in the mining industry, taking into account the phase of design, implementation, monitoring and impact assessment for the industry and local communities.

Design/methodology/approach: The theses presented in the article have been verified using: literature review, critical literature analysis, document research and comparative analysis. The article presents a research method enabling social assessment of barriers and determinants of the employment restructuring process in the mining industry under the just transition mechanism. The method of researching the social perception of the hard coal mining employment restructuring process, due to the specificity and complexity of the issue under consideration, uses various, mutually complementary methods and techniques of social research: quantitative and qualitative.

Findings: As a result of the interviews carried out, it seems that all the expert assessments and opinions expressed confirm thesis that if the changes related to the just transition process cannot be stopped, then one must learn to take advantage of it. The view expressed above regarding the process of just transformation, which implies both economic and social challenges that are important for mining communes, among which the following deserve special attention as increasing the importance of the participation of mining communes in making government decisions, more friendly conditions shaping cooperation, need for mining communes to implement projects based on local mobility, adaptability and social sensitivity, need to increase social awareness related to mining in mining communes with responsibility for the just transition process, disappearance of state policies in the implementation of social functions in the phase of ongoing changes and taking them over by the local society.

Originality/value: The article enriches knowledge and develops a discussion in the area of social perception of the employment restructuring process in the mining industry. Based on the assessments and opinions of experts, it seems that in the perspective of the predictable occurrence of the transformation process, it could be important for local governments, and in particular mining communes, to promote actions for an evolutionary, not short-term shift from coal-based energy to low-emission sources - striving to make it a multi-stage and long-term process. Equally important may be the pursuit of solutions according to which the principle of introducing funds directly to individual communes for the implementation of the just transformation process will be adopted. Must be considered need for local governments, including mining communes, to obtain state intervention appropriate to the scale of the

challenges, while equipping them with reliable and comprehensively planned proposals for transformational activities limiting their spontaneity.

Keywords: human being, economy, region, model, restructuring.

Category of the paper: Research paper.

1. Introduction

Poland, and in particular the Śląskie Voivodship, is facing rapid economic changes, the effects of which will be felt both economically and socially. This transformation is necessary to implement the European Union's climate and energy policy.

A just transition is identified with the concept of a comprehensive restructuring of the mining and conventional energy sectors, causing significant changes in the labor market and in the production structure (Drobniak, 2021). Transformation processes can lead to growing and consolidating social divisions – the syndrome of "inheriting poverty and scarcity" – economic, civilizational and cultural territorial divisions. As the Silesian Marshal's Office notes, the Silesian Voivodship is the most coal-dependent region in the European Union, and mining plays a key role in the regional economy. In recent years, a gradual decline in its importance has been observed due to the decreasing production (Potencjały i wyzwania..., 2022). When analyzing changes in the level of employment in the country in 2012-2020, as reported by the data of the Central Statistical Office of Poland, in the Mining and quarrying section, the largest decrease in the number of employees was observed (by 19.6%). The largest number of employees in the mining industry is in the southern region of Poland, i.e. in the Śląskie and Małopolskie voivodeships (61.4% of employees, i.e. 91.9 thousand people), of which the Śląskie Voivodship accounted for almost 84 thousand. employed under section B, which accounted for as much as 4.7% of total employment in the region (GUS, 2019). The largest employment in the mining industry in the Śląskie Voivodship was in the Rybnik Agglomeration. As stated by the data of the European Commission, number of employed in the EU in mines is almost 185 thousand. people, with more than half of this number in Poland (Eurostat, 2022). In the country, the Śląskie Voivodship definitely dominates in this respect, concentrating nearly 70,000. working in mines (Hetmańczyk, 2022). The share of the Śląskie Voivodship in employment in the mining industry is almost 80% of the employed in mines in Poland and 43% of employees in the EU (Joint Research Centre, 2018).

The complexity of the transformation - the resultant of technological, infrastructural, organizational, market and legal changes as well as consumer behavior (Geels et al., 2017) meant that the conditions of this process became the subject of scientific discussion and public. The scientific discussion focuses mainly on defining the concept of energy justice (Jenkins et al., 2018; Sareen, Haarstad, 2018; Williams, Doyon, 2019), while the public one – around

practical solutions and scenarios for the development of the industry and related regions (Alves et al., 2018; World Bank, 2018). In Poland, the scientific discussion revolves around coal mining and the importance of coal for the functioning of the national energy system (Kamiński, 2009; Jonek-Kowalska, 2015; Rybak, Rybak, 2016).

The article presents a research method enabling social assessment of barriers and determinants of the employment restructuring process in the mining industry under the just transition mechanism. This subject is a difficult research area, because the speed and deepening dynamics of changes cause overlapping of various elements. The subject of the method is the diagnosis of barriers and determinants of employment restructuring under the just transformation mechanism, including such issues as: assessment of the instruments proposed to be used to manage surplus employment, effects in the area of local economy and economy, effects in the area of natural environment, specific local problems (e.g. economic, social), as well as an indication - based on experience - of other instruments to mitigate the effects of restructuring as part of a just transition. The method was verified in pilot studies carried out in mining communes. The obtained results should be treated rather in terms of demonstrating the possibilities of the method itself than as a real picture of the situation.

As a result of the economic transformation of mining sub-regions, entire value chains will be liquidated or their current profile of activity changed (Magretta, 2014; Cedillo et al., 2006)¹ in which workplaces focused on coal mining and related companies currently operate. Closing mines will be accompanied by a change in the production profile of mining-related companies, which will lose their existing customers for their products and services. In order to support the diversification of the activities of companies from the mining and mining-related industries, it will be necessary to implement the necessary production and logistics investments contributing to changing the profile of activity, introducing new products, services, processes or gaining new markets, as well as maintaining or creating new jobs that will enable employment for people leaving from declining sectors.

In connection with the long-term goal of carbon climate neutrality adopted by the European Union by 2050 (Komisja Europejska, 2019), the Śląskie Voivodeship faces a huge challenge to carry out a just transition (Kiewra et al., 2019; McCauley, Heffron, 2018)², which will require changes at the social, economic and technological level as well as the transition from carbon-intensive industries and energy sources to clean energy technologies.

In order to mitigate the effects of the energy and socio-economic transformation, including the liquidation of employment in the mining sector, it will be necessary to provide by 2030 almost 82,5 thousand new jobs, including those working in mining-related companies (Umowa społeczna..., 2021). The effects of actions taken in the process of just transformation of the

¹ The value chain is the sequence of activities undertaken by a company to develop, manufacture, sell and deliver a product and then provide after-sales services.

² A just transition is a process of systematic and gradual changes which, in the long perspective, will allow the region's economy to be based on modern, environmentally neutral industries. Approximately one million people working in mining and mining-related industries will be directly affected.

region will be felt mainly in the mining sector, but will also be noticeable in sectors requiring deep restructuring, such as energy, metallurgy, chemical, mineral, machinery and transport.

In order to mitigate the socio-economic consequences of the transformation of the region, it is necessary to prepare the key stakeholders of the transformation process for the upcoming changes, establish and maintain permanent cooperation between employee organizations, employers' organizations, economic self-governments and scientific and research institutions, systematically inform local communities of mining subregions, and support the process of managing the socio-economic transformation. One of the challenges will also be the proper functioning of social dialogue as the basis for effective problem solving. The subject of social dialogue is the joint shaping of professional relations, working conditions, wages, social benefits, as well as other issues of economic policy that are of interest and competence to all parties, as well as relations between partners and their mutual obligations. Dialogue, however, allows for the search for a practical consensus and balanced decisions, especially in such an important topic as transformation, which facilitates their social acceptance.

In view of the problems described above, it is also important to correctly define the term transformation, which will be used in all analyses, research and expert opinions. The term transformation has its origin in Latin – "transformation" and means conversion – regarding to social, economic, political, technological or IT areas. The term transformation is commonly synonymous with another term, which is change. It is significantly rarely associated with the term development or progress (Lipiński, 2017).

In such a context, it should be noted that the term transformation is perceived as more complex and, at the same time, narrower than the term change mentioned above. On this basis, it should be concluded that known transformations are changes, but not every change will be a transformation. This is how the term is perceived by R. Lipiński, who at the same time defines the term change as follows: change is any noticeable modification of any element of reality. Meanwhile, transformation in its source should be perceived as a non-trivial and intentional process of changing one fragment of the environment implemented at a given time, which is designed to create a new and sustainable state of the environment (Lipiński, 2017).

2. The social diagnosis method of assessing the barriers and determinants of the hard coal mining employment restructuring process

The purpose of using the method is to obtain information on the social perception of the employment restructuring process in the mining industry, taking into account the phase of design, implementation, monitoring and impact assessment for the industry and local communities.

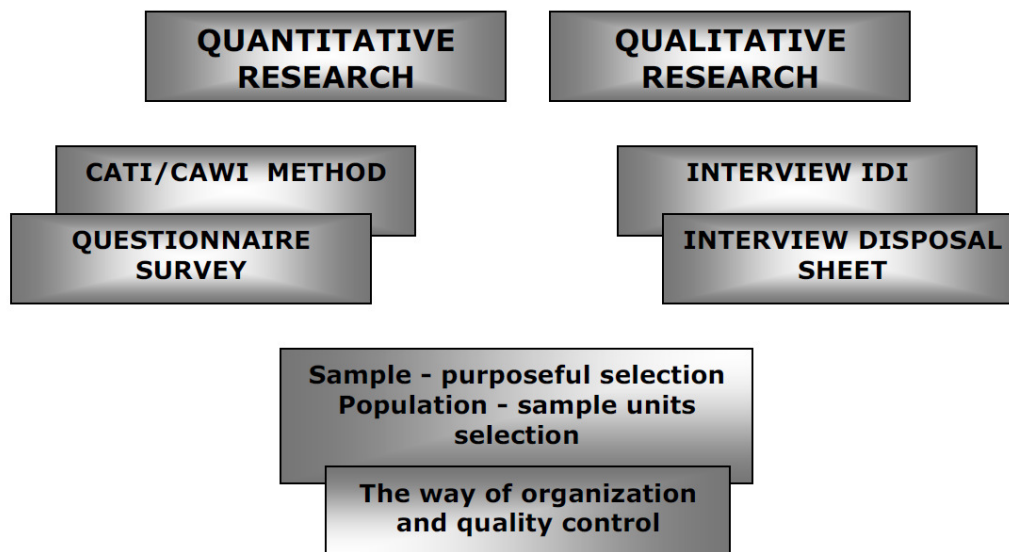


Figure 1. Social assessment diagnosis method of employment restructuring process.

The method of researching the social perception of the hard coal mining employment restructuring process, due to the specificity and complexity of the issue under consideration, uses various, mutually complementary methods and techniques of social research (Figure 1):

- quantitative evaluation studies – which include: a survey, a survey technique (CATI/CAWI), which is a technique of collecting information consisting in filling in questionnaires by the respondent himself, usually with a high level of standardization. CAWI (Computer Assisted Web Interview) and optional CATI (Computer Assisted Telephone Interview) will be used, if necessary, to supplement the study. However, the basic method will be a survey carried out via the Internet (Batorski, Olcoń-Kubicka, 2006). The CAWI research technique is an interview conducted by receiving a questionnaire or survey via the Internet and completing it online. It is currently one of the most popular and dynamically developing methods of scientific research. Thanks to the sense of anonymity and the possibility of participating in the survey at a time convenient for the respondent, it allows you to collect reliable data. A feature of CAWI research is also the fact that we are sure of reaching a specific target group, which was extremely important from the point of view of this research. This type of survey also allows you to eliminate the "pollster effect", i.e. the influence of the person conducting the survey on the answers given, which is of great importance for the reliability of the results obtained.
- qualitative research – in the study of problems as complex and difficult as phase evaluation and effects of the employment restructuring process in the industry, it was considered that better results would be obtained through an in-depth analysis of fewer cases than a superficial analysis of a larger number of cases. Therefore, it was considered necessary to use a qualitative method. The most adequate – in relation to the

planned group of respondents – is the technique of in-depth, individual interview, often used in the case of diverse categories of respondents, especially difficult to reach – specialists, decision makers and people geographically dispersed. Individual in-depth interviews will be conducted based on a list of problem questions, containing areas of issues to be discussed (research tool).

The purpose of quantitative research is to assess the impact of actions taken in the field of employment restructuring on the immediate environment, which include:

1. Social assessment of the impact on the condition of local communities and the local economy.
2. Evaluation of instruments used at the local level to mitigate social and economic effects.
3. Specific local problems, including positive phenomena (e.g. social, economic, environmental) related to the course and results of restructuring.

The tool used for quantitative research is a questionnaire covering four thematic blocks:

1. Factors determining the need for economic transformation.
2. Financial preparation of the region for economic transformation.
3. The impact of the closure of mining plants on the local environment, e.g. entrepreneurs, labour market.
4. Anticipating and mitigating the possibility of negative social consequences related to the process of closing mines and protecting employees from dismissal.

One of the most important issues to be examined (questions in the questionnaire) is the assessment of the instruments used to mitigate the effects of employment restructuring in terms of their adequacy and effectiveness, as well as the sustainability of the achieved results. It is worth noting that the studies carried out so far have not focused on a comprehensive assessment of the solutions applied from the point of view of the support beneficiaries themselves.

In quantitative research, the proper population of respondents are representatives of local government authorities, labour market institutions, local economic self-government institutions and local development agencies, i.e. people (sample unit) with knowledge about the effects of industry restructuring for the poviats. Due to the spatial area of the research (poviats where business entities of the restructuring industry were or are located), significant diversity of the population of research participants (knowledge about the effects of restructuring) and the substantive scope of the research (social, economic and environmental issues at the local level), purposeful selection of the research sample, taking into account the following criteria:

- spatial,
- knowledge and experience.

The purpose of the qualitative research, to which the article is devoted, is to assess the course of employment restructuring in the hard coal mining industry (design, implementation, monitoring phases together with the instruments used) and its effects in the economic, social and environmental dimensions.

The list of topics covered in the planned in-depth interviews includes the following:

1. Is the EU energy and climate policy the only factor determining the need for economic transformation of mining communes and poviats?
2. What may be the key challenges for mining communes resulting from the departure from hard coal mining?
3. Is it possible to plan a complete departure from coal mining in Poland?
4. What may be the most important areas of intervention to minimize the socio-economic effects resulting from the departure from hard coal?
5. Do the sector diagnoses on the basis of which restructuring programs are developed cover all functional subsystems (management, production, marketing and sales, logistics, human resources, occupational safety, finance)?
6. Are alternative diagnoses of problems and needs taken into account?
7. What factors influenced the restructuring of the sectors?
8. How is communication with stakeholders about the restructuring process in terms of problems and needs carried out?
9. The impact of economic, political, economic external (national, European, global) and internal conditions on the objectives and instruments specified in the restructuring programs of the sectors.
10. Factors inhibiting and stimulating the process of employment restructuring in the mining industry in Poland.
11. Ways of agreeing sector restructuring programs with stakeholders.
12. Whether and what negative effects may be caused by the restructuring activities carried out?
13. Ways to eliminate the negative effects of restructuring processes in the coming years.
14. Is there a sufficient level of support in the region in terms of managing the process of socio-economic transformation of the region?
15. Is there a sufficient level of social awareness in the region about the process of energy and socio-economic transformation in the region?
16. Has an analysis of the level of preparation of the key staff to carry out restructuring processes been carried out in the region?
17. What are the factors that inhibit and stimulate the process of restructuring the mining industry?
18. Is there a negative experience of previous restructuring in the region causing resistance to change?

The research sample for qualitative research will be selected purposeful (Stupnicki, 2015), and the main criterion will be the knowledge of the respondents, resulting from participation in design, programming or executive (implementation, monitoring) restructuring processes. The participants of the research are representatives of: government administration,

at the voivodship level, enterprises or groups of enterprises in the industry, corporate organizations (associations, associations), industry/regional structures of trade unions.

In the selection of respondents, the snowball method will be used, which consists in recruiting participants by other participants (Castillo, 2009). The priority in their selection will be comprehensive knowledge of the restructuring process. Conducting individual in-depth interviews requires knowledge of the researched issues. Therefore, conducting the interviews will be entrusted to competent persons – who know the issue of restructuring a given industry or have been trained in this field.

The general characteristics of the research used in the model of social assessment of barriers and determinants of the employment restructuring process are presented in Table 1.

Table 1.

Purpose and sample of methodology that enables carry out barriers and determinants diagnosis of social assessment of the employment restructuring process

	Quantitative research	Qualitative research
Purpose	Impact evaluation of the undertaken restructuring activities on the immediate environment	Evaluation of employment restructuring in the industry (design, implementation, monitoring phases along with the instruments used) and its effects in the economic, social and environmental dimensions
Sample selection criteria	Spatial – 28 poviats where business entities of the restructured industry were or are located (with a significant impact on the local economy). Competence - knowledge and activities of experts to mitigate the effects of industry restructuring at the local level	Knowledge resulting from participation in design, programming or executive (implementation, monitoring) restructuring processes
Study population	These are people with knowledge of the effects of industry restructuring for the poviat, representing: <ul style="list-style-type: none"> – local government authorities, – labour market institutions, – local economic self-government institutions, – local development agencies 	Representatives: <ul style="list-style-type: none"> – government administration at the voivodeship level, – enterprises in the industry, – industry organizations (associations, associations), – sectoral/regional trade union structures.

Source: Own elaboration.

3. Results of the application of the method

3.1. Research assumptions

In order to determine the social assessment of the barriers and determinants of the employment restructuring process under the just transition mechanism, individual in-depth interviews were conducted in the third quarter of 2022 with a group of 10 experts. According

to the adopted research assumptions, these are people with long work experience and life and professional experience. The selection of experts for the interviews was dictated primarily by the purpose and problem scope of the interview scenario developed for the purposes of the research and the complexity of the questions included in it. In this light, only the indicated persons – as demonstrated by the pilot study of the research tool – could fully refer to the issues and problems posed in the study. In the research, the method of direct interview was used, carried out with the tool of the interview sheet and technique CATI (Babbie, 2019).

After pretesting, which was carried out on a sample of three experts, the interview sheet consists of three questions regarding the characteristics of the respondent, 11 basic, open questions. Questions relating to the characteristics of the respondent concerned:

1. respondent's gender,
2. workplaces,
3. type of work performed.

The main questions – as indicated earlier – included issues related to:

1. factors determining the need for economic transformation,
2. financial preparation of the region for economic transformation,
3. the impact of the closure of mining plants on the local environment, e.g. entrepreneurs, labour market,
4. anticipating and mitigating the possibility of negative social consequences related to mine closure process and protecting employees against dismissal.

As part of the pretesting, the following elements of the questionnaire were verified:

1. technical correctness: analysis in terms of transition rules, logic and order of questions asked, instructions for interviewers, etc. (technical notes),
2. linguistic correctness: analysis in terms of the complexity and logic of sentences, comprehensibility of the used vocabulary and abbreviations (language and editorial comments).

Based on the comments and opinions obtained in the pretesting, the structure of the interview sheet was clarified and questions were unified in terms of language. As a result, a research tool was obtained that was technically and linguistically correct. This tool was used for the proper research as a source of research material for analyses.

The results of the survey were developed with a division into previously adopted problem groups, according to thematic blocks.

3.2. Description of the research sample for the interview

GIG address data was used to construct the research sample, on the basis of which a list of over a dozen institutional experts was prepared, who were selected as survey respondents. Everyone of the respondents received a letter inviting them to participate in the study, which was additionally arranged through a telephone conversation. Out of a sample of

10 experts, all accepted the invitation to participate in the research. In total, the interview sheet contains three personal data questions and 11 extended open questions.

The rich analytical material obtained from expert interviews in the first phase of the work was put in order. In the second stage of work, its transcription was made. In the third phase, the acquired cognitive material was corrected and edited. Recommendations were developed on the basis of such cognitive material and conclusions summarizing the results of the study.

The distribution of the sample according to the following criteria is presented below: gender, type of work performed, place of work, commune/powiat.

Local experts (institutional leaders) representing deeply diverse social environments, professions and professional experience were invited to participate in the expert interviews. When building the research methodology, it was assumed that the experts would have higher education, be characterized by extensive life and professional experience, be recognized in their socio-professional environment, and directly or indirectly create the socio-economic image of mining communes through their profession.

The target sample of experts from the surveyed mining communes by gender, carried out in the research, was as follows: three interviews were given by women (30,0%) and seven by men (70,0%). All experts participating in the research held managerial positions.

Analyzing the distribution of the surveyed people according to the criterion of the place of work, in relation to the commune - in alphabetical order - they represented: Bytom, Jastrzębie-Zdrój, Rybnik, Rydułtowy, Tychy. According to the administrative unit criterion, the experts represented the following poviats: Bieruńsko-Lędziński, Bytom, Jastrzębie-Zdrój, Rybnik, and Wodzisław.

In total, 10 complete and acceptable due to the methodological correctness of expert interviews were obtained in the research, the results of which are presented in the discussion below.

3.3. Findings – discussion

The first question addressed to experts in the above cognitive area was the question about the factors determining the need for economic transformation of mining communes and poviats. The impact of the EU energy and climate policy on Poland's decision to abandon coal-based energy policy was considered an important factor, but not the only one. In their assessments, the experts recognized that the systematic increase in the cost of coal mining, the degradation of the natural environment and the depletion of minerals were equally important factors that influenced the decision.

In the next question, the experts faced two issues. The first addresses the issue of the possibility of planning a complete departure from coal mining in Poland. The second focuses on diagnosing problems and needs when developing industry restructuring programs.

First of all, experts' opinions were dominated by the conviction that the decision the departure from hard coal mining, in the context understood so far, is a foregone conclusion. This view was even stronger expressed by one of the experts who stated that re-profiling the energy policy of our country is possible, even necessary. In fact, we have no turning back from this change. However, it must certainly be reliably and comprehensively planned. In other assessments, experts stated that it is desirable to plan the process of completely moving away from coal mining in Poland. However, in this perspective, they decided that basing the national energy policy on renewable energy sources is unrealistic. Perhaps in the distant future such changes are possible, but currently experts state that in Poland there will be a need to diversify sources guaranteeing energy security. The key challenge in the area of source differentiation will be the need to have appropriate technologies related to their financial development. In a pessimistic assessment, experts state that currently Poland is not at all prepared to develop alternative energy sources to coal. As one of the experts notes, "Abandonment of the coal economy is economically unjustified at the moment. We are a region based on coal deposits. It is possible to use more ecological solutions related to :with coal. Utilization of methane deposits for energy production. The use of modern solutions related to the use of modern, ecological solutions based on coal combustion equipment, e.g. the use of filters". The sector of new energy sources is just developing and can only draw on the experience of other European Union countries in this development.

Another expert states that "nuclear energy is a stable source of electricity, and the ability to store nuclear fuel for a long time improves the energy independence of the country. Coal energy will remain the pillar of the Polish economy, while a nuclear power plant that does not emit CO₂ will allow Poland to achieve the EU's climate goals European".

In conclusion, it can be said that in the perspective of the passing time, Poland will move away from coal-based energy, if not completely, then probably to a large extent. This will be influenced by the EU policy as well as the awareness of the decreasing hard coal resources each year.

It is worth paying attention to the diagnosis of problems and needs when developing industry restructuring programs. Experts say that this diagnosis – if carried out – is not enough. One of the experts clearly states that "The developed industry restructuring programs are not preceded by a diagnosis of problems and needs". All experts agreed that such diagnoses should be carried out by the government in cooperation with local governments and residents.

The next question concerned the possibility of implementing economic transformation in mining communes and poviats in the coming years. Expert opinions were dominated by the conviction that the economic transformation is already being successively implemented as employment in mining plants is falling and coal production is decreasing. It was emphasized that this is a long and costly process. It is worth quoting the statement of one of the experts, in which he says that "The economic transformation in Upper Silesia has been going on for years, and according to the WWF Polska Foundation, the mining sector employs less than

4% of employees in the province. Currently, the right questions are not about whether there is a possibility (it is already happening), but how to ensure a sense of security and real alternatives to earn money for residents, and energy security for the country".

The next question concerned the positive and negative effects resulting as a consequence of the process of economic transformation. The opinion of experts prevailed that the economic transformation would contribute to the improvement of the environment and change of the economic model. Areas of concern among experts were: rising unemployment, impoverishment of society and social unrest. In order to limit the negative effects of the transformation process, experts agreed that it should be well planned in consultation with local governments and citizens.

The consequences for mining communes and poviats, as a consequence of the economic transformation process, will be diverse. However, the most important and common for all is the maximum use of measures to minimize the social effects of transformation related to the liquidation of hard coal mining, and thus the loss of thousands of jobs in the mining industry itself, as well as in the branches directly and indirectly related to mining – the chain of dependence. Social impacts are closely related with activities aimed at remodeling the economic sector. There is still the problem of degraded post-mining areas and the country's energy security - the transition to RES.

In this area, experts emphasize that the key challenges resulting from the abandonment of hard coal mining that mining communes will face will be:

- support for communes where mining plants will be closed, appropriate to the scale of changes caused by the transformation,
- need to create new alternative jobs to those that are disappearing in transformed mining,
- need to support families living in the mining industry,
- support in the area of development of post-mining areas.

Also in expert assessments there is a tendency to indicate solutions that can minimize social and economic losses of mining communes as a result of economic transformation. In the foreground in the sphere of actions taken, experts indicate the need to provide miners and their families with work that would allow them to maintain the current level of life security. In further assessments, the experts pointed to the following actions:

- preparation of programs and strengthening of sectors of the economy alternative to the mining industry, including production enabling easy employment for the so-called underground workers,
- recultivation of post-mining areas in order to prepare investment areas along with the transfer of funds to communes for this purpose,
- strengthening all available reliefs for entrepreneurs in order to encourage them to conduct business activity in mining communes,

- promoting among entrepreneurs the idea of obtaining measurable investment benefits that balance outlays related to the preparation of land for investments or training future employees.

The next question referred to the areas of intervention minimizing the socio-economic effects. Experts clearly emphasized the following key strategic fields of intervention for the transformation:

- creating alternative energy sources to coal,
- reclamation, revitalization and development of degraded post-mining areas,
- searching for opportunities to create new areas of economic activity on the basis of supporting the SME sector already operating in the transformed areas, as well as large and large companies,
- creation of conditions by the local government for locating new investors and companies from the business environment in the area of transformed mining communes,
- opening up to innovative and experimental solutions in the area of R&D - e.g. related to the use of waste, geological resources, etc.,
- guaranteeing jobs for redundant miners through re-industry, training, striving for changes in the culture and social awareness of the inhabitants of the transformed areas (at present, an economic monoculture is established in this society, shaping a specific culture of life, choosing well-paid work only in mining, lack of involvement in setting up own companies often associated with a family model based on a non-working woman),
- skilful reaching people's consciousness with information that there is an alternative to coal.

In conclusion, the experts stated that there is no need to discuss the job prospects for current miners at present. The transformation process will be a long-term one. In this process, it will be very important to properly direct the development of the young generation (19-25 years old), so that they understand and find themselves in a new perspective, not related to mining.

In your opinion, is social dialogue conducted in mining communes and poviats in Poland in order to carry out the process of economic transformation? This is another question asked by experts in research. According to experts, there is no social dialogue with local governments, and one indicates the reason – "both sides do not want it". The experts unanimously believe that all stakeholders should be involved in the dialogue, starting with local governments, trade unions, mining companies and residents. According to the expert, the most important thing is the appropriate management of human resources, finding an alternative to the hard coal mining sector, preventing the social and economic impoverishment of the transformed areas. In the opinion of the expert, it seems necessary and logical to develop a plan for the gradual phasing out of the hard coal mining sector. In the opinion of experts, broad social participation based on social dialogue is an obligation resulting from the key assumptions of the

Transformation Mechanism. It is a necessary condition in the process of obtaining funds from the transformation mechanism.

In conclusion, based on the assessments and expert opinions, it should be stated that local governments from mining communes face a big challenge and numerous new additional obligations aimed at preparing their inhabitants for the inevitable transformation processes. In the aftermath, it will be extremely important for the inhabitants to face the challenge of trusting local government authorities that the transformation will create new ones for them and better development opportunities. As one of the experts emphasizes, I would consider the partnership of both entities to be the most important in social dialogue. After all, every interested party should have the opportunity to comment and comment, whose voice would be important in making strategic decisions.

In your opinion, are mining communes and districts in Poland prepared to move to a new model of economic development not based on mining? What factors may influence the process of economic transformation of mining communes and poviats? Are changes as a result of the process of economic transformation of mining communes and counties inevitable? These are more questions asked by experts. In their answers, the experts concluded that the communes are not prepared for this process. According to most experts, this is due to the limited activity of mining communes and districts in the area of transformation and the lack of alternative sources of raw materials. An important element of preparation for a new model of economic development not based on mining is financial support – governmental and EU.

The next question referred to the factors that may affect the process of economic transformation of mining communes and poviats. Experts clearly emphasized that the pace of changes and the involvement of the state will be of key importance. Equally important factors include:

- providing transport infrastructure - road and railway - of the transformed region,
- good planning and consistency in action,
- changing the professional mentality among employees of the mining industry and their families,
- friendly approach to investors - support, tax reduction, legal regulations,
- creating long-term urbanization and infrastructural plans.

The last question addressed to experts in the study addressed the issue of the inevitability of changing the model of economic development of mining communes and poviats as a result of the transformation process. Experts have unequivocally settled this issue, stating that change is inevitable. They justified their assessments as follows. Change is inevitable, municipalities must follow the times and develop, and so they will remain stagnant. Changes are inevitable, if only because of depleting coal deposits and increasing costs of its extraction. A change in the model of economic development of mining communes and counties is inevitable due to the possibility of developing post-mining areas, the emergence of new companies, new industries and thus the departure from the mining monoculture.

4. Conclusions

Due to research results described above, it seems that all the expert assessments and opinions expressed confirm the thesis that if the changes related to the just transition process cannot be stopped, then one must learn to take advantage of it. The view expressed above regarding the process of just transformation, which implies both economic and social challenges that are important for mining communes, among which the following deserve special attention:

- increasing the importance of the participation of mining communes in making government decisions,
- more friendly conditions shaping cooperation,
- the need for mining communes to implement projects based on local mobility, adaptability and social sensitivity,
- the need to increase social awareness related to mining in mining communes with responsibility for the just transition process,
- disappearance of state policies in the implementation of social functions in the phase of ongoing changes and taking them over by the local society.

In addition, based on the assessments and opinions of experts, it seems that in the perspective of the inevitable occurrence of the transformation process, it may be important for local governments, and in particular mining communes, to promote actions for an evolutionary, not short-term shift from coal-based energy to low-emission sources - striving to make it a multi-stage and long-term process. Equally important may be the pursuit of solutions according to which the principle of introducing funds directly to individual communes for the implementation of the just transformation process will be adopted. Consideration should be given to the need for local governments, including mining communes, to obtain state intervention appropriate to the scale of the challenges, while equipping them with reliable and comprehensively planned proposals for transformational activities limiting their spontaneity.

Assumptions and actions related to the process of just transformation should become the basis and the essence protecting mining communes in this process against the occurrence of a short-term socio-economic shock. It should be a long-term process, characterized in the first phase of implementation by a very extensive social information campaign raising awareness of the community living in mining communes - how their future is shaped in this process - what awaits them? Expert assessments clearly show that the achievement of such goals as: conscious acceptance of the need for change, acceptance of the future new socio-economic order in mining communes, acceptance of the goals of just transformation will probably reduce or even significantly limit the effects of the economic and social collapse that may occur in mining areas.

Experiences related to the restructuring of the mining industry evoke unpleasant experiences resulting from unprepared actions, carried out in a proverbial hurry, liquidation of mines without planning the future of the areas where they conducted business activity (Lipiński, 2017). According to experts, these are among the most serious concerns related to the just transition process. As one of the experts notes, one should be aware of the long-term nature of the change process.

If the socio-economic shock scenario materializes, it should be stated that its source will be unprepared in accordance with the program and key assumptions, proceeding in a spontaneous and uncontrolled way, transformation. Counteracting these shocks should primarily be achieved by maximally strengthening the alternative sectors of the economy, so that they are ready to absorb the employees of the coal sector. As experts note, the justice of the transformation process - clearly and precisely defined goals, challenges and needs - is to serve the following purposes:

- protection of transformed areas against possible tremors,
- the evolutionary transition from a high-carbon to a low-carbon economy,
- a smooth and controlled departure from employment in the mining industry to shifting qualified personnel to sectors such as: information technology, modern business services, logistics, etc.,
- optimizing the re-adaptation of post-mining areas.

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IMPACT OF THE COVID-19 PANDEMIC ON THE RATES OF RETURN OF SELECTED WSE LISTED COMPANIES

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Purpose: Financial crises, stock market crashes and consequently bursts of speculative enthusiasm have been accompanying investors since the 17th century. The first speculative bubble, so-called “tulip mania”, occurred in the Netherlands between 1636 and 1637, while a speculative “fever” spread among the shareholders of the Dutch East India Company from 1636 to 1640. Those events exposed remarkable possibilities and complexity of the financial markets, and later encouraged investors to explore a variety of investment strategies bringing above-average rates of return. However, the question remains: how do modern-day investors react to the market disruptions and which investment strategies are popular among them. The purpose of this paper is to provide an understanding of how and why the COVID-19 pandemic affected the investors’ behavior and the rates of return earned by selected WSE listed companies. An attempt was also made to estimate the sensibility of investing in selected stocks through the use of the basic and most popular fundamental analysis market ratios, i.e. P/E and P/BV. Furthermore, based on selected companies, semi-strong information efficiency of the Polish stock market was assessed, with a particular focus on the COVID-19 pandemic period.

Methodology: The paper assesses the rates of return of companies constituting the WIG20 index and selected “covid” companies and calculates P/E and P/BV market ratios to verify how the fundamentals of a given company affect its rates of return. As a measure of relationship strength between the market value and rate of return indicators, the Spearman's rank correlation coefficient and a significance test for the Spearman's rank correlation coefficient were selected.

Findings: The research reveals that, during times of violent turmoil and massive panic on the stock markets, an interesting investment strategy that brings above-average rates of return is to build a stock portfolio based on a current trend. All hypotheses formulated were positively verified in the paper.

Practical implications: The study's results provide a valuable source of information for stock market investors, particularly individual investors who, when making tough investment decisions, i. e. during stock market crashes or financial crises, can employ strategies that involve building an investment portfolio based on trending companies and achieve above-average rates of return. Furthermore, the suggested investment strategy is adaptable and, over centuries, still effective.

Originality: The considerations concentrated not only on identifying an appropriate investment strategy in times of a stock market turmoil, but largely focused around behavioral aspects of investing, which represent an important addition to theories about rational decision-making by investors and the efficiency of financial markets.

Keywords: COVID-19 pandemic, rate of return, P/E and P/BV ratios, information efficiency, Spearman's rank correlation coefficient.

Category of the paper: Research paper, viewpoint.

1. Introduction

Massive turmoil and high volatility of the capital markets, caused by the global COVID-19 pandemic, triggered another speculative bubble, which can be referred to as the “covid bubble”. It has become particularly apparent in certain sectors of the economy, such as medical, biotechnology, game development or IT companies. Despite the fact that such developments do not frequently occur in the history of stock exchange listings, they provide enormous investment and speculative opportunities and consequently translate into a significant capital injection and a radical change in the investment strategies employed in the capital markets. As a result of the COVID-19 pandemic, the market boom has attracted a large number of individual investors to the capital markets, determined to achieve above-average rates of return. In Poland, additional arguments for investing in the stock market were: interest rate cuts, a rise in inflation and extremely low valuations of the companies (in many cases below the valuations of the last financial crisis of 2007-2009). These factors have triggered a wave of mostly uncontrollable stock price advances and improved performance of certain domestic companies. Additionally, in order to better understand company-specific market valuations, the impact of their fundamentals on rates of return was examined, using P/E and P/BV market ratios¹. Research by S. Basu (1977) reveals that stocks with lower P/E ratios get higher rate of return than those with high ratios. Similarly, R.A. Haugen has conducted a research using both ratios, showing that companies with high P/BV ratio are characterized by the highest risk and the lowest rate of return (Haugen, 1999, pp. 2-10). However, R. Banz (1981) proved that this rate is even higher for companies with lower market capitalization. J. Czekaj, M. Woś and J. Żarnowski (2001) came to analogous conclusions, but pertaining to the Polish stock market and P/BV ratio. They proved that companies featuring low P/BV ratios have brought statistically significant above-average rates of return, as opposed to the companies with high P/BV ratio values. Based on a research conducted by E. Fama and K. French (Fama, French, 1992) concerning all stocks listed on the New York Stock Exchange, the American Stock Exchange and over-the-counter market (Nasdaq) for the 1963-1990 period, with respect to the

¹ Unlike P/E and P/BV.

relationships between the book value of equity and the market value of the stock, indicate that companies characterized by low P/BV ratios enjoyed 16.4 pp higher rate of return. However, there is a gap in the literature of the subject, in terms of research and analysis, as to the methods of creating securities portfolios based on the trending industries or speculative bubbles compared with P/E and PBV indicators of those companies. That is why, in light of the widespread interest in the matters discussed and the current lack of synthetic considerations, supported by empirical examples, in this area, it would seem necessary to conduct a comprehensive analysis of the impact and implications of the “covid bubble” on the listing of selected WSE listed companies and investors' behavior, including P/E and P/BV market ratios.

The purpose of this paper is to provide an understanding of how and why the COVID-19 pandemic affected the investors' behavior and the rates of return earned by selected Warsaw Stock Exchange (WSE) listed companies. An attempt was also made to estimate the sensibility of investing in selected shares through the use of the basic and most popular fundamental analysis market ratios, i.e. P/E and P/BV.

This paper presents the results of research aimed at verifying the following hypotheses:

- H₁: In the periods of stock market crises, creating investment portfolios based on so-called trending companies results in increased investment efficiency by achieving above-average rates of return;
- H₂: During the “covid bubble” (all speculative bubbles in general), the above-average rates of return achieved by the “covid” companies resulted from the trend for these companies, rather than their actual financial results or their P/E and P/BV ratios levels.
- H₃: Speculative bubbles contribute to increased interest in the stock market by the individual investors (rising number of the new investment brokerage accounts and volume).

2. Impact of the COVID-19 pandemic on the efficiency of the rates of return of selected WSE listed companies

Since the 17th century, the global stock markets have been repeatedly facing various economic and financial crises (Kindleberger, 1999; Kenourgios, Samitas, Paltalidis, 2011, pp. 92-106; Dimitriou, Kenourgios, Simos, 2013, pp. 46-56; Luchtenberg, Vu, 2015, pp. 178-203; Yarovaya, Brzeszczyński, Lau, 2016, pp. 96-114), speculative bubbles, or multi-year market slumps (Piech, 2003, pp. 130-131), but it wasn't until arrival of the deadly SARS-CoV-2 virus in Q1 2020 that put the world on a brief standstill, leading to the fastest, shortest, and relatively big stock market crash. The COVID-19 pandemic, described as an exogenous shock (Murawska, 2020, pp. 79-93) or a „black swan” (Taleb, 2020; Yarovaya, Matkovskyy, Jalan, 2020), had a huge impact on the functioning of all the economies around the world, one of its first effects being a mass panic in the capital markets, i.e. sudden and steep stock price declines

in most companies listed on various trading floors. The analysis of historical data revealed that a significant collapse in the value of the global market stock indices began after 19/02/2020, and this trend, depending on the exchange, continued until 12-23/03/2020. The most important stock market indices across all continents saw declines of 25-49% in less than a month (Murawska, 2020, pp. 79-93; Wagner, 2020). For instance, S&P 500 index, tracking the stock performance of 500 large companies listed on stock exchanges in the United States, during 16 trading days has witnessed a 30% decline (Ali, Alam, Rizvi, 2020, p. 100341). In Poland, the worst performing indices after 16 sessions were the WIG20 and WIG, losing 38.27% and 35.88% of their initial value, respectively (Fig. 1). In this context, smaller (sWIG80) and medium (mWIG40) company indices performed slightly better, recording losses of 29.19% and 30.72%, respectively. It is worth noting that within 100 days, almost 30% of wealth has disappeared from stock exchanges globally (Ali, Alam, Rizvi, 2020, p. 100341). Moreover, the research of H. Liu et al. (2020, p. 2800), R. Hong et al. (2020), B.N. Ashrafa (2020, p. 101249) and P. Jaworski (2021, pp. 157-172) conducted on selected stock market indices proved that the outbreak of the COVID-19 pandemic had a significant negative impact on the rates of return of stock exchanges in all countries and areas. Stock indices reacted faster and stronger in Asian countries.

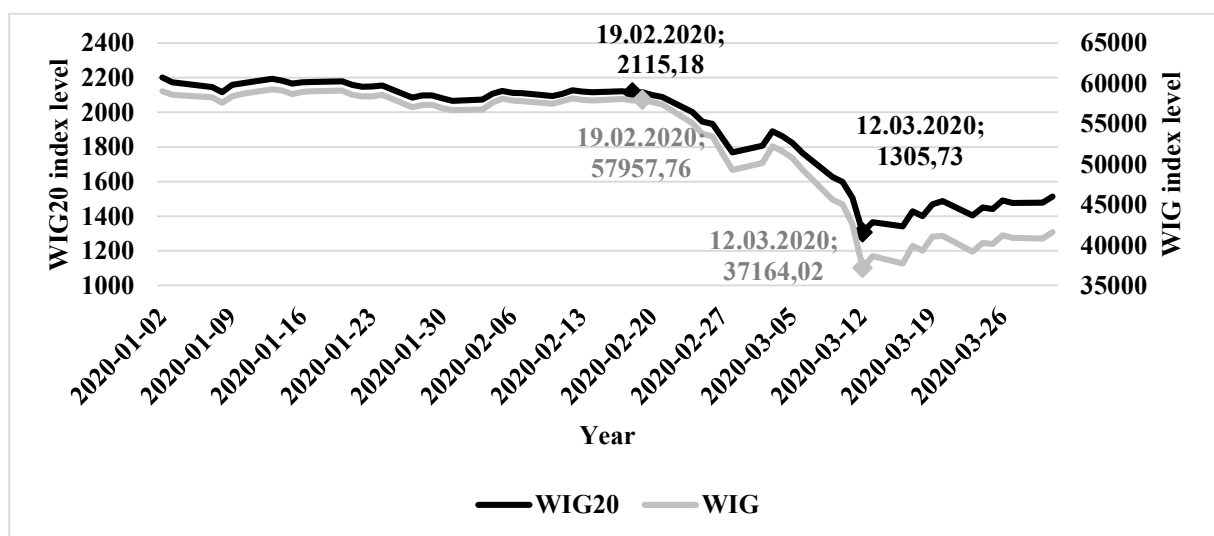


Figure 1. WIG20 and WIG indices quotes in Q1 2020.

Source: Own study.

Significant stock market discounts always prompt investors to seek similarities with previous periods to predict the scope of current declines. For this reason, the recent crash was mainly compared with the financial crisis of 2007-2009 (Sharif, Aloui, Yarovaya, 2020) and the “Dot-com bubble” of 2000-2001. For instance, the scope of the WIG20 index declines in the said periods was significantly greater, i.e. 59.97% and 66.11%, compared to the scope of index declines during the pandemic (38.27%), but it is also important to note that the declines were clearly longer (Fig. 2). Therefore, the crash caused by the COVID-19 pandemic, due to its unpredictability, uniqueness and dynamism, presented a rare investment opportunity in the

stock markets. However, it should not be forgotten that the risk of global financial markets increased significantly in response to the pandemic, and individual stock market responses were clearly linked to the severity of the outbreak in each country. The great uncertainty of the pandemic and the related economic losses have made markets highly volatile and unpredictable (Zhang, Hu, Ji, 2020, p. 101528). On the other hand, every huge turmoil in the capital markets has always attracted a large number of new individual investors and profiteers who are looking to quickly multiply their capital and generate above-average rates of return by utilizing the inefficiency of the global stock markets² (Haugen, 1999). Figure 3 illustrates a rapid increase of the investment brokerage accounts (particularly at the onset of the pandemic in March and April 2020) in view of fluctuations of the WIG20 index value. Bringing in new investors also translates into turnover increase (Fig. 2), which has a positive effect on improving liquidity and promotes the development of the stock exchanges, as some of the shareholders will certainly stay in the market long-term. Similar conclusions were also presented in the work of M. Chiah and A. Zhong (2020, p. 101784), where the impact of COVID-19 on the trading volume on exchanges around the world was analysed.

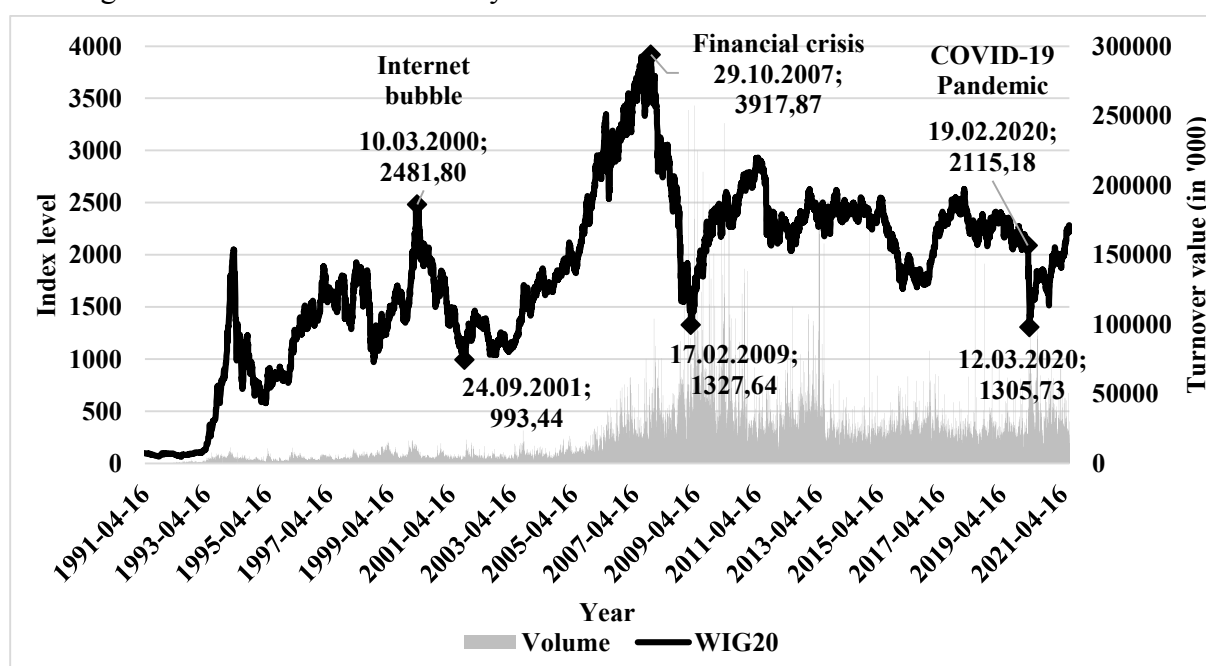


Figure 2. Historical listings and turnover value of the WIG20 index.

Source: Own study.

² The stock market's information efficiency concept is described by, among others, E.F. Fama: *Efficient Capital Markets: A Review of Theory and Empirical Work*, "The Journal of Finance" May 1970, Vol. 25, No. 2, pp. 383-417; R. Bula: *Information efficiency and the price behavior of WIG20 stock market prices* Economic Studies 177/2014, pp. 152-167; R. Slepaczuk: *Capital market anomalies in light of the efficient market hypothesis*, "E-Finance: Financial Internet Quarterly", no. 1/2006, pp. 1-12.

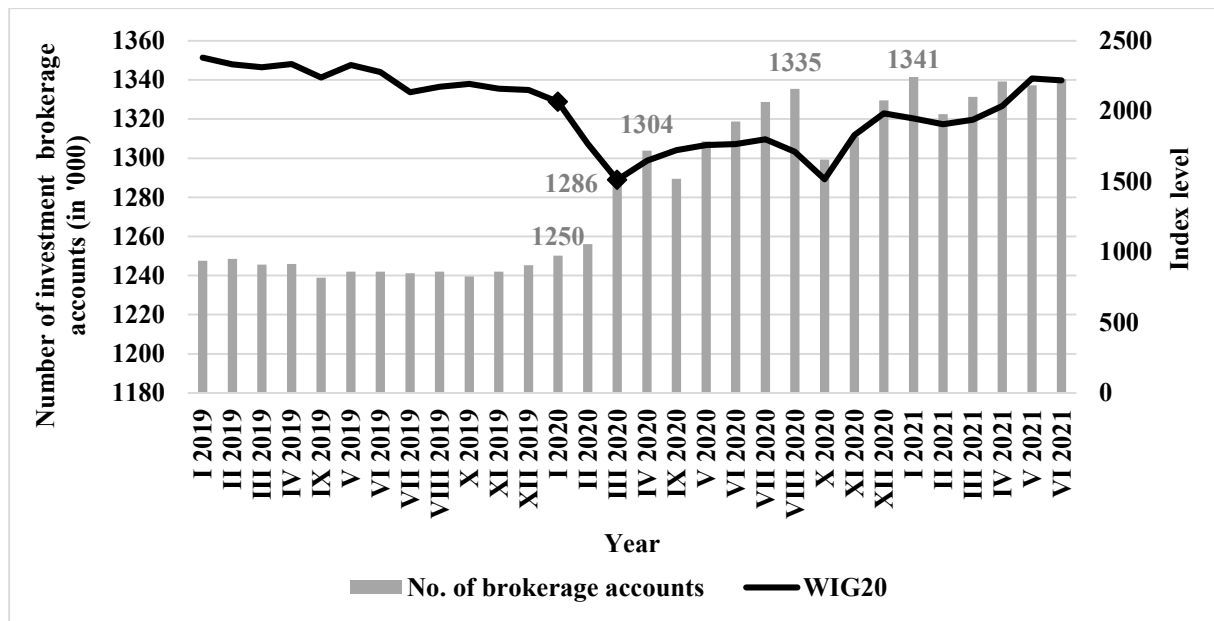


Figure 3. The number of investment brokerage accounts in light of the WIG20 index value changes during the COVID-19 pandemic.

Source: Own study.

3. Research methodology

To verify the hypotheses, a rate of return assessment of the WIG20³ companies was made (as a benchmark of the Polish stock market) as well as selected “covid” companies (so-called trending companies), i.e. companies which benefited the most from the coronavirus pandemic and were the most popular in the eyes of investors, as they were characterized by either high liquidity (significant daily turnover) or a significant capitalization increase. Therefore, 10 companies were selected, mainly from the pharmaceutical, medical and biotechnology industries, but also from the computer and electronics industries, all of which were in great demand due to off-site work and remote learning. The comparison also features X-Trade Brokers⁴ as an example of a company that indirectly benefited from the COVID-19 pandemic by attracting new clients who opened a large number of investment accounts or paid fees more frequently by making more high-risk trades (Tab. 1).

³ Only companies included in the WIG20 index were taken into account, following the revision made on 20/12/2019.

⁴ Besides X-Trade Brokers, only one broker is listed on the WSE, namely IPOPEMA Securities. This company was characterized by a similar trend towards a change in financial results in 2020 as X-Trade Brokers and generated a rate of return of 127%.

Table 1.
Characteristics of “covid” companies

Name of the company	Symbol	Index*/Market	Sector	A product that is in demand in the market
ASBISc Enterprises PLC	ASB	sWIG80	computers and electronics	notebook; smartphone; CPU
Mabion	MAB	mWIG40	biotechnology	vaccine
Mercator Medical	MRC	WIG	pharmaceutical and medical	gloves
PZ Cormay	CRM	sWIG80	pharmaceutical manufacturing	test
BioMaxima	BMX	NewConnect	biotechnology	test
Biomed-Lublin Serum and Vaccine Production Plant	BML	WIG	pharmaceutical manufacturing	plasma-derived medical product
Blirt	BLR	NewConnect	biotechnology	test
Inno-Gene	IGN	NewConnect	biotechnology	test
Harper Hygienics	HRP	Alert list /WIG**	cosmetics and household chemistry	hand sanitizer
X-Trade Brokers	XTB	WIG	stock exchanges and brokerage offices	brokerage account

* Index inclusion following the revision made on 20/12/2019.

** WIG Index inclusion following the revision made on 19/06/2020.

Source: Own study.

To check the impact of a company's fundamentals on the rates of return for all companies, the P/E and P/BV market ratios were calculated. Research by S. Basu (1977) revealed that stocks with lower P/E ratios get higher rate of return than those with high ratios. However, R. Banz (1981) proved that this rate is even higher for companies with lower market capitalization. J. Czekaj, M. Woś and J. Żarnowski (2001) came to analogous conclusions, but relevant to the Polish stock market and P/BV ratio. They proved that companies featuring low P/BV ratios (so-called companies with value potential) have brought statistically significant above-average rates of return, as opposed to the companies with high P/BV ratio values (so-called companies with growth potential). Despite the fact that the research presented represents an important contribution to the discussion on the rejection of the efficient market hypothesis, the matter remains unresolved to this day. Therefore, this article aims to complement the above considerations, taking into account an unusual time of the stock market crash triggered by the COVID-19 pandemic.

In order to illustrate significant changes in the rates of return earned by individual companies, analyses were conducted, not only during the stock market crash triggered by the SARS-CoV-2 virus, but also during periods preceding and following it, that is, from 03/01/2018 to 30/06/2021. However, the research on the relationship of the companies' fundamental ratios, namely P/E and P/BV, covered the 2017-2019 period and the following year's stock rates of return, respectively. As a measure of relationship strength between the market value and rate of

return indicators, the Spearman's⁵ rank correlation coefficient and a significance test for the Spearman's rank correlation coefficient were selected. A nonparametric t test was conducted to determine whether the estimated correlation was statistically significant. The closer the value of the Spearman coefficient is to 0, the weaker the monotonic relationship between the analyzed characteristics. Therefore, the following hypotheses were adopted:

H_0 : $\rho = 0$ (this is no monotonic relationship between the two characteristics in the sample),

H_1 : $\rho \neq 0$ (this is a monotonic relationship between the two characteristics in the sample).

Next, p-value calculated by a test statistic was compared with significance level of α (assumed α value = 0.05), thus:

- if p-value $> \alpha$, there are no grounds to reject H_0 ;
- if p-value $\leq \alpha$, H_0 should be rejected by assuming H_1 (the correlation is significant).

4. Research findings

A research conducted on the Polish stock exchange clearly indicates that during the COVID-19 pandemic, companies from sectors directly or indirectly involved in the fight against the SARS-CoV-2 virus were most successful. Among the so-called “covid” companies with above-average rates of return are:

- companies that produced and distributed drugs, PCR and antigen tests, hand sanitizers, masks and disposable rubber gloves (pharmaceutical, medical and biotechnology companies),
- companies that provided the necessary hardware and software for learning and remote learning and off-site work (IT companies),
- companies that provided entertainment for children and youth (game development companies).

Table 2 shows the rates of return of the “covid” companies during the year of the pandemic, as well as immediately before and after it.

⁵ Similar research featuring, however, the Tau-Kendall coefficient can be found in the work of M. Kalinowski, G. Krzykowski: *Semi-strong information efficiency of the Polish stock market at a time of the financial market instability*, *Annales Universitatis Mariae Curie-Skłodowska Lublin, Sectio H*, vol. XLVI, 2/2012, pp. 71-82.

Table 2.

Simple rate of return of the “covid” companies in the period from 03/01/2018 to 30/06/2021

Company	Rate of return [%]			
	2018	2019	2020	I-VI.2021
ASB	-22.70	49.90	166.47	168.87
MAB	-23.36	-7.23	-73.93	226.17
MRC	-36.84	-7.88	3963.94	-38.69
CRM	-28.85	-13.62	13.41	3.58
BMX	-14.92	-17.51	649.99	1.58
BML	-36.75	-2.78	753.33	2.07
BLR	-21.25	74.62	1611.95	-23.18
IGN	-32.39	-14.88	812.84	-47.16
HRP	-83.78	-33.50	1706.25	-23.74
XTB	-1.12	-7.38	365.58	-5.33
Arithmetic average	-30.20	1.97	996.98	26.42

Source: Own study, based on data from the www.stooq.pl portal.

The highest rate of return for the entire 2020 was generated by Mercator company, that is 3963.94% (Table 2). The company earned almost PLN 1 billion by manufacturing disposable rubber gloves, a product under demand in all hospitals, medical and commercial facilities worldwide. Another company that saw a rapid improvement in its financial performance was Harper Hygienics (net profit in Q1 2020 amounted to PLN 821,000, whereas in Q2 2020 it amounted to PLN 5,940,000), specializing in the sale of different types of disinfectants. Harper earned an impressive rate of return as early as the 1st half of 2020, amounting to 1181.25%, and by the end of the year it was even higher at 1706.25%. All the biotechnology companies, which competed in production and distribution of tests to detect the SARS-CoV-2 virus and, subsequently, COVID-19 antibody tests also performed excellently. As an example, Blirt generated a rate of return of 1611.95% in 2020 and Biomaxima a rate of 649.99%. However, Inno-Gene and Biomed-Lublin provided investors with the highest session turnover values and therefore spectacular profiteering opportunities. In the first instance, euphoria erupted when Inno-Gene informed, in the fall of 2020, that it had entered into an agreement to distribute and promote RT Lamp Fast Detection Kit tests in the United Kingdom and Ireland, with the value of the agreement estimated at more than PLN 50 million. Then, the stock price climbed rapidly to PLN 91, i.e. in just 11 trading sessions (from 24/09/2020 to 08/10/2020), the investor could earn a rate of return of 454.88% (Fig. 4).

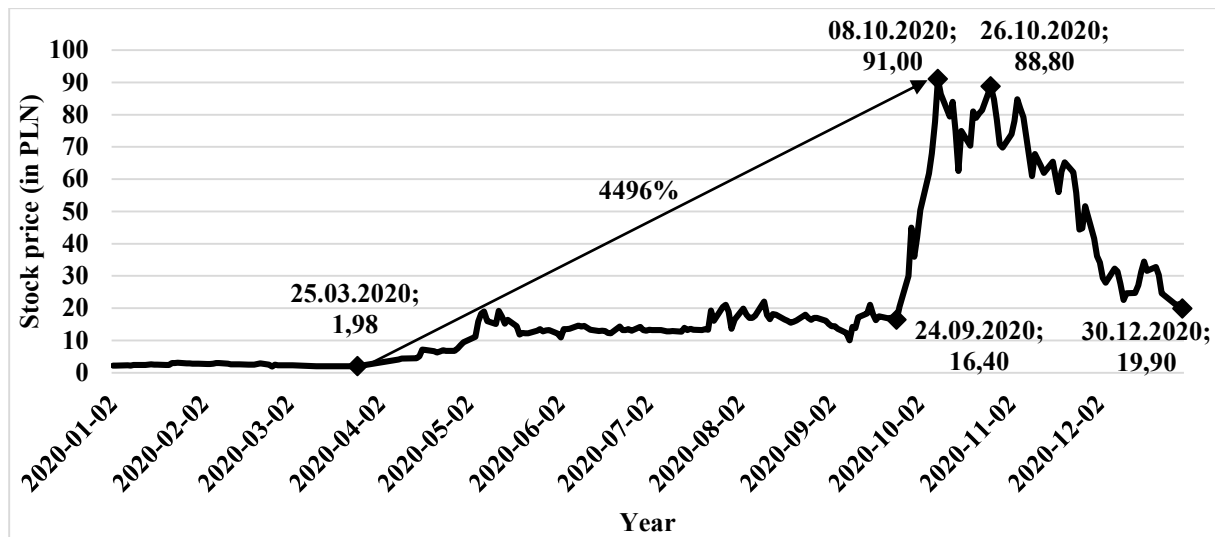


Figure 4. Impact of the COVID-19 pandemic on Inno-Gene stock price volatility in 2020.

Source: Own study, based on data from the www.stooq.pl portal.

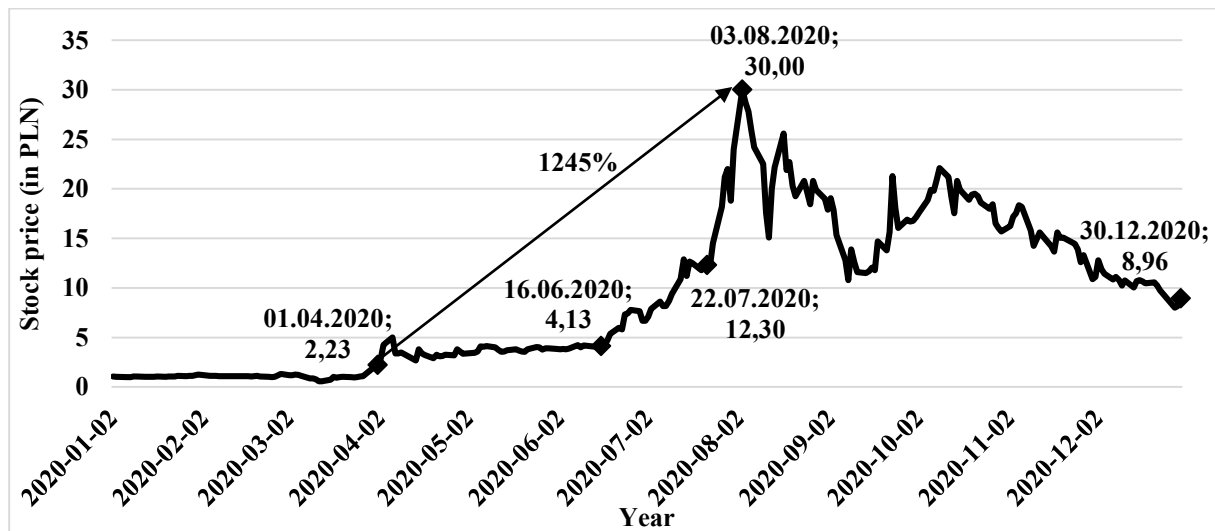


Figure 5. Impact of the COVID-19 pandemic on Biomed-Lublin's stock price volatility in 2020.

Source: Own study, based on data from the www.stooq.pl portal.

Biomed-Lublin, on the other hand, became notorious for the first time back in March 2020 when it was revealed that Biomed-Lublin was one of three European manufacturers to start testing the potential of an anti-tuberculosis vaccine in strengthening the coronavirus immunity. Then the company announced that it had launched efforts to develop a coronavirus treatment based on the convalescents' plasma, resulting in significant interest from investors. At the beginning of July, Biomed-Lublin even climbed at the top of Bankier.pl's ranking of the most popular WSE listed companies, and in June it was included in the mWIG40 index because of its rapid increase in capitalization (over PLN 400 million) and a high turnover (Hajdamowicz, 2020). The rate of return that could be generated by investing in Biomed-Lublin

stock mid-June and selling it at its peak a month and a half later, i.e. 03/08/2020, was a staggering 626.39% (Fig. 5).

Looking at the rates of return of the “covid” companies, two other aspects should be highlighted. First, it should be noted that the above-average, or rather gigantic rates of return were observed not only in companies that offered a unique or even essential product at the time (such as Mercator Medical, Harper Hygienics or Blirt), but also in companies that were only planning to develop such a product (Inno-Gene or Biomed-Lublin). As history shows, it is the other group of companies, with so-called potential, that is all too often insanely trending among investors and gives rise to speculation. A number of individual investors, especially beginners who want to become rich in a short time by exploiting depressed stock prices, follow “buy the rumors, sell the news” strategy, which consequently leads to the choice of trending companies without any reasonable justification. Thus, it can be concluded that the “covid” boom was to some degree driven solely by euphoria among investors, rather than by improvements in the companies' actual financial performance. Interestingly enough, while observing historical stock price data (stock valuations were often completely detached from fundamentals), it was perceived that for many investors, absence of profits was not a problem, as they believed that these profits would come in the future. Inno-Gene company is, again, a good example, where the management board itself increased the stock price by making official announcements about sky-high contracts that were not corresponding to reality. These were only plans, forecasts and opportunities that have not translated in any way into the company's financial performance. As a result, the Financial Supervisory Authority intervened, and the company temporarily suspended its operations. Eventually, the absence of specifics and actual agreements triggered panic, causing steep declines in the stock price.

On the other hand, following trends is not a bad thing, and has even become a tendency in recent years, assuming that the investor buys stocks of a given company at the right time and then sells them at the right time (this procedure does not assume generating a maximum rate of return). Initially, all companies in the trending industry behaved identically, making it an extremely difficult task to determine which one of them would prove to be a “bull's-eye” in the future. Only after some time, once the companies signed their first big contracts or published their quarterly results, an investor could select a portfolio of noteworthy companies and reject absolute profiteers. The year 2020 presented many opportunities to quickly generate above-average rates of return (this is particularly evident compared to the previous years' rates of return), but only a few, who were able to contain enormous emotions and set future trends, and then took risks through buying shares of often small or unknown companies, succeeded.

The rates of return of the WIG20 companies were also analyzed (Tab. 3). In the year of the COVID-19 pandemic, only 7 companies recorded a stock price increase at the end of 2020. Dino achieved an impressive rate of return of 99.31%. It should be noted that this company benefited indirectly from the pandemic by leveraging changing trends in the economy. As a convenience store chain, mostly located in small and medium towns, Dino has taken over

customers of the large supermarkets or malls. The CCC company was the exact opposite of Dino. It was on the verge of bankruptcy as the government imposed trade restrictions in shopping malls. Until the end of June, CD Projekt, most recognizable Polish game developer, was also performing well, generating a rate of return of more than 37%. Sadly, it was unable to maintain this performance throughout 2020 due to problems with the release of their new game, “Cyberpunk 2077”, which failed to meet expectation of the fans. Among the other WIG20 companies, high rates of return were generated mainly by companies in the mining and energy sectors. Except for KGHM, a company whose stock rate increased in the second half of the year due to a global increase in the price of copper, no particular reasons can be identified for the relatively high rates of return of the other companies. It can only be assumed that investors, based on their fundamental analysis, found the valuation of PGN, TPE or JSW to be too low in relation to their assets [for all companies, the P/BV ratio in 2018-2020 was below 1, revealing the market undervaluation of these companies (Sierpińska, Jachna, 2004, pp. 213-215) – see Tab. 5].

Table 3.

Simple rate of return of the WIG20 companies in the period from 03/01/2018 to 30/06/2021

Name of the company	Symbol	Rate of return [%]			
		r2018	r2019	r2020	rI-VI.2021
Powszechna Kasa Oszczędności Bank Polski [State Savings Bank]	PKO	-8.93	-12.11	-19.03	30.00
Polski Koncern Naftowy Orlen	PKN	2.52	-16.11	-32.53	30.18
Powszechny Zakład Ubezpieczeń	PZU	1.32	-2.98	-21.65	14.58
CD Projekt	CDR	48.57	85.99	-4.22	-31.13
Bank Polska Kasa Opieki	PEO	-17.11	-4.01	-40.10	51.22
KGHM Polska Miedź	KGH	-18.76	7.18	86.93	-2.83
LPP	LPP	-14.25	13.29	-6.33	58.89
Santander Bank Polska	SPL	-10.45	-12.47	-40.17	36.41
Cyfrowy Polsat	CPS	-6.70	27.92	10.69	0.47
Polskie Górnictwo Naftowe i Gazownictwo	PGN	11.27	-36.92	25.75	19.96
Grupa Lotos	LTS	55.26	-1.46	-51.33	25.64
Polska Grupa Energetyczna	PGE	-16.25	-21.96	-21.36	38.42
Dino Polska	DNP	17.52	48.00	99.31	-4.67
mBank	MBK	-11.63	-7.73	-54.56	74.17
Orange Polska	OPL	-19.50	44.13	-8.85	2.21
Play	PLY	-39.71	62.19	9.74	-*
CCC	CCC	-33.48	-43.68	-24.49	32.05
Alior Bank	ALR	-31.82	-47.85	-43.24	98.39
Tauron Polska Energia	TPE	-27.96	-25.45	59.65	12.76
Jastrzębska Spółka Węglowa	JSW	-32.40	-66.34	7.05	30.11
Arithmetic average		-7.62	-0.52	-3.44	27.20

* No listings for 2021, as the company was delisted on 31/03/2021.

Source: Own study, based on data from the www.stooq.pl portal.

By comparing the arithmetic average rate of return of the portfolio composed of the “covid” companies (portfolio 1) and the portfolio composed of the largest and the most liquid WIG20 companies (portfolio 2), it can be noticed that the first group of companies earned significantly higher rates of return (Tables 2 and 3). In 2020, portfolio 1 generated a rate of return as high as

996.98%, while portfolio 2 reported a loss of 3.44%. Observation of the remaining results confirms the assumption that such a good result of the “covid” companies was the result of trends in certain industries, rather than a representation of their long-term work.

Finally, an effort was made to assess an impact of the P/E and P/BV market ratios on the rates of return and to verify whether there is a relationship between these ratios. One of the most commonly utilized market ratios around the world for evaluating the rationality of investing capital in stocks is P/E, which is the stock market price to its net earnings (Marcinkowska, 2011, p. 276; Krysiak, 2011, pp. 399-400). It indicates a number of years required for return of the capital employed to buy stocks, assuming that the company generates profits at its current level. The P/C ratio assumes high values for fast-growing companies that show increasing profits. For investors, it means that the company can distribute increasing profits in the form of dividends in the future, and the stock price will increase. Sadly, it is common for the high P/C companies to be unable to live up to the inflated expectations of investors and, as a result, they see a steep decline in their stock price. Meanwhile, low P/C values are embraced by the companies with little potential for growth and reflect a higher risk level, which investors want to compensate for with higher return on investment margins. Buying low P/C stocks constitutes one of the long-term investment strategies developed by J. Neff (Neff, Mintz, 1999; Celej, 2013, pp. 467-482; Mackiewicz, 2016, pp. 16-20). Also, it is assumed that the larger the company, the lower the P/C value should be.

The P/BV ratio, or price to book value, is an indicator illustrating the difference between investors' valuation of a company and its carrying value (Melich, Tuzimek, 2006, p. 315). In other words, the P/BV ratio theoretically indicates how much an investor pays for PLN 1 of a company's net assets. High P/BV companies are greatly regarded by investors as they have good outlook and are characterized by a low level of risk (so-called companies with growth potential). On the other hand, low (below 1) P/BV companies, are undervalued by the market (value potential companies), which may be related to poor asset management by the companies' managers or out-of-fashion industries in which they operate (e.g., mining or energy - low parameters are often caused by a shift from old industries and technologies towards new development models associated with renewable energy sources).

Table 4 shows the values of P/E and P/BV market ratios for selected “covid” companies. By analyzing the value of P/E ratio each year, high volatility can be noticed, which seems natural in the medical and biotechnology sectors. Only X-Trade Brokers was notable for a low P/B value over the years, reflecting the high risk of its business during turbulent times. However, observation of the P/BV ratios indicates an advantage for the growth-oriented companies, which corresponds to their business activities and prospects.

Table 4.

The value of P/E and P/BV market ratios for selected “covid” companies

Company/Index	P/E				P/BV			
	2017	2018	2019	2020	2017	2018	2019	2020
ASB	25.37	11.62	11.86	12.28	1.87	1.41	1.68	3.31
MAB	-22.99	-17.25	-16.58	-5.12	-24.58	28.20	-48.96	-3.69
MRC	36.32	14.96	-45.26	4.81	1.51	0.90	0.79	4.30
CRM	-58.07	-3.74	-2.08	-7.65	0.91	0.84	1.17	1.55
BMX	23.09	-32.66	-953.81	15.78	1.08	0.94	0.81	4.48
BML	133.60	-2.02	26.33	125.67	1.36	2.15	1.99	14.95
BLR	-1.96	-6.58	-35.56	15.61	1.31	1.36	2.55	10.02
IGN	24.39	32.35	-71.18	72.12	10.85	5.86	5.16	29.61
HRP	-8.61	-0.88	12.93	11.69	0.55	0.09	0.02	0.37
XTB	5.64	5.09	8.04	5.23	1.31	1.13	0.94	2.37

Source: Own study, based on data from the www.bankier.pl.

Table 5.

The value of P/E and P/BV market ratios for WIG20 companies

Company/Index	P/E				P/BV			
	2017	2018	2019	2020	2017	2018	2019	2020
PKO	17.84	13.19	10.69	-14.04	1.53	1.26	1.04	0.90
PKN	6.81	8.33	8.54	8.96	1.41	1.29	0.95	0.59
PZU	12.58	11.80	10.49	14.61	2.49	2.54	2.14	1.49
CDR	46.56	128.00	153.24	23.95	10.56	13.96	24.30	12.64
PEO	13.73	12.51	12.18	14.56	1.46	1.25	1.13	0.63
KGH	14.18	10.73	13.45	20.33	1.26	0.93	0.95	1.74
LPP	36.92	28.49	37.99	-80.09	6.66	5.03	4.93	4.96
SPL	17.77	15.47	14.68	18.30	1.80	1.46	1.23	0.70
CPS	16.21	17.31	16.24	16.96	1.32	1.09	1.29	1.34
PGN	12.43	12.43	18.24	4.36	1.08	1.09	0.66	0.73
LTS	6.38	10.31	13.40	-6.69	1.00	1.36	1.22	0.66
PGE	8.67	12.48	-3.76	110.49	0.50	0.40	0.35	0.29
DNP	36.17	30.57	34.36	44.06	8.54	7.76	8.70	12.52
MBK	18.03	13.78	16.32	73.12	1.38	1.18	1.02	0.46
OPL	-126.64	628.62	113.95	188.01	0.76	0.60	0.89	0.82
PLY	22.15	7.09	10.26	13,72*	-40.35	-26.31	27.65	15,66*
CCC	40.89	134.20	-165.27	-3.75	10.66	7.79	4.70	26.43
ALR	2.18	9.73	15.08	-7.12	0.15	1.07	0.56	0.34
TPE	3.87	18.73	-263.49	-1.92	0.30	0.21	0.16	0.31
JSW	4.45	4.55	3.99	-1.97	1.77	0.98	0.30	0.44

* Data through the end of Q3 2020.

Source: Own study, based on data from the www.bankier.pl.

An analogous analysis was prepared for the WIG20 listed companies. Table 5 indicates that P/E ratios vary, heavily depending on the investors' expectations of future profits for particular companies. An exceptionally high P/E was estimated for CDR in 2018-2019 and OPL in 2018-2020. As for the CDR game developer, the investors expected above-average profits for the company in the coming years, which were to be provided by a new game called “Cyberpunk 2077.” In turn, a high P/E of the telecommunications service provider's stock was associated with investors' hopes of strengthening the company's position in the Polish market as a result of full-scale transformations in its business model, introduction of state-of-the-art technologies that employ AI, and participation in the process of frequency allocation to support

5G technology. Relatively high P/E's were also observed for stocks in the banking (PKO, SPL, MBK, PEO) and food and clothing (DNP, LPP, CCC) sectors. It would appear that investors still recognize immense opportunity for the expansion of banking services in the Polish market, particularly in the areas of loans and online banking. Similar expectations are associated with the food and clothing industries, surely due to the companies' pursuit of market niches (e.g., DNP targets small towns and villages) or concern for low business costs (e.g., manufacturing clothes in Asia due to lower labor costs). In several instances, there were negative P/E's attributable to the losses of individual companies caused by temporary restructurings, regulatory adjustments or other one-off problems.

By analyzing P/BV ratio value of the WIG20 companies in 2017-2020 (Tab. 5), it was observed that the CDR, LPP, DNP and CCC stocks were characterized by a high level of the ratio, i.e. above 3. In theory, it means that the stocks of these companies were overvalued. However, PGE, OPL and TPE stocks were underestimated. A P/BV below 1 was yet observed in 2019 and 2020 for the stocks of PKN, PGN and JSW. The P/BV values earned do not translate into the rates of return generated by individual companies in the subsequent year, which may indicate a mismatch of theoretical assumptions to current conditions. For example, Play company has reported a P/BV ratio of 27.65 in 2019, which may have given investors an impression that the company is vastly overvalued and therefore should be sold. In fact, the rate of return earned by PLY in 2020 was almost 10% (Tab. 3). The opposite results were obtained for PKN company, for which the P/BV in 2019 was below 1 and the rate of return for 2020 was -32.53% (Tab. 3). Analogous situations were observed in particular years for all WIG20 companies. In view of the above, it can be assumed that today, the analysis of the market ratios such as P/E and P/BV, while still used and featured in the business press that follows global stock listings on a daily basis, no longer serves a key role. While in the last century, the investors mainly followed these parameters in their investment decisions, in the 21st century, massive development of advanced technologies (notably Internet) and developments in the way of operating and conducting business (shift towards innovative industries) render it difficult to estimate value of these parameters. In this light, the thesis by B. Lev and A. Srivastava concerning the US market seems justified. The thesis claims that it has been for at least 30 years that investing in companies with value potential (*value investing*; B. Graham, 1949)⁶, namely, among other things, those characterized by low P/E and P/BV ratios, is not very effective. The authors argue that this method is no longer effective for two reasons, i.e. accounting systems shortcomings, which contributed to poor identification of the valuable companies, and fundamental economic developments, especially slow economic growth, which made it very slow for the *value* companies to recover from crises (Lev, Srivastava, 2019, pp. 1-29). The authors believe that another reason for these changes is also the on-going

⁶ The value investing approach was first described by B. Graham and proved effective in the US market for some 40 years.

popularity and trend towards growth-potential companies (*growth/glamour type*), namely new, innovative companies utilizing not only state-of-the-art technology, but also established by outstanding individuals. This is why individual investors, having witnessed rapid growth of individual IT, game development or biotechnology companies in recent decades, noticed that it is possible to achieve above-average rates of return in relatively short periods, making it no longer necessary to freeze capital for several years to achieve investment success.

Generating above-average rates of return by leveraging current information is in coincidence with equity market inefficiency. Therefore, the lack of correlation between the rate of return and the fundamental P/E and P/BV ratios should be understood as an indication of market efficiency, while the presence of a correlation indicates the likelihood of above-average rates of return.

Table 6.

Spearman's rank correlation coefficient and p-value levels for the two-sided hypothesis of the "covid" companies rank coefficient zeroing

Correlation / Year	P/E and rates of return		P/BV and rates of return	
	rho	p-value	rho	p-value
2017/2018	-0.1152	0.7588	-0.0424	0.9186
2018/2019	-0.0667	0.8648	0.5273	0.1228
2019/2020	-0.3576	0.3128	0.1152	0.7588

Source: Own study in the R-CRAN statistical analysis package.

Table 7.

Spearman's rank correlation coefficient and p-value levels for the two-sided hypothesis of the WIG20 companies rank coefficient zeroing

Correlation / Year	P/E and rates of return		P/BV and rates of return	
	rho	p-value	rho	p-value
2017/2018	0.1714	0.4682	0.1489	0.5296
2018/2019	0.3263	0.1602	0.1895	0.4219
2019/2020	0.0947	0.6907	0.0286	0.9064

Source: Own study in the R-CRAN statistical analysis package.

The research revealed that the stock market crash caused by the COVID-19 pandemic, affected the efficiency of the analyzed stock market in Poland to a certain extent (Tables 6 and 7). In the research period 2019/2020, the behavior of the rate of return in relation to the P/C ratio for the portfolios of the "covid" and WIG20 companies contradicts the stock market efficiency, whereby there are no grounds to reject the H_0 hypothesis stating that the variables are independent ($p\text{-value}_{\text{"covid"}_companies} = 0.3128$, $p\text{-value}_{\text{WIG20_companies}} = 0.6907$).

In the case of the "covid" companies portfolio, the Spearman rank correlation coefficient indicated equity market efficiency for the 2017-2019 (correlation of P/E and rates of return) and 2017/2018 and 2019/2020 (correlation of P/BV and rates of return) periods. In the period preceding the stock market crash (2018/2019), a moderate correlation between P/BV and the rates of return of the "covid companies" was observed, indicating information inefficiency of the equity market. In the case of the WIG20 companies portfolio, there were no explicit correlations observed, which may indicate information efficiency of the Polish equity market.

Referring to the research presented, it can be concluded that, in the 21st century, the informative value of the P/E and P/BV market ratios, or at least their relationship with the rate of return, is no longer an indisputable source of information that could support an appropriate investment decision. Instead, behavioral aspects and temporary investment trends are becoming increasingly important.

5. Conclusions

The steep, yet short-lived declines on all global stock exchanges in Q1 2020 once again revealed the shortcomings of the various stock valuation theories and models, investors' inability to correctly understand company announcements and, most importantly, that financial market participants follow market trends driven by immense emotions. The research revealed that the COVID-19 pandemic quickly evolved into a 'covid' bull market, allowing above-average rates of return to be generated for investors who correctly evaluated future trends and immediately, during this time of uncertainty, invested funds in companies directly or indirectly involved in the fight against the pandemic. The "covid" companies provide a good example, with their stock prices setting new records during consecutive trading sessions, but also significantly increasing their market capitalization and turnover, placing such companies in the ranking of the most liquid and popular WSE listed companies. Mercator Medical was the undisputed business growth leader, with its financial gain amounting to nearly PLN 1 billion and its rate of return reaching a staggering 3964% in 2020. In turn, Inno-Gene and Biomed-Lublin, which sparked investors' imagination with newer and newer, not entirely reliable announcements concerning further expansion of their COVID-19 products, are very much eligible for the "kings of profiteering" title. It's worth noting that the initial panic and chaos, followed by the companies racing to recoup their losses, prompted many new investors and profiteers alike to put their skills to the test in the stock markets, a fact best confirmed by the record data on the number of new investment brokerage accounts created by individual investors (up by 6.4 p.p in 2020).

The conducted research positively verified all of the adopted research hypotheses, which stated that:

- H₁: In the periods of stock market crises, creating investment portfolios based on so-called trending companies results in increased investment efficiency by achieving above-average rates of return;
- H₂: During the "covid bubble" (all speculative bubbles in general), the above-average rates of return achieved by the "covid" companies resulted from the trend for these companies, rather than their actual financial results or their P/E and P/BV ratios levels;

H₃: Speculative bubbles contribute to increased interest in the stock market by the individual investors (rising number of the new investment brokerage accounts and volume).

This article also indirectly addresses the issue of semi-strong information efficiency. The results presented revealed that semi-strong information efficiency varied depending on business conditions, further explaining and strengthening the credibility of the second hypothesis (H₂). In light of the above, it can be concluded that an attempt was also made to estimate the sensibility of investing in selected shares through the use of the basic and remarkably popular fundamental analysis market ratios, i.e. P/E and P/BV.

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THE CLASSIFICATION OF THE CAPABILITIES OF THE FIRM

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Purpose: The aim of this article is to present an identification of the premises for the classification of firm capabilities and to show the types of firm capability classification found in the literature.

Design/methodology/approach: The classification of capability groups presented in this article is based on the literature review conducted.

Findings: Standard classification of a firm's capabilities, in addition to structuring existing knowledge in the area of capabilities, can provide a starting point for identifying the firm's key capabilities leading to competitive advantage.

Practical implications: Identifying a firm's capabilities is one of the key steps in creating and leveraging capabilities. The correct classification of a firm's capabilities can become a tool to help identify and then properly exploit them.

Originality/value The literature describes the issue of firm capabilities, pointing to a variety of definitions, sources of origin, as well as the effects achieved through the use of capabilities, but does not show a standard classification of capabilities. The classification of firm capabilities provides a starting point for further research on firm capabilities for management researchers as well as firms seeking to achieve competitive advantage.

Keywords: capabilities, classification of capabilities.

Category of the paper: Conceptual paper.

1. Introduction

A firm's capabilities, rooted in the resource stream of strategic management, are an essential element in the functioning of a firm, leading to the achievement of the firm's aims. The resource stream assigns the capabilities and resources of the firm, which form the basis of capability development, a special role in achieving competitive advantage. However, in order for an firm to be able to create and develop individual capabilities leading to competitive advantage, it is necessary to identify the types of capabilities created within a given firm, as well as where they originate in the organisational structure.

The capabilities of an firm are an issue that can be considered in many approaches, depending on the research approach adopted. The literature provides many definitions of firm's capabilities, as well as pointing to the effects that a firm can achieve by developing capabilities. However, previous research on the subject of capabilities does not exhaust the issue of capability classification.

The aim of this article is to present the premises for the classification of firm capabilities and to show the types of firm's capabilities found in the literature. The development of a standard classification of an firm's capabilities, which would encompass the existing research on capabilities, would not only allow for the systematization of the knowledge possessed in the area of capabilities, but may also provide a starting point for further consideration of an firm's capabilities, in particular the identification of capabilities leading to the achievement of competitive advantage.

2. The nature of firm's capabilities

In the 1990s, the assumptions of the resource school, according to which an firm should focus on the possession and development of resources and capabilities in order to achieve competitive advantage, became widespread in the strategic management stream. Every firm operating in the economic space possesses a certain set of resources, ensuring both the fulfilment of the firm's basic functions, as well as contributing to a certain extent to the achievement of the firm's intended objectives. Firms striving to achieve competitive advantage, based on the use of resources, with reference to the assumptions of the resource school, should focus their tasks on the collection and use of resources that have VRIN characteristics. The term VRIN (valuable, rare, inimitable, non-substitutable) introduced by J.B. Barney (1991) refers to four resources characteristics that contribute to competitive advantage. Based on the cited characteristics, firms should focus on accumulating and exploiting resources that are unique, have no substitutes and are difficult for competitors to acquire and imitate.

However, an firms based on the use of resources should not only have a range of resources, but, above all, be able to use them properly so as to achieve the greatest possible benefit. One of the ways in which resources can be used effectively is through the capabilities of the firm. The term firm capabilities, now widely described by researchers, was first used in the literature by I.H. Ansoff (see 1965). The very issue of capabilities, despite many studies, is often equated with competences or possibilities, which can lead to an incorrect interpretation of the essence of capabilities. An firm's competencies are a set of capabilities created as a result of the integration of capabilities related to the processes implemented in the firm and the resources used in these processes (Matwiejczuk, 2011). Also inextricably linked to the notion of firm capabilities and competencies is the notion of firm potentials, which are the sum of

an firm's resources, capabilities and competencies (Matwiejczuk, 2011). Capabilities are also not synonymous with skills, it is the capabilities of the firm that constitute the set of skills and knowledge indicating the effective use of resources (Morash, Droge, Vickery, 1996). The capabilities of an firm should be equated with the repetitive activities or processes involved in the use of resources, while the terms capabilities, competencies and skills are concepts that should not be used interchangeably when referring to firms.

An important aspect of firm capabilities found in the literature that influences the identification and subsequent classification of capabilities is the perception of capabilities as specific resources or processes. These two directions in the understanding of capabilities derive from the two research streams that initiated the study of firm capabilities. The first approach represented by D.J. Teece (1984), who sees the origins of the emergence and development of an firm's capabilities in organisational routines, understood as patterns of behavior, based on the firm's experience in a particular area. D.J. Teece, referring to the resource approach, considers the firm's capabilities as a certain type of resource, enabling the firm to fulfil its current tasks of increasing competitiveness and development and responding to changes occurring on the market.

The second research strand represented by the team of K.M. Eisenhardt and J.A. Martin (2000) considers corporate capabilities as processes that integrate, reconfigure, acquire and release resources in order to adapt to market changes. The cited authors point to the existence of research and development teams, product creation processes, knowledge transfer and rules for controlling and measuring performance as the source of the emergence of capabilities.

The two approaches indicated, despite their different perspectives on the issue of capabilities, are not mutually exclusive and point to the main objective of capabilities, which is the utilization of resources. A firm's capabilities, whether viewed as a specific type of resource or as a process, aim to acquire, integrate and modify resources so that they lead to the desired outcomes. Examples of capabilities outcomes include: (1) responding dynamically and effectively to changes in the environment, (2) holistic management of the firm and its relations with the environment, (3) achieving a certain level of efficiency in the market and economic dimension, and (4) managing the firm's relations with market participants (Matwiejczuk, 2019). However, irrespective of the specific objective pursued, capabilities should first and foremost lead to improved efficiency in the use of the firm's resources.

3. Identifying the premises for classifying a firm's capabilities

Capabilities are undoubtedly an important part of the functioning of a firm, and their creation and development can guarantee the firm a number of benefits that can contribute to competitive advantage. The firm's capabilities are an issue widely described in the literature, both domestic and foreign. The large number of scientific articles in this area shows that, although corporate capabilities are not an entirely new issue, they are still an interesting research topic. The literature has largely focused on the issue of dynamic capabilities, i.e. one of the types of capabilities used under specific environmental conditions. The focus of researchers on this particular type of capabilities has its determinants in changing market conditions and the need for firms to adapt quickly to emerging changes. In the existing publications, the authors present a number of arguments pointing to the great importance of dynamic capabilities in achieving intended aims, as well as presenting a definitional account of dynamic capabilities or their genesis related to the resource approach. There are also publications indicating the existence of other types of capabilities, but there are far fewer works on this topic, which mainly focus on specific capabilities in a functional perspective.

Despite the wide range of literature in the area of firm capabilities, an issue that remains unsystematic is the classification of capabilities. The current divisions of firm capabilities, based on both differentiated and identical division criteria, introduce some discrepancies that mean that no standard classification of firm capabilities has so far emerged. Such a wide variation in the division of capabilities, especially on the basis of the same characteristics, introduces misunderstanding, especially among people and actors who are not familiar with the subject of firm capabilities, as exemplified by dynamic capabilities. So far, despite many studies explaining the essence of capabilities, it has not been possible to develop a universal definition of dynamic capabilities. Therefore, the development of a uniform classification of firm capabilities, would make it possible to systematize the existing knowledge on firm capabilities, while introducing a standard characterization of capabilities, which would also facilitate the standardization of concepts describing capabilities. Uniformity of definition would not only allow for an understanding of the nature of capabilities, but also facilitate the use of capabilities in the achievement of the firm's objectives.

The classification of firm's capabilities, in addition to introducing some systematization to the current knowledge in the field, can provide a starting point for further research on firm capabilities. Capabilities are elements of a firm that are not subject to purchase and sale transactions. Capabilities arise only as a result of the activities developed in the firm. Capabilities cannot be acquired through purchase or borrowed from competitors. Because of this characteristic of capabilities, it is so important where in the organisational structure the capability originates and can be developed. The classification of a firm's capabilities will allow the firm to identify the basic types of capabilities that can be created and the organisational units that should be responsible for creating a particular type of capabilities.

All firms operating in the market conduct their activities for a specific purpose, often the purpose of which is to achieve competitive advantage. According to the aforementioned assumptions of strategic management, including the resource school, this is possible through the use of resources and capabilities. However, in order for a firm to use its capabilities to gain a competitive advantage, it must first identify or create its capabilities and then develop them. A firm's capabilities classification can be a tool for a firm to identify the capabilities it has or the capabilities it needs to develop. On the basis of a capabilities classification, a firm can analyse not only the capabilities it has internally, but also the capabilities needed to function effectively in specific market conditions. The classification of capabilities can form the basis for the development of a firm's capabilities, on the basis of which a specific firm is able to develop a distinctive group of capabilities that are useful in achieving its objectives as well as achieving competitive advantage.

4. Overview of the firm's capability classification

As already mentioned, the literature describes the issue of capabilities in broad terms. Based on a review of the existing literature in the area of firm capabilities, a set of classifications of firm capabilities was developed consisting of three main divisions, which are presented in Figure.1.

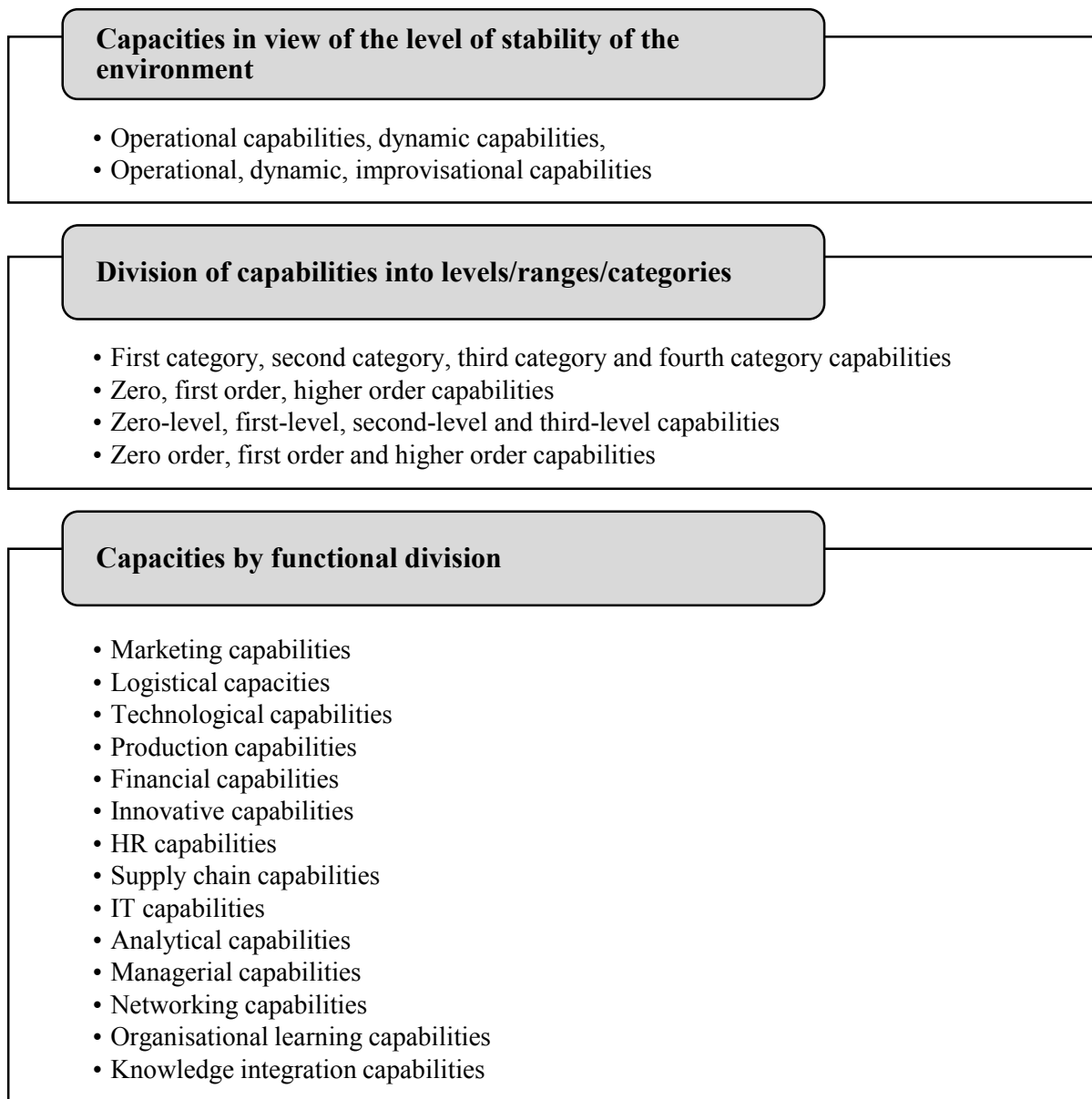


Figure 1. A breakdown of the firm's capabilities.

Adapted form: Own study.

All firms are operating in a certain environment, which is characterized by a certain level of variability. D.J. Teece, creator of the Dynamic Capabilities Concept (DCC), in his research on firm capabilities, divided capabilities into two main groups, namely operational capabilities and dynamic capabilities. The division of capabilities introduced was based on the conditions of the environment in which firms operate and, more specifically, its stability or volatility. In the author's opinion, the division of capabilities into two groups is sufficient, as the new types of capabilities will only form part of the dynamic capabilities (Teece, 2012).

Operational capabilities are related to stable activities based on organisational routines, with the aim of achieving the core tasks of the firm, while dynamic capabilities change according to market situations. Operational capabilities, which are standard activities, are stable in nature and rooted in organisational routines. Operational capabilities consist of both internal

and external processes related to the core, day-to-day activities of the firm. Although operational capabilities are a set of repeatable activities, the effect of implementing these capabilities does not always lead to identical results. The effect of capability utilization depends on the starting point as well as the path taken, which depends on the genesis of the firm, the organisational structure and the way the processes are implemented (Teece, 2012).

The dynamism of dynamic capabilities, to which the name capabilities is attributed, refers to the ability to react quickly to changes in the environment. The primary objective of dynamic capabilities is to adapt quickly to emerging new situations, which leads to increased flexibility and innovation for the firm. In defining the characteristics of dynamic capabilities, it is also worth pointing out the three types of capabilities that make up dynamic capabilities, more specifically: (1) identifying and assessing opportunities (sensing), (2) mobilizing resources (seizing) and (3) updating standard capabilities (transforming). Opportunity identification and assessment is related to the analysis of opportunities and threats arising from the environment, in particular to meet customer needs. The second component capabilities of resource mobilization relates to designing, selecting and acting on the firm's resources. In contrast, updating standard capabilities is based on modifying existing resources and capabilities used by the firm (Teece, 2012).

Based on the work of D.J. Teece, a team comprising P.A. Pavlou and O.A. El Sawy (2010) developed a division of capabilities into three groups - operational capabilities, dynamic capabilities and improvisational capabilities, taking into account the level of stability of the firm's environment as a criterion for the division. According to the above authors, operational capabilities are zero-level capabilities used in a stable environment. Dynamic capabilities represent capabilities used in a low-volatility environment, while in a turbulent environment, a firm should focus on creating and developing improvisational capabilities. The understanding of operational and dynamic capabilities is largely the same as the work of D.J. Teece, while a different type of capabilities here is improvisational capabilities, which should be considered as spontaneous and innovative activities undertaken to respond quickly to sudden market situations (Vera, Nemanich, Velez-Castrillon, Werner, 2016). Based on the aforementioned division, it should be concluded that, depending on the stability of the environment, the firm should concert its efforts on developing operational, dynamic or improvisational capabilities, as this specific type of capability will ensure that the firm achieves its specific objectives. However, regardless of the conditions of the environment, the firm should not focus its attention solely on developing one type of capability, as it can achieve the greatest results by integrating capabilities. Lower-level capabilities, i.e. capabilities of the environment with less variability, form the basis for the development of capabilities at higher levels. According to this assumption, operational capabilities related to the implementation of the core functions of the firm, are the basis for the development of dynamic capabilities, while dynamic capabilities can contribute to the formation of improvisational capabilities. Only the integration of capabilities can contribute to the achievement of the firm's objectives.

A second classification groups of capabilities found in the literature is that based on levels, orders and categories. This classification, despite the different authors and names of the different ability groups, is based on similar assumptions, distinguishing abilities in a hierarchical system. The first division of capabilities is that proposed by D.J. Collins (1994), who indicated the occurrence of capabilities in view of categories, introducing four categories of firm's capabilities. First category consists of capabilities used to perform the core functions of the firm. In second category, D.J. Collins included dynamic capabilities that improve the performance of the firm. Third category comprises capabilities with similar characteristics to dynamic capabilities, but focused on creating a new strategy for the firm. In the last category, the author included all capabilities that influence the capabilities belonging to the other categories.

Based on the experience of D.J. Collins, his own classification was presented by S.G. Winters (2003), introducing the division of the firm's capabilities into three levels, namely: (1) zero-level capabilities, (2) first-order capabilities and (3) higher-order capabilities. Zero-level capabilities are core capabilities, concerned with the day-to-day operations of the firm, performing the core functions of the firm. Dynamic capabilities focused on resource modification, have been assigned to first-order capabilities. S.G. Winters included all dynamic capabilities interacting with first-order capabilities in the last group, higher-order capabilities.

Another classification of capabilities worth citing is the division of capabilities into four levels developed by C.L. Wang and P.K. Ahmed (2007). The authors presented a hierarchy of a firm's capabilities, indicating the existence of a zero-order level, which consists of a firm's resources with VRIN characteristics. The authors argue that this assignment of a resource as a capability is related to the fact that it is the resource that forms the basis for the emergence and development of a firm's capabilities. The first-order are the first-order capabilities that contribute to improved performance where the firm has the ability to deploy resources. The second-order are core capabilities, which represent a set of resources and capabilities, most leading to competitive advantage. The last group of capabilities are those related to the creation, renewal and modification of the firm's resources and capabilities, which should be categorized in the third-order.

Building on previous research work by S.G Winters and C.L. Wang and P.K. Ahmed, in the area of capabilities, a group of researchers consisting of H. Ma, C. Lang, Q. Sun and D. Singh (2021) presented their own division of the firm's capabilities by taking environmental conditions and the level of capabilities as the criterion for division. The authors presented capabilities at three levels depending on the environment condition, assigning them the characteristics of operational, dynamic and improvisational capabilities. Zero-order capabilities are those used in a stable environment, in which case they are referred to as operational capabilities. Dynamic capabilities, are first-order capabilities, developed in a changing environment. The high-order comprises improvisational capabilities, developed in a turbulent environment.

The cited classifications of firm capabilities have two key features in common, the division of capabilities according to the conditions of the environment and the purpose of the existence of a given group of capabilities. At the lowest level in the capability system are the capabilities used in a stable environment, corresponding to operational capabilities. At the middle level, we can distinguish the existence of dynamic capabilities, used in a volatile environment, while at the highest level, we should place improvisational capabilities, used in a highly volatile, turbulent environment. The second common element, the purpose of capabilities, also varies from level to level. Capabilities at the lowest level focus on the efficient use of resources. Mid-level capabilities modify resources to improve efficiency, while top-level capabilities modify lower-level capabilities. A summary of the cited capability classifications is presented in Table 1.

Table 1.
Division of capabilities by levels, orders and categories

First category, second category, third category and fourth category capabilities	Zero order, first order, higher order capabilities	Zero, first-, second- and third-level capabilities	Zero order, first order and higher order capabilities
First category: capabilities related to the core business of the firm.	Zero order capabilities: used in a stable environment, operational capabilities.	Zero-order capabilities: firm resources.	Zero-level capabilities: capabilities related to current activities.
Second category: dynamic capabilities that improve the firm's tasks.	First order capabilities: dynamic capabilities.	First-order capabilities: lead to efficiency gains.	First-level capabilities: dynamic capabilities that change resources.
Third category: based on a broader view of the firm, in the context of creating a new strategy and determining the value of resources.	Higher level capabilities: used in a highly turbulent environment, improvisational capabilities.	Second-order capabilities: a collection of resources and capabilities.	Higher-order capabilities: dynamic capabilities that affect first-order capabilities.
Fourth category: higher-level capabilities interacting with lower-level capabilities.		Third-order capabilities: renew, reconfigure and reuse resources and capabilities.	

Adapted from: Collis, D.J.(1994). How valuable are organisational capabilities?, *Strategic Management Journal*, nr 15(2), s. 143–152; Winters, S.G. (2003). Understanding dynamic capabilities, *Strategic Management Journal*, nr 24(10), s.991–995; Ma, H., Lang, C., Sun, Q., Singh, D. (2021). Capability development in startup and mature firms, *Management Decision*, vol. 59(6), s.1442-1461.

Based on the divisions of firm capabilities presented, it is also possible to see a significant influence of the individual classifications on the research of other authors. This simultaneous duplication of assumptions and introduction of our own, indicates a great diversity in the understanding of firm capabilities, indicating at the same time the need to standardize certain issues related to firm capabilities and the need for further research in this area.

Every firm carries out a number of diverse as well as standardized processes related to its activities. In view of the functions performed by the firm, a distinction can be made between the capabilities of the firm in functional terms. This division of capacities introduces capacities that arise as a result of the implementation of the firm's processes, such as marketing capacities, logistical capacities or financial capacities. A given type of capability in terms of function is related to the use of a given resource associated with the implementation of a specific firm process. Due to the wide variety of activities carried out by firms, creating a standard list of functional capabilities is still a challenge. Since capabilities are not acquired, but only created in the firm, each firm can create its own set of functional capabilities related to the activities performed in the firm. An important point about the division of capabilities in functional terms is that capabilities can take the form of both operational, dynamic and improvisational capabilities, depending on the conditions of the environment in which the firm operates. Operational capabilities in functional terms will be a set of the underlying activities of the firm, in the context of a given resource used in a functional process, in order to fulfil the core tasks of the firm. In contrast, individual functional capabilities in dynamic or improvisational terms will be those capabilities associated with the execution of a process, in order for the firm to adapt to changing environmental conditions. On this basis, an firm can create, for example, both operational marketing capabilities and dynamic marketing capabilities, and analogously the other types of functional capabilities in operational, dynamic and improvisational terms. Integrating capabilities and considering capabilities both from a functional perspective and in relation to the environment allows the firm to more accurately characterize the capabilities required to perform particular tasks.

5. Conclusions and directions for further research

Derived from the resource school, firm capabilities are an element of the firm that contributes to the achievement of multiple objectives by the firm, leading to competitive advantage. The identification of the firm's capabilities is one of the key stages in the creation and utilization of capabilities. The correct classification of an firm's capabilities can become a tool to help identify and then properly exploit them.

Firm capabilities are a characteristic issue in the context of strategic management, which are characterized by considerable diversity. Such a wide variety of firm capabilities is the result of a fundamental characteristic of capabilities, namely the fact that capabilities cannot be acquired, but only developed in a specific firm. Capabilities are the resultant of the activities and processes taking place within a firm, as well as the conditions of the environment in which the firm operates. Therefore, each firm with specific resources may develop a different capability from a competing firm with the same resources. A consequence of the specificity of

capabilities is the difficulty of creating a standard classification of capabilities, which is still a challenge. The classic division of capabilities in terms of the variability of the environment, i.e. the division into operational and dynamic capabilities, will be the case in every firm, as every firm operates in an environment and it is impossible to detach a firm from its environment. The functional division of capabilities, on the other hand, can take different forms, given the firms in which the capabilities arise.

A standard classification of a firm's capabilities, in addition to systematizing existing knowledge in the area of capabilities, can provide a starting point for identifying the firm's key capabilities leading to competitive advantage. The classification of capability groups presented in this article is based on the literature review carried out, while it does not represent a definitive form. It will change as the issue develops and as further work is done on firm capabilities. In addition, a standard, one-size-fits-all classification of capabilities will probably never take a definitive shape and may exist indicating only individual capability groups rather than individual, specific capabilities belonging to a given set. Capabilities are used to outperform competitors using the same resources, so as the market develops, firms will continue to create new capabilities, used to adapt to new emerging situations in a given market. However, whatever the direction of the capability issue in terms of the distribution and types of capabilities, it is undoubtedly an issue that should be directions for further research. This research should focus on the identification of new groups of capabilities leading to the achievement of a given aim, which may be the starting point for the identification of specific capabilities leading to selected aims that can translate into competitive advantage.

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INDIVIDUALIST AND COLLECTIVIST BEHAVIOUR IN PUBLIC AND BUSINESS ORGANISATIONS

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Purpose: to show differences between public and business organisations within the scope of individualist and collectivist behaviour.

Design/Methodology/Approach: the study was carried out among employees of public and business organisations performing various organisational roles. 497 persons participated in the study. It comprised two stages. Stage I was carried out with the use of a structured interview, while in stage II, questionnaire surveys were used. To put the content in order, the semantic field analysis was used, which allowed for separating the main research categories. Individualist and collectivist behaviour is one of many identified organisational types of behaviour.

Findings: differences exist between members of public and business organisations as far as behaviour is concerned. In business, individualist behaviour is predominant, while in public organisations – collectivist behaviour.

The structure of collectivism is complex and comprises of different types of behavior, i.e.: concordance, conformism and cooperation. In public organisations, concordance is predominant, while in business it is on a lower level. In both types of organisations, cooperation-type behaviour is at a low level.

Research Limitations/Implications: inability to fully objectify the research results obtained.

Practical Implications: knowledge about the behaviour manifested by the majority of the participants and about the marginalised behaviour allows for a better understanding of the phenomena that take place and in effect conscious management and support for the development of those that an organisation cares about. The structure of behaviour is a carrier of information about motifs guiding the actions of individuals. Separating behaviour that is dominant provides information about the motifs of such behaviour and what affects the behaviour of people – whether it is legitimisation of the value of the organisation and the established standards, or the power of the group. Accurate identification of orientation offers possibilities for predicting behaviour and for more efficient designing and carrying out organisational changes.

The third issue is the possibility of using such knowledge during coordination. An organisation where collectivist behaviour is dominant requires different tools for coordination than an organisation where individualist behaviour is dominant.

Originality/Value: to supplement theoretical constructs with examples of organisational behaviour manifested in Polish organisations and to show collectivism as a complex dimension as part of which various activities may be performed. Dominance of a specific behaviour shapes the quality of functioning of an individual in an organisation. Whether an individual consciously adopts and accepts organisational norms or acts in line with them under the impact of a group

may influence the behaviour and the engagement of the individual, along with the course and effort put in the performance of processes related to the management of human resources in the organisation.

Keywords: individualism, collectivism, public organisation, business organisation.

Category of the paper: research paper.

Introduction

Collectivism and individualism are some of the best known concepts used for describing cultural differences occurring between countries, organisations, groups and individuals. They refer to social phenomena which are the manifestations of a specific mode of perceiving and interpreting the world. These concepts express the attitude of an individual to the group and to the obligations that result from affiliation to a group and describe the type of relation that an individual forms with others (Adamska, Retowski, Konarski, 2005). Flourish of studies on individualism and collectivism was initiated by Geert Hofstede who indicated relations between the national and the organisational culture (Hofstede, 2000).

Since that time, the concepts have been used, among others, in the area of management with a view of highlighting the significance of cultural determinants in the formation of organisational behaviour and a system of values (Abbas, Amirshahi, 2002), in explaining the managerial orientation (Bobina, Sabotnova, 2017; Sîrbu, Roşca, Puiu, 2017) and employee orientation (Oyserman, Lee, 2008), as well as describing organisational cultures (Chatman, O'Reilly, 2016).

However, some researchers of socio-cultural phenomena stress more and more often that these are general concepts, with respect to which there is no consensus in the area of cultural determinants forming their part and the behaviour that is their manifestation (Wong, Wang, Klann, 2018).

This paper presents sample organisational behaviour exhibited by members of public and business institutions, which may supplement the practical dimension of individualism and collectivism. Differences between these organisations in the area of individualist and collectivist behaviour were also shown.

1. Individualism and Collectivism As Socio-Cultural Dimensions

Individualism and its opposite, collectivism, are the ideas describing social phenomena that constitute two different concepts of perception and organisation of the world. They are expressed by the relation of an individual to a group and obligations that result from participation in a group and formation of relations with its representatives (Adamska, Retowski, Konarski, 2005). Both dimensions have become a basis for performance of identification studies that make use of the cultural similarities and differences in the process of managing organisations and creation of new definitions of these concepts (Hofstede, 1980; Schwartz, 1990; Triandis, 1995).

However, attention is drawn to the imprecise nature of these two concepts (Wong, Wang, Klann, 2018) and the inner contradiction (Fiske, 2002; Oyserman et al., 2002; Taras et al., 2014).

For example, collectivism is defined as equality, justice, promotion of peace in the world, understanding (Kou, 2013), affinity, affiliation, obligation towards a group, seeking the advice of others (Oyserman, Coon, Kimmelmeier, 2002), counselling, harmony (Shulruf, Hattie, Dixon, 2007), or as external location of control, indirect communication, avoidance of conflicts and organisational engagement (Marcus, Le, 2013).

In turn, individualism is autonomy, competitiveness (Fiske, 2002), independence, striving for own goals, competition, direct communication (Oyserman, Coon, Kimmelmeier, 2002), responsibility (Shulruf, Hattie, Dixon, 2007).

Furthermore, there is no consensus as to the cultural phenomena forming a part of these dimensions, or unanimity as to the fact that the relation of an individual to various groups and persons remains the same. There is some quite convincing evidence (Brewer, Chen, 2007; Chen, West, 2008) that people approach these two separate groups of people differently. Family, friends and colleagues from work are treated differently, and the definitions of the concepts of collectivism and individualism fail to account for it.

According to some researchers, both orientations are embedded in the cultural approach and defined as a cognitive scheme, which comprises such aspects as: goals – why act, content – self-awareness and knowledge about the world and procedures – how to think and act (Arieli, Sagiv, 2018). In consequence, all individuals are capable of an individualist and collectivist approach, yet to a varying degree. This depends on the cultural indicators visible in a specific situation, e.g. exhibiting individualist standards in an organisation causes a specific mode of perceiving and interpreting the reality. It is sufficient to activate one aspect of cultural approach (e.g. content) to trigger specific cognitive and behavioural processes that will be compliant with the perceived and applicable standards (e.g. individualist). In this mode, cultural orientation adopted at a specific time and place affects the behaviour of an individual (Oyserman, Lee, 2008).

Thus, individualist and collectivist orientation co-exists in the mind of every man and means a certain tendency to perceive, value, sense and react to the social reality.

The first feature characterising the two orientations is the mode of defining self by an individual, which is related to the significance of other persons in defining oneself. It may be captured in the form of two concepts: the interdependent self and the independent self (Triandis, 1989).

Individualist understanding of the world means to perceive and think about self as an self-standing individual entering into interactions with others, yet remaining independent, responsible for oneself and making own choices. Personal goals take precedence over group goals, while personal stances over group standards (Triandis, 2001). The main value for an individualistically-oriented person is personal freedom, possibility of making decisions, sense of control and self-realisation (Wagner, 1995). They contribute to the activity of individuals and thus the economic development of a given country.

The feature of the collectivist concept of the world is an assumption that an individual cannot exist outside a group because he/she depends on it. A man perceives himself as a member of a certain social whole, i.e. a family, a nation, an organisation and in relation to this, believes that he is related and subordinated to a given group. The community gives a feeling of safety and affiliation to an individual, it is also a source of moral values for the individual and thence man becomes liable for acting for the benefit of a group and making sacrifices for it (Markus, Kitayama, 1991). An individual with a collectivist orientation is ready to sacrifice own goals for the sake of the group's goals. The prize is approval and social support. It may be said that a group and an individual are responsible for one another.

The individualist approach implies a rule that every person is responsible for themselves, while the collectivist approach adopts the principle of joint responsibility (Reykowski, 1992).

Another feature characterising both dimensions is the type of relations maintained with people. In the case of individualist orientation, this is a relation of exchange, and in collectivism – community. In the community relations, people feel liable for caring for somebody's well-being. They offer benefits in reaction to the needs or to satisfy others. Receiving benefits does not trigger liability to return comparable benefits in a near future. The case is different in the exchange relation, where the participants – giving something – expect reciprocation with a comparable value, and when they receive something, they feel obliged to repay in kind (Adamska, Retowski, Konarski, 2005). Thence, the standards of exchange indicate the necessity of remuneration depending on the contribution, while the community standards emphasise the necessity of accounting for the needs of others.

Relations are also connected to the maintenance of specific interpersonal relations – equality-based or hierarchic. According to some researchers, hierarchical or equal nature of a relationship indicates a specific type of individualism and collectivism (Hwang, Francesco, Kessler, 2003).

Equality-based individualism characterises persons who focus on accomplishing their interests and goals, rejecting limitations that are imposed on them by a group.

Persons to whom hierarchic individualism can be attributed fulfil their own needs by means of competing with others, which may result in creativity and engagement in the performance of tasks.

Equality-based collectivism refers to people who notice a great similarity between themselves and others. Special attention is paid to joint goals and reciprocal dependence, yet it is uneasy for them to become subordinated to authorities.

In turn, hierarchic collectivism happens when an effect of group actions is higher than the sum of actions of its individual members. Persons of this type are ready to fulfil extremely unacceptable expectations of their leaders, if only the welfare of the entire group is at stake. They are also characterised by inclination to compete, but within the group (Adamska, Retowski, Konarski, 2005).

Studies on individualism and collectivism have shown that differences in this respect refer not only to the world-view sphere, but also the mechanisms of personality functioning, or behavioural aspects (Boski, 2010). For example superiors for whom inter-personal relations are important are more prone to collectivist behaviour, while employees cherishing such values more often help others and engage in cooperative behaviour (Moorman, Blakely, 1995).

The dominance of collectivist culture is identified with a higher degree of trust and motivation, as well as greater psychological sense of teamwork. It was also determined that public organisations with a dominant collectivist culture may, to a greater degree, use the employees' engagement as opposed to the organisations where individualist standards are dominant (Triguero-Sánchez, Peña-Vinces, Matos Ferreira, 2022). An organisation with a strong collectivist orientation focuses on common goals and interests, cooperative behaviour and group rewards (Cox, Lobel, McLeod, 1991).

A positive relationship between collectivism and the fulfilment of additional roles at the social level has been confirmed (Lam, Hui, Law, 1999).

It has also been found that collectivist cultural orientations can be important factors in enhancing individual performance in public sector organisations (Organ, Podsakoff, MacKenzie, 2006) and the willingness to engage in behaviours that contribute to the creation and maintenance of social capital (Taejun, Faerman, 2010)

It is also interesting to show the relationship between collectivism and efficiency (Singelis et al., 1999). In a situation when task-orientation is required, persons focused on creating a collective put high efficiency at risk, because they focus primarily on others towards whom they feel greatly obliged. To a great degree, they are also interested in how their efficiency is perceived by others and not the degree in which the result contributes to the improvement of their position. In result, the collectivist standards and values may intensify the individual's fear of presenting his/ her competence to others and may induce the individual to avoid tasks that may lead to failure.

Organisational individualism, on the other hand, therefore focuses on individual development, autonomy and competitive behaviour, as well as individual performance and reward (Robert, Wasti, 2002).

2. Method

Individualist and collectivist types of behaviour are some of several research categories identified as part of a greater research project, the aim of which was learning the modes of interpreting organisational borders by the employees of public and business organisations.

An organisational border is a cognitive construct that positions the individual either on the side of striving for maintenance of the hitherto known *status quo*, or mobilises the individual to change what is known and to strive for what is unknown. An assumption was adopted that with the aim of accomplishing inner comfort, an individual is trying to engage, by assumption, in actions adequate to the mode of thinking and the accompanying emotions in order to maintain the greatest possible cohesion between these elements.

During the project that was implemented between 2017 and 2019, a structured interview was used at stage I, in the course of which the respondents provided answers to two questions. The first referred to what an organisational border is for the respondents and the second referred to the sample borders that they encounter in the organisation on a daily basis.

At stage II of the study, the mode of interpretation of the border was linked to the manifested organisational behaviour. To this aim, a questionnaire survey was used, where two questions were asked: the first referring to what an organisational border was for the respondent and the second that was used to identify the behaviour with respect to the organisational borders. In response to this question, the respondents described what actions they took in a situation when they encountered an organisational border. To analyse the content and to select the research categories, the semantic field analysis was used.

The survey was completed by the employees of business and public organisations, differing by organisational functions at which they were employed. Ultimately, 497 persons took part in the study (Table 1).

Table 1.

Structure of study group according to organisational role and experience

Differentiating criterion	Type of organisation	
	Business organisations	Public organisations
Respondents' functions		
Operative/ clerical personnel	182	135
Leader	31	-
Manager	52	34
Director	10	21
Owner	32	-

Source: authors' own study.

When choosing the respondents, attention was also paid to their differentiation on account of the type of organisation (Table 2).

Table 2.
Structure of study group according to organisation

Type of public organisation	Number of participants
Unit supervising food safety	35
Public school	24
Agricultural counselling centre	5
City office	11
County office	23
Labour office	10
Police	8
Hospital	14
Care home	16
Institution of culture	14
University	15
Budget unit (no additional data)	15
Business organisations	
Accounting and financial services	42
Gastronomic and hotel services	46
Transport services	14
Construction and renovation services	16
Production and trade services	44
Health and beauty services	16
Educational services	18
IT services	28
Office and administration services	16
Own business	15
Carpentry and upholstery services	7
Other (e.g. dry cleaning, florist, post-office, energy, temping agency)	14
No data	31

Source: author's own study.

The paper presents the results received during stage II of the study carried out with the use of questionnaire surveys. It turned out that the organisational border is a category to which different meanings were attributed and the mode of its interpretation became a valuable source of information about the actions taken with respect to organisational problems and challenges, which the participants of organisations face on a daily basis. The diversity of the meanings assigned to the term triggered various forms of employee activity. Using the method of content analysis – the semantic field analysis – different types of organisational behaviour were distinguished: innovative behaviour, cooperative behaviour, individualistic behaviour, resistance behaviour (discord and rebellion) and concordance, conformism, separation, avoidance and passivity. Categorisation of the manifested types of behaviour allowed for showing the dominant activities among the study participants. The results pertaining to individualist and collectivist behaviour manifested by the members of public and business organisations are presented below.

3. Individualist and Collectivist Behaviour in Public and Business Organisations: Results

It follows from the performed studies that in the business organisations, more members engage in individualist than collectivist behaviour, while in public organisations, the scale of both types of behaviour is similar. It may also be claimed that there is a difference between the organisations in collectivist and individualist behaviour (figure 1).

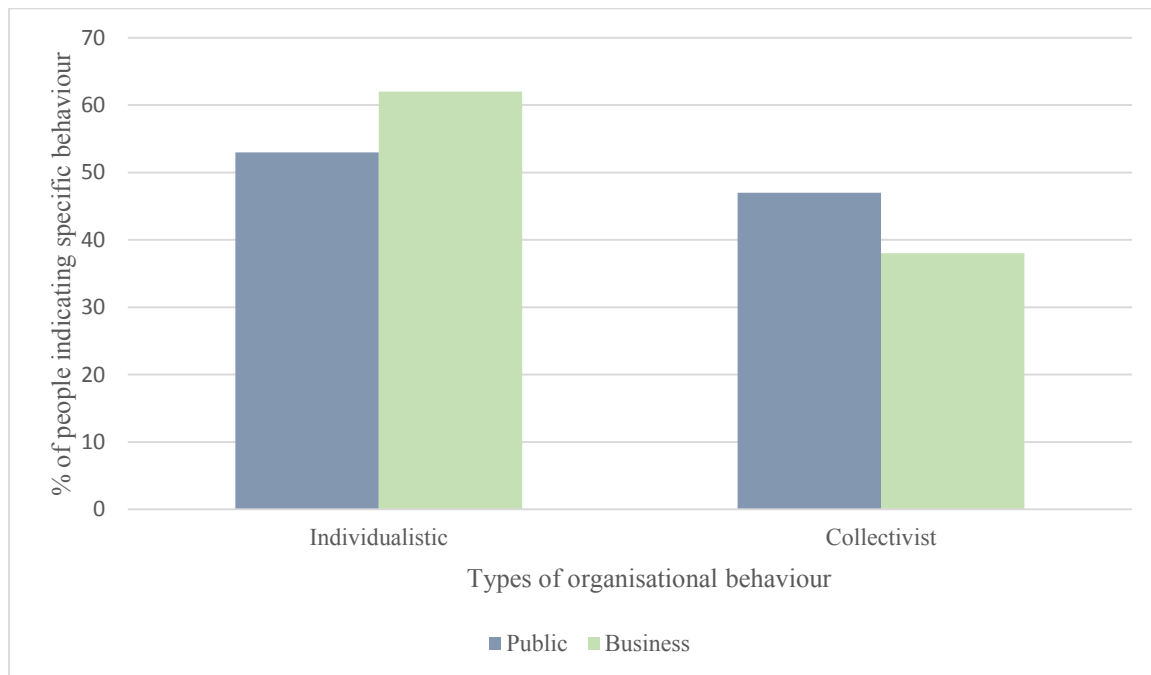


Figure 1. Individualist and Collectivist Behaviour in Public and Business Organisations.

Source: author's own study.

The main value for persons behaving in an individualist manner is autonomy, self-reliance and sense of impact and control. An individual with such orientation most willingly engages in independent initiatives leading to self-development and improvement of the organisation. Such persons improve the modes of task performance by determining 'own priorities, goals', designing 'own schedules', improving 'own management style'; these are also measures adjusting the 'style of behaviour' to the requirements of the organisational system or improving organisational and employee aspects.

Individuals with this type of orientation manifest great activity, willingly initiate actions and engage in tasks rather than wait for ready-made solutions. They are engaged and may act (eventually also for the benefit of others), as they are characterised by lack of fear when preparing for new actions, organisational roles and ongoing development of their competence.

In turn, collectivist behaviour comprises various activities. According to the performed studies, these are concordance, conformism and cooperation.

Concordance is characterised by acceptance and adoption of organisational standards, rules and principles. It is a result of the individual's free choice with respect to the willingness to participate in the organisational system of dependence. The organisational system is thus guaranteeing order and balance for the individual. Persons behaving in this mode harbour an inner conviction that breach or change of the rules violates the internal order and does not allow for efficient functioning of an institution. An individual behaving in this mode accepts the goals of the organisation, follows the organisational solutions, consciously agrees to act in line with the adopted organisational rules and trusts the ideas and decisions of various members of the organisation.

What is more, such individual pays attention to his/her work, but is also aware of the links with others and that is why he/ she is trying to share his/her results of work with others on time and without mistakes, takes care of the welfare of the organisation, knows his/ her rights, has certainty and trust as to own experience and knowledge.

According to W. Leirman, there are two paths to accomplishing behaviour of this type (Leirman, 1984).

The first one is an *informed consent* to a given situation, which may be a result of discovery that adjusting to the requirements is a condition precedent for meeting own interests. Such adjustment is not perceived as limiting; on the contrary, it is seen as a source of personal satisfaction, good frame of mind and satisfaction.

The second is *consent and acceptance* which follow from a *subjective choice*. This type of adjustment is a manifestation of consciously striving for the accomplishment of recognized values. Hence, concordance may give stability to the employees, understood as certainty and predictability.

Another behaviour classified under collectivism is conformism. It is an expression of adjustment and subordination to the majority, adoption of organisational standards and rules, in spite of internal discord or experienced doubts.

This behaviour is a result of impact of other members of the organisation. To avoid standing out and to become a part of a group, the individual adjusts, gives in to the flow of affairs and renounces own opinions for the sake of others. This behaviour is a certain type of copying and adopting the models of others, while the goal is the desire to blend in with the rest.

A person behaving in a conformist way gives way and becomes accustomed to the current state of affairs even if it diverges from his/ her inner desires and keeps silent about numerous issues and problems. Persons behaving in this way do not change the organisational borders on account of sanctions that may be imposed on them by the authority and the group in case of failure to adjust. Sometimes, the organisational determinations and standards are treated like a duty, like something that could possibly be changed, but should not be done.

A number of group standards have a hidden, covert character and uniform behaviour of others is sometimes an important indicator of the existence and content of standards for the individual.

The third type of collective behaviour is cooperation, which is characterised by the fact that a person perceives himself/herself as a member of an organisation/division/team. This behaviour is manifested by the desire to share knowledge, to help others in the performance of tasks, joint resolution of problems, devoting time to teaching other employees in the team, engagement and acting for the benefit of others (e.g. readiness to perform work for somebody, overtime work, reducing the burden on others), joint rituals.

It follows from the performed studies that differences exist between business and public organisations also within the structure of the manifested collectivist behaviour.

In public organisations, there is much more concordance and less conformist behaviour than in business organisations. Cooperative behaviour is initiated by a small number of persons in both types of organisations (figure 2).

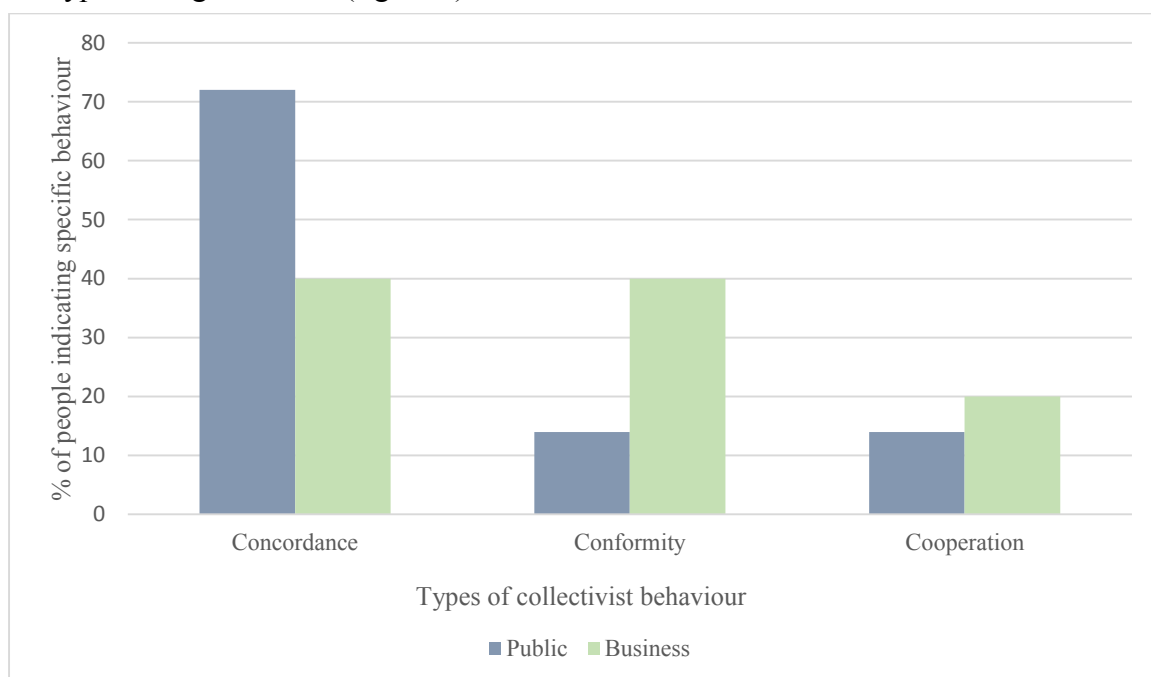


Figure 2. Structure of Collectivist Behaviour in Public and Business Organisations.

Source: author's own study.

Taking into account the organisational role, a difference is also seen in the structure of manifested behaviour. In a public organisation, individualism is dominant among clerical employees, while among the managers and directors of organisational units, individualism and collectivism are manifested to an equal degree. The respondents performing managerial roles do not engage in cooperative behaviour at all. Such behaviour is only present among the employees.

In turn, in business organisations, irrespective of the performed organisational role, individualist behaviour is dominant – its occurrence increases together with the level of management. An opposite phenomenon is visible in the case of concordance; more behaviour of this type is observed among the employees than among the managers.

Additionally, in business organisations cooperative behaviour was also identified among all respondents (figure 3).

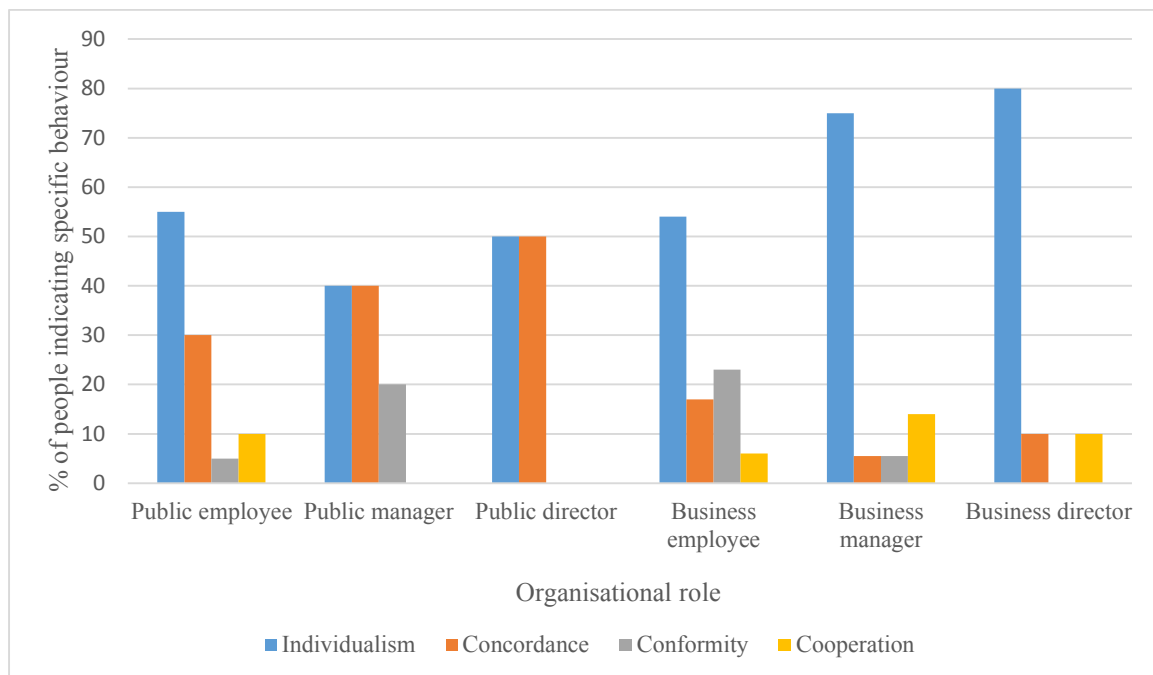


Figure 3. Individualist and Collectivist Behaviour vs. Organisational Role.

Source: author's own study.

5. Discussion

The results pertaining to the behaviour displayed by the members of public and business organisations show that there are differences between the two types of organisations.

The first visible difference pertains to the dominance of individualist behaviour in business organisations; in turn, in public organisations more individuals act collectively.

The second significant difference is the different structure of behaviour comprising collectivism.

In public organisations, concordance is dominant; it is present in all persons, irrespective of the organisational role held and it may be said that it grows along with the level of management. In turn, in business organisations concordance is manifested on a definitely lower level; it is levelled with conformism and is reduced together with the level of management.

In both types of organisations, cooperative-type behaviour is at a low level; in public organisations, it is manifested only by clerical employees, while in business organisations also by managers and directors.

The occurring differences may shape specific consequences for the process of management in both types of organisations.

First of all, the revealed dominant behaviour shows the attitude of the members of the organisation to the organisational standards.

In business organisations, predominant individualism may trigger a negative attitude to the established standards and organisational rules, which becomes a problem in a situation when an organisation is intent on maintaining repetitiveness and standardisation of actions. Organisational rules become a limitation, a barrier and thwart the individual's development.

A negative approach to the organisational rules is an impediment during the coordination of organisational activities. Lack of consensus may lead to the formation of separate fractions within the organisation, which will wish to cherish different values. Lack of concord and cohesion in the determined directions of actions, priorities and standards of conduct generates conflict and uncertainty, which increases anxiety among the remaining members of organisations (Yip et al., 2003).

The atmosphere of resistance, aversion and lack of trust to the superiors and decisions made by them may block self-development, creative expression, ambition and possibilities of using own potential for the welfare of the entire organisation. Interpreting standards in a negative mode may thus result in the fact that the members of the organisation behave adequately to their convictions and beliefs (Nawrat, 2014).

Predominant concordance, i.e. trust, acceptance, respect and adherence to the established organisational standards will exert different impact on the functioning of an organisation. In this approach, the standards are a certain form of the organisational 'capital', thanks to which it is possible to accomplish durable benefits, both by its participants and the organisation. The accepted standards facilitate cooperation, reduce uncertainty and risk related to the lack of trust in inter-personal relations (Dendura, 2018).

Respect for standards allows for reduction of costs (not only in the financial sense) related to the supervision of processes and actions as the participants themselves appreciate and assess one another. Hence, approval of standards performs the role of a system of social control for stances and behaviours (Yip et al., 2003). Such situation leads to self-regulation of social processes and through this, coordination of actions is facilitated, while accumulation of knowledge and experiences, self-organisation and democracy may be a basis for the development of an organisation and its members, as well as conscious introduction of changes.

From the psychological point of view, perception of a system and organisational standards as the necessary organisational content guarantees order, certainty of results and mode of action, as well as reduces relational tension and sense of uncertainty. In such situation, the standards operate as a reference framework used for individual and inter-subjective interpretation of the world. They may be treated as systems of constructs with values ascribed to them, which provide predictability and order to the environment of a given person. They help function in a more optimal way, in particular in new or ambiguous situations, where they provide guidelines for the performance of tasks (Brown, 2006).

The predominant concordance offers stability to the employees understood as certainty and predictability and allows for supporting and maintaining organisational identity. According to some researchers, an individual – in order to make decisions and introduce changes – needs a feeling of stability and conviction that there is order in the organisation and that it is heading in the right direction. Accomplishing such organisational status is a basis for introduction of organisational changes (Krot, Lewicka, 2014).

Yet concordance may also lead to the formation of conservatism and slow down reactions to the changes occurring in the environment. In such situations, employees and managers may excessively aim for maintaining the hitherto *status quo* which is known to them and which offers a sense of stability and safety. Actions for the sake of change may be perceived as risky, not only in the economic aspect, but primarily the organisational and psychological one, as they may disrupt the accomplished and recognized status of organisational balance.

In turn, such circumstances may lead to the solidification of convictions that a change is not needed and may be negative for the organisational order, preference of organisationally shared opinions about maintaining stability and internal unity or rejecting persons with different views.

Individualism, namely focus on accomplishments is, in turn, conducive to changes of the hitherto solutions.

The needs of participants of organisations are also shown via dominant behaviour.

It may be concluded that the main motif for action in business organisations is striving for the sense of autonomy, independence, impact and control; impact exerted by other members of the organisation is of lesser importance. It is visible among clerical employees of business organisations.

In turn, in public organisations where concordance is dominant, the sense of order, balance, predictability and consistency between personal values and the organisation's mission are vital for the organisation's members.

This difference shows that in the process of motivation, completely different mechanisms of influencing the individual should be used.

The last issue, significant for management, is to show – next to dominant behaviour – also the behaviour that is manifested by a minority. This is cooperative behaviour, the marginality of which may testify to the growing impact of individualism on interpersonal relations.

Hence, it may be said that both in public and business organisations, sharing of knowledge, information about organisational difficulties, joint problem solving or devoting time to other members of the organisation is missing. The standards of individualism related to focus on goals and tasks are sustained by the higher managerial ranks, especially in business organisations. In public organisations, individualism and concordance occur to an equal degree among managers, which may indicate an attempt at integrating performance of the goals based on the established organisational standards.

6. Conclusion

The purpose of the paper was to show differences between public and business organisations within the scope of individualist and collectivist behaviour. As a result of the presented studies it was concluded that such differences occur.

First of all, individualist behaviour is dominant in business organisations, while in the public ones it is on a lower level.

Secondly, it was noted that the sole concept of collectivism is too general; it triggers stereotypical thinking about the phenomenon. For the process of management, it may be important not only whether individualism or collectivism is dominant in an organisation, but also what type of collectivist behaviour is dominant. It turns out that collectivism is a complex dimension, within which various activities may be initiated, e.g. concordance, conformism and cooperation. Dominance of specific behaviour shapes the quality of functioning of an individual in an organisation. Whether an individual consciously adopts and accepts organisational standards or acts in line with them under the impact of a group may influence the behaviour of individuals, his/ her engagement and the course and effort put in the performance of processes related to management of people in the organisation – coordination of actions, encouragement, control and change of behaviour.

Thirdly, in both types of organisations, cooperative actions are missing; these are actions on which interpersonal, team, inter-process and inter-departmental relations are built, while in public organisations the inter-level (e.g. county, province) and inter-organisational ones. Such behaviour as concordance and conformism may reduce conflicts, improve atmosphere in a team, a sense of order, yet organisational processes go beyond specific divisions/units/teams and more and more often beyond the borders of a single organisation. Such situation forces the participants to face the necessity of performing actions outside of the set scope of duties, acting in new circumstances, using new knowledge at the disposal of other persons. That is why support and development of cooperative behaviour is necessary for efficient performance of processes taking place among various public and business organisations, or as part of public and private partnerships.

The existing differences within the structure of behaviour between members of public and business organisations also show that another outlook on both types of organisations is required, especially during the formation of conditions for change of organisational behaviour and motivation. Thus, striving for creation of models objectifying the management processes should be abandoned.

7. Managerial Implications

The results presented in this paper show the dynamic of various types of behaviour among members of public and business organisations. Knowledge about the types of behaviour manifested by the majority of participants and the marginalised behaviour allows for better understanding of the organisational phenomena that take place and in effect conscious management and support for the development of those that an organisation cares about.

The structure of behaviour is a carrier of information about motifs of action of individuals. Separation of behaviour that is dominant provides information about which motif underlies a specific action: is it striving for power, autonomy, or does a person care about personal development? Familiarity with organisational behaviour may thus be used in the process of motivating people.

It also seems that knowledge about the dominant organisational behaviour provides information as to what affects people's behaviour, whether it is legitimisation of values of the organisation and the established standards, or the force of the group or the force of an individual. Accurate identification of orientation offers great possibilities for predicting organisational behaviour and more efficient designing and carrying out organisational changes.

The final issue refers to the possibility of using the dynamic of behaviour in the coordination process. Different tools are required by coordination in an organisation where collectivist behaviour is dominant and within it concordance (e.g. rules and procedures) and others will be effective when individualist behaviour is dominant (e.g. individualised goals and tasks, delegation of rights).

It may thus be said that knowledge about the dominant organisational behaviour allows, in a conscious mode, for using various methods and tools of management, so that certain organisational phenomena may be solidified and changed, in line with the adopted management strategy.

8. Future Research

The presented results are a starting point for further studies. The next stage will be examination of differences between business and public organisations in the area of organisational behaviour. It is known that in both types of organisations, individualist and collectivist behaviour is manifested; it may be valid to determine the relationship between these types of behaviour and various psychological dimensions of individuals (e.g. perception of self-agency and efficiency, subjectivity) and organisational phenomena, e.g. acting within the established roles and outside of them.

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TECHNICAL EDUCATION AND EXPERIENCE OF A LEADER AS A DETERMINANTS OF TEAM WORK EFFECTIVENESS IN IT PROJECTS

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Purpose: The realization of large, characterized by high uncertainty and variability IT projects is usually complicated and overlong, and their effectiveness often lower than expected. Hence the role of the project leader as the person responsible for the success of the project is of particular importance. In this context the purpose of the paper was to investigate the relationship between technical (directional in IT) education and technical experience in IT of a leader, and team work effectiveness in IT projects, recognized as one of the predictors of the project's success.

Design/methodology/approach: Empirical research was conducted to verify the existence of the predicted relationship and to reach the aim of the paper. The study was quantitative in character. The set of hypotheses was built based on the theoretical research and then verified the CAWI method on sample of 178 respondents working on IT projects in organizations operating in Poland. The calculations were made using the PS Imago Pro ver. 7.0 and Process macro for SPSS ver. 4.1 by Andrew F. Hayes.

Findings: It has been shown that there is indirect relationship between the studied variables, and the mediators of this relationship are leader's technical competences and the leader's efficiency. There is a mediation relationship between the dependent variable (team work effectiveness) and independent variables (technical education and technical experience in IT of a leader).

Research limitations/implications: Performed empirical study is burdened with certain limitations. The obtained sample of 178 respondents is by far not a representative sample and verified only in one business context (Poland). In order to generalize the results in future research cross-national study and larger samples can be collected.

Practical implications: The obtained results contribute to practice of management, showing that among various groups of factors determining team work effectiveness in IT projects both soft and hard (technical) competencies of the leader are important. The latter are shaped by the technical, directional (in IT) education and technical (in IT) experience of the leader. This has practical implications, especially for HR services in the process of employees recruitment. In addition to soft skills, knowledge of programming languages and programming experience should be a significant assets wanted when hiring IT project managers.

Originality/value: This research enhances understanding factors determining team work effectiveness in IT projects. The research make an important contribution to the body of project management and human resources management literature by demonstrating the meaning of the technical education and technical experience of a leader for team work effectiveness in IT projects.

Keywords: project management, technical competencies, leader efficiency, team effectiveness.

Category of the paper: Research paper.

1. Introduction

The Standish Group International publishes reports which gather information about project management. In 2020 half of all IT projects have been completed with a delay, over the planned budget or without fulfilling the requirements. 19% of projects have been cancelled before completion or completed but never deployed and used. Only 31% of projects have been successfully completed (The Standish Group International, 2020) and most projects failures are related to social issues (Belout, Gauvreau, 2004). Among factors affecting project success project management success is often pointed (Alias et al., 2014; Cooke-Davis, 2002; Radujković, Sjekavica, 2017; Shokri-Ghasabeh, Kavouosi-Chabok, 2009), and going deeper into this area – factors influencing it, related to the project manager and the way he manages (Belout, Gauvreau, 2004; Sanches, Terlizzi, 2017; Verner, Evanco, 2005; Westerveld, 2003), related to the team members (Belassi, Tukul, 1996; Sanches, Terlizzi, 2017) (e.g. project team commitment, team work (Chan et al., 2001)) and to communication as well (Andersen et al., 2006; Garbharran et al., 2012; Trocki, 2012).

Haffer (2013) considers the commitment of the project executors (both leaders and team workers) to be the key factor in the success of the project. Project realization is always team work, thus team work effectiveness seems to be a fundamental condition for project success achievement. In this context, the role of the project leader as the person responsible for the success of the whole is of particular importance. Nowadays, the importance of the leader's soft skills is strongly emphasized (Werewka, Wietecha, 2015; Mtsweni et al., 2016; Smółka, 2006), however, taking into account that in IT projects we often deal with innovative solutions, new technologies and advanced programming languages, the leader's technical competences - largely shaped by his experience in the industry and education in the field of IT - seem to be no less important. This issues has not been addressed directly in literature yet and there is a research gap that needs to be addressed.

In order to fill the observed gap the main purpose of the paper was to investigate the relationship between technical (directional in IT) education and technical experience in IT of a leader, and team work effectiveness in IT projects, recognized as one of the predictors of the project's success. Additional attempt was made to identify the mediators of this relationship.

Such research intent was structured by literature review on the factors shaping team work effectiveness related to the person of the leader. Following the aims of the research, the paper was structured as follows. Section 2 presents and discusses the conceptual background of factors shaping team work effectiveness and leader efficiency. The set of hypotheses is built based on the theoretical research. In section 3 research design is described along with data and method. As a next step empirical, quantitative in character research is conducted to verify the existence of the predicted relationship and to reach the aim of the paper. The CAWI method is used on sample of 178 respondents working on IT projects in organizations operating in Poland. Findings and their theoretical and practical implications, along with limitations of research are presented respectively in sections 4 and 5.

2. Theoretical background and the development of the hypotheses

2.1. Leader's efficiency as a factor determining the effectiveness of teamwork in IT projects

Regardless of the mode of performing tasks (process or project approach) organizational success can never be reached without qualified and motivated personnel (Belout, Gauvreau, 2004). According to Yang et al. (2011) teamwork is positively related to project success, thus we can suppose that higher effectiveness of teamwork will be also translated more strongly into the project's success.

Literature research provides information on many factors determining effectiveness of teamwork. Most frequently mentioned are: team size, specialist and interpersonal skills of team members, a way of doing the work accepted by everyone, difficult but achievable goal, commitment and responsibility among team members (Katzenbach, Smith, 1993; Kozusznik, 2002). According to the K. Ćwik (2013), the factors are: a common goal, communication, friendly atmosphere and sense of belonging. Information qualities (field of study, time spent in the organization and team), personality and team composition with the same level of diligence but different seniority, experience and knowledge are also important (Piskorz, 2013). E. Masłyk-Musiał (2014) lists the members' attitude towards the product (not its functions), reducing the distance in relations, correct communication, flexible structure, control over processes and elements of tasks (not tasks itself). B. Tracy (2014) distinguishes five factors of effective teamwork - a common achievable goal, common principles of cooperation and respected values, common plans for carrying out tasks, regular meetings and discussions and a caring leader. Especially this last one factor seems to be of great importance. J. Kopeć (2013) points out that one of the most important factors influencing the effectiveness and efficiency of project implementation is the project manager. Its decisions, their quality and competences have an impact on the effectiveness of cooperation with individual stakeholders of the project,

and in particular on the effectiveness of the project team. This is confirmed by research of Ammeter & Dukerich (2002), Francik (2003), Springer (2013), Verner & Evanco (2005) or Wateridge (1997).

Teamwork effectiveness reflects the way the project manager runs the project and how tasks and responsibilities are divided. According to Westerveld (2003) team working habits are strongly influenced by leadership style and a way of co-operation in the project team. Efficient leaders are able to lead a team in such a way that each of its members can comprehensively use their skills, abilities and the possibility to carry out tasks the best he can (Dźwigoł, 2014). They not only communicate well with team members, achieve set of goals or resolve conflicts, but also make team members strive to achieve the goal (Igielski, 2015).

The efficiency of the leader can be assessed indirectly (by assessing his team work effectiveness) or directly. This can be done through the prism of the substantive tasks assigned to him - including the fulfilment of managerial functions, i.e. setting goals, defining tasks, developing and making the right decisions and motivating employees, creating conditions suitable for harmonious cooperation, as well as verifying the level of achieved results.

According to Camilieri (2011) IT projects can be classified to medium- or high-tech projects. This types of projects use technologies that are existing, but sometimes also new and may utilize some new technological features. Therefore, they are usually characterised by a medium or high level of uncertainty. Such a specificity imposes specific requirements on the project leader.

First of all it must be underlined that the leader in IT can take different roles - leading the project as project manager, leading the team as team leader or unit leader, or be responsible for technology choices as teach lead. Technologies and methodologies used have big impact on the leader's roles. Size of the organization also impacts the leader's responsibilities. In a case of a smaller organization, the leader's responsibilities are much broader. They include tasks which would be split between few managers with different specializations in bigger organizations (Jurga, 2022).

After consultations with business analytics, the leader assigns tasks priority and delegates them to team members. The difficulty and kind of given task must be taken into account. Too many repeating tasks may be tedious and boring which is not desired in creative work as IT. Tasks should stimulate team members to grow. Usually such list of tasks is being updated each two weeks. The amount of work needs to be considered: too long list of tasks can be discouraging, too short list can end before next consultations. The leader's responsibilities include short term planning - organizing tasks for given day, and long term planning - planning goals for next year, considering processes and issues that might block progressing towards the goals. During long term planning, order of tasks and choice of correct tools must be considered. The same goes for keeping spare time for project improvements, cleaning the source code and library upgrades. The leader's tasks include short daily meetings that allow team members to communicate what has been done lately and what is going to be done soon. There are also

longer and less frequent meetings summing up changes since last meeting of this kind, usually once each 2 weeks. In a case of hybrid office model, the leader is responsible for ensuring that whole team at the office during more important meetings.

The leader is also responsible for organizing or reorganizing the resources among team members. This includes both hardware like monitors and software like licenses. The leader decides which tools will be used by the team, who will gain the access to them in a case of limited licenses available, or which issues will have priority when contacting third party software providers. The leader assigns tasks to given team members allowing them develop their skills and grow their careers. The leader should take care of transferring the knowledge between team members and between different teams (Jurga, 2022). In this way, he can affect team work effectiveness. The more efficiently he manages the better team work effectiveness can be supposed. Therefore, following hypothesis may be formulated:

H1: There is a positive relationship between the project leader's efficiency and the team work effectiveness in IT projects.

2.2. The importance of the leader's hard and soft competencies for the leader efficiency and team work effectiveness in IT projects

The success of the organization is related to employment the best specialists and keeping them in the company. This, in turn, depends on the managers who, by managing human capital, have an impact on the career of employees (Kazak, 2017). The skills of IT managers are critical to the success of projects (Wateridge, 1997) as evidenced by research into practices leading to project success (Verner, Evanco, 2005). The effectiveness of project management significantly depends on the competences and skills of the team manager (Kopacka, 2015; Kopeć, 2013).

The competencies expected by companies on management positions can be analyzed on the basis of job offers (Werewka, Wietecha, 2015). The IT industry is dominated by project-based approach to the work, hence soft skills are indicated as indispensable and necessary for a success (Mtsweni et al., 2016). The expectations set by employers differ depending on the type of leader. Scrum master should know scrum methodologies, be agile and team working. Project manager and project owner should have both soft and hard skills such as project management, knowing agile manifest and programming knowledge. In the offers looking for a team leader, an ability to program is the first requirement, an ability to lead a team appears less often. In the case of a technical leader offers, almost only technical skills are required (Jurga, 2022).

The leader's soft skills are essential in achieving a success for both individual employees and the entire organization (Smółka, 2008; Konarski, 2008; Mitchell et al., 2010). Soft skills are needed by a leader whose daily duty is contact with people (Paszkiwicz, Silska-Gembka, 2013). C. Fournier notes that it is easy to wrongly assume that a leader position in IT projects is not a technical job (Fournier, 2018). It is also false to reason that if the leader is not responsible for software development, then hard skills are not needed. However, in order to

efficiently supervise the work of team members and to identify signals that indicate the technical condition of the team, knowledge of programming is needed. Although the manager himself does not have to deal with writing code, he is responsible for the implementation of tasks, including also technical one, thus the knowledge of code and technical tools that facilitate making changes to it is important. Moreover, the leader should be also able to catch valuable and important information from the general buzz (Kamiński, 2016) and understand the problems related to the work performed. In the IT industry, it means having the technical competence to be able to filter the information received or be able to reliably assess what the employee has achieved and what he has to work on. Without technical competences it is difficult to say whether a given code is performed correctly and the knowledge provided to other team members is clear and uncomplicated. Technical competences are also useful to formulate a correct working tip or when working with IT team members who often use specific, technical vocabulary to describe the encountered problems. The hard competencies of a leader help to define key qualifications and competencies needed in project team, and are essential to the successful recruitment of team members (Kisielnicki, 2011).

K. Frączkowski (2003) describing the project leader points that his role is a combination of the role of a businessman who works with the client, the role of a manager who has human resources in the area of its influence, but also the role of a technologist. The latter role is related to resource selection, technical innovation and adaptation of the operating method. Thus project leader does not necessarily have to be a "super specialist" in computer science, but he combines economic and technical issues, and from this point of view the technical competencies are needed.

Summarising, research on project team members indicates that the leader should have soft and hard competences (Sobczak, 2014), and apart from the increase in the demand for soft skills, there is also an increase in the demand for specialists with hard, technical competences (Butryn, Sobińska, 2019). Considering all the above, the following research hypotheses were formulated:

H2: There is a positive relationship between the project leader's soft competencies and his efficiency (a), and a team work effectiveness in IT projects (b).

H3: There is a positive relationship between the project leader's hard (technical) competencies and his efficiency (a), and a team work effectiveness in IT projects (b).

Competences (both hard and soft) are an important factor determining the effectiveness of the leader's actions in work processes. Therefore, the following hypothesis can be adopted:

H4: The project leader's soft competencies (a) and project leader's hard (technical) competencies (b) influence a team work effectiveness in IT projects (an indirect effect) through project leader's efficiency (an intermediary variable).

2.3. Factors shaping the leader's hard competences

Hard competences are a certain type of professional qualifications, the possession of which allows for effective fulfillment of duties in a given position. These qualifications are often confirmed with appropriate certificates or diplomas and associated with specialist knowledge (Armstrong, 2006). They are inextricably linked with specialist and substantive requirements for a given position, therefore they are often referred to as technical competences (Fastnacht, 2006). In IT industry that hard skills can be expressed as knowledge of the tools, technologies, programming language or design patterns (Butryn, Sobińska, 2019). The hard competences include also the knowledge about a task or process, practical abilities to complete a task and motivation to complete a task with a given pattern (Branowska et al., 2011).

In IT industry it is often emphasised that hard skills arose on education or work experience. They can be developed by formal education, informal education and non-formal education (Maslowski et al., 2009) or through experience in work processes (Kopacka, 2015), i.e. changing the workplace, self-growth, and contact with specialists in the field, reading industry articles and books, all of that impacts hard skills (Spychała, Branowska, 2019). Considering all the above, the following research hypotheses were adopted:

H5: There is a positive relationship between the project leader's technical (directional in IT) education and his hard (technical) competencies.

H6: There is a positive relationship between the project leader's technical experience in IT and his hard (technical) competencies.

Taking into account all the previous arguments on the impact of hard team leader competencies on his efficiency and the effectiveness of the teamwork, the following hypotheses can be formulated:

H7: The project leader's technical (directional in IT) education (a) and the project leader's technical experience in IT (b) influence a team work effectiveness in IT projects (an indirect effect) through project leader's hard (technical) competencies and project leader's efficiency (an intermediary variables).

Fig. 1 presents the diagram illustrating the list of adopted research hypotheses.

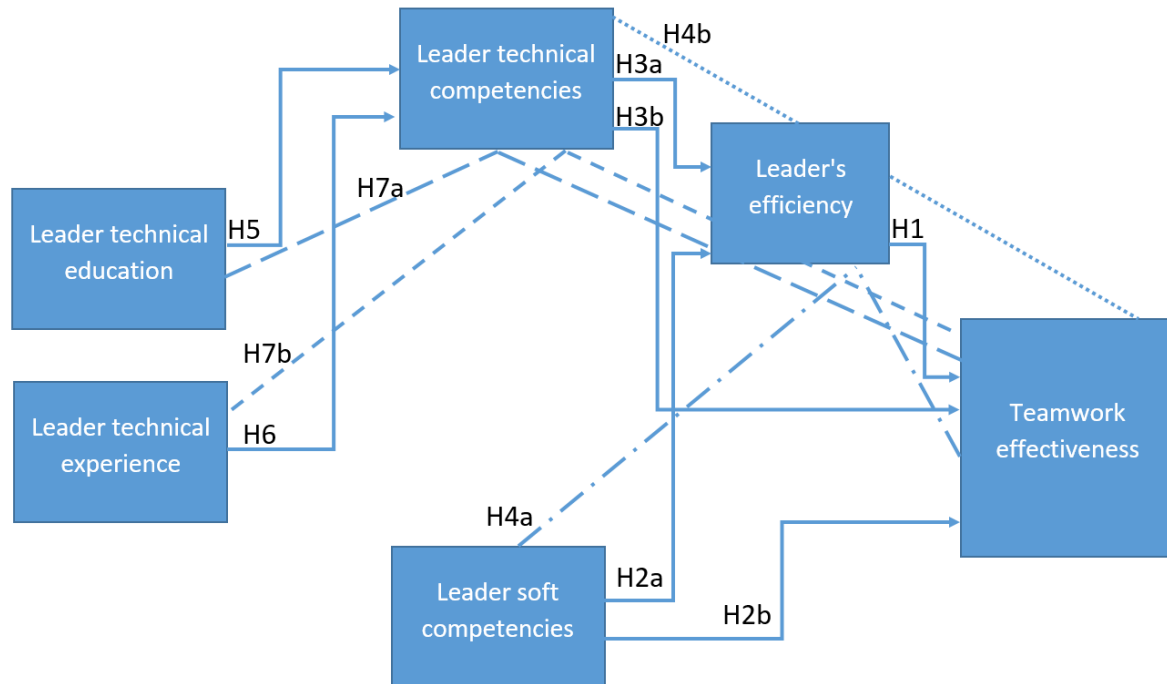


Figure 1. Project leader's hard (technical) competencies and project leader's efficiency as a mediators of relation between project leader's technical (directional in IT) education and the project leader's technical experience in IT, and the team work effectiveness in IT projects. Source: own research (based on (Jurga, 2022)).

3. Research methodology and the results of research

3.1. Data gathering process and characteristics of the research sample

Aiming to verify the proposed hypotheses quantitative research was conducted. The purpose of the research was to verify if the leader's technical competencies and the leader's efficiency can be mediators of relation between team work effectiveness (the dependent variable) and technical (directional in IT) education and technical experience in IT of a leader (independent variables). The research was conducted to complete a master's thesis (Jurga, 2022). The study was conducted in April 2022 using the CAWI method. Google Forms and Survio tools were used to collect data. The questionnaire was published in the form of a post on three groups on Facebook associating programmers. The questionnaire was firstly filled by 141 respondents working in project teams in the IT industry for organizations located in Poland (which was the only limitation of the research sample), and then additionally sent to 8 teams in a software company operating in Poland and filled by 37 respondents. In total 178 responses were collected. The questionnaire was sent to both leaders, who could rate themselves, and to team members who could rate their leader (the questionnaires for both groups differed slightly - the questions were personalized, depending on a respondent role). The obtained results were

analyzed using Microsoft Excel and the SPSS statistical package with an overlay created by A. Hayes - the PROCESS macro.

The sample was selected using a non-random method. According to the data gathered by Eurostat, at the end of 2020, almost 554'000 people has been working in IT industry in Poland (Eurostat, 2022). Unfortunately, there is no data on how many of that people have formal education related to IT. A formula was used to assess whether the sample is representative (Szewczyk, Ciesielska, 2010):

$$N_{min} = \frac{N\alpha^2 f(1 - f)}{Ne^2 + \alpha^2 f(1 - f)} \tag{1}$$

where:

N_{min} is minimum sample size,

N is the size of the studied population,

α is trust level,

f is fraction size,

e is maximum error.

It is not known what part of the IT sector employees has higher technical education so we have to take f equal to 0.5. In order to achieve representative sample with confidence level equal to 95% and maximum error equal to 5% minimum 384 questionnaires should be obtained. For 178 respondents participating in the study and the confidence level equal to 95% the quantity given in a sample is representative of the maximum error 7%.

The distribution of the respondents with the division into roles and working time in a given team is presented in Table 1.

Table 1.

Distribution of the responders grouped by role and seniority in the team

Time in this team \ Role	Leader	Team member	Σ
Up tp 2 years	26	75	101
From 2 to 5 years	23	36	59
More than 5 years	15	3	18
Σ	64	114	178

Source: (Jurga 2022).

Among all responders, 104 (58%) leaders have technical education related to the IT industry, 52 (29%) leaders have technical education related to different technical fields and 35 (20%) leaders have no technical education. 60 leaders were leading an IT team for up to 2 years. 74 leaders were leading for between 2 to 5 years. 44 leaders were leading an IT team for more than 5 years.

3.2. Variables measurement

In order to verify the proposed hypothesis the following variables were defined: Leader technical education, Leader technical experience, Leader technical competencies, Leader soft competencies, Leader efficiency and Team work effectiveness.

Leader technical education was a dichotomous variable with values of *yes, no*. Respondents were asked to indicate whether they have formal IT education.

To build *Leader technical experience* variable 2 items were used. Respondents assessed how much experience a leader has as a programmer and when was the last time the leader worked with the code. Each item was rated on a 4-point scale.

Variable *Leader technical competencies* was measured using 5 items describing, how much the leader has developed hard skills. The scales were built on the basis of literature (Spychała, 2013; Fournier, 2018; Butryn, Sobińska, 2019). They were rated on the 5-points' Likert scale (from *fully agree* to *fully disagree* with middle point *I have no opinion*).

Leader soft competencies was measured using 9 items describing, how much the leader has developed soft skills. The scales were built on the basis of literature (Ahmed et al., 2012; Mirska, 2012; Fournier, 2018). They were rated on the 5-points' Likert scale.

Building *Leader efficiency* variable 10 items were used in the case of questionnaire directed to a team member and 8 - in the case of questions directed to the leader. The scales were built on the basis of literature (Igielski, 2015; Fournier, 2018). Items were rated on the 5-points' Likert scale.

To build *Team work effectiveness* variable 14 items assigned into 4 groups (technical efficiency, team performance, attitude and behavioural results) were used. The scales were built on the basis of literature (Hackman, Morris, 1975; Fournier, 2018). Here again 5-point scale was used.

3.3. Descriptive statistics and reliability analysis of scales

At the beginning of a research process, the reliability of scales of each variable was verified. Cronbach's coefficient (α) was computed to test the reliability and internal consistency of the responses. The results of the analysis of the reliability of the measurement scales are presented in tab. 2. All of the α values for constructs are above 0.7 (most over 0.8), indicating a high degree of internal consistency in the responses.

Table 2.

Defined variables along with the results of the reliability analysis of scales

Variables	n	CR	M	SD
Leader technical education	-	-	-	-
Leader technical experience	2	0.767	3.311	1.012
Leader technical competencies	5	0.950	4.224	1.086
Leader soft competencies	9	0.882	4.231	0,693
Leader efficiency	8	0.836 for leaders		3.942
	10	0.907 for team members		
Teamwork effectiveness	14	0.823	4.029	0.529

Source: own study (based on (Jurga 2022)).

The questionnaire was completed by two groups of employees: leaders and team workers. Moreover, the leader efficiency was measured differently in two groups of respondents. So a natural question arose whether the opinions of these two groups of employees could be used in the further research process. Thus in a first step of analysis a smaller sample collected from one particular software company was used to verify whether the evaluation of the leader's efficiency and teamwork effectiveness differs in the eyes of the leaders themselves and their team members. Then this analysis was extended to the entire sample. The equality of means test (Student t-test for independent samples) has been performed. It turned out that there are no statistically significant differences between the both groups in the evaluation of the leader efficiency ($t(178) = -0.433$; $p = 0.666 > 0.05$) and teamwork effectiveness ($t(178) = -0.089$; $p = 0.929$) as well. The rating of the leader's efficiency and team work effectiveness assessed by leaders and team members is consistent and this measurement method can be taken into account in the following research.

3.4. Research results

The next step of the analysis was the correlation analysis between studied variables. To verify the proposed hypothesis an *r-Pearson* correlation analysis has been conducted. The results can be found in Table 3.

Table 3.
Correlation analysis between studied variables

	Leader technical experience	Leader technical competencies	Leader soft competencies	Leader efficiency	Team work effectiveness
Leader technical education	0.314** ($p < 0.001$) N = 160	0.305** ($p < 0.001$) N = 163	0.076 ($p = 0.333$) N = 163	0.109 ($p = 0.166$) N = 163	0.041 ($p = 0.601$) N = 163
Leader technical experience	-	0.770** ($p < 0.001$) N = 172	0.253** ($p < 0.001$) N = 172	0.336** ($p < 0.001$) N = 172	0.142 ($p = 0.063$) N = 172
Leader technical competencies	0.305** ($p < 0.001$) N = 163	-	0.497** ($p < 0.001$) N = 178	0.551** ($p < 0.001$) N = 178	0.369** ($p < 0.001$) N = 178
Leader soft competencies	0.253** ($p < 0.001$) N = 172	0.497** ($p < 0.001$) N =	-	0.724** ($p < 0.001$) N = 178	0.623** ($p < 0.001$) N = 178
Leader efficiency	0.336** ($p < 0.001$) N = 172	0.551** ($p < 0.001$) N = 178	0.724** ($p < 0.001$) N = 178	-	0.606** ($p < 0.001$) N = 178

Note: **Correlation is significant at the 0.01 level (two-sided).

Source: own study (based on (Jurga 2022)).

The results showed that:

- variable *Team work effectiveness* is statistically significantly correlated with:
 - *Leader efficiency* ($r(178) = 0.606**$, $p < 0.001$), which is the basis for positive verification of the hypothesis H1,

- *Leader soft competencies* ($r(178) = 0.623^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H2b,
- *Leader technical competencies* ($r(178) = 0.369^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H3b, although it must be noticed that the correlation is moderate here;
- variable *Leader efficiency* is statistically significantly correlated with:
 - *Leader soft competencies* ($r(178) = 0.724^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H2a,
 - *Leader technical competencies* ($r(178) = 0.551^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H3a;
- variable *Leader technical competencies* is statistically significantly correlated with:
 - *Leader technical education* ($r(162) = 0.305^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H5, although it must be noticed that the correlation is moderate here,
 - *Leader technical experience* ($r(172) = 0.770^{**}$, $p < 0.001$), which is the basis for positive verification of the hypothesis H6.

As it can be seen, correlations are positive and in almost all cases strong.

As a final step of research, in order to verify hypotheses H4(a,b) i H7(a,b) mediation analysis was performed using Process macro for IBM SPSS Statistics. According to Cohen & Cohen (1983) mediating effects are inferred when the independent variable is significantly related to the intervening variable (mediator) and the intervening variable (mediator) is significantly related to the dependent variable (what was already checked in correlation analysis), that is when separate tests for all paths are jointly significant. The analysis was carried out using the stepwise method, in each step always only one of the four different paths were considered to verify derived hypotheses.

First mediation model was built to verify the H4a for *Leader soft competencies* as an independent variable and *Team work effectiveness* as a dependent variable. *Leader efficiency* was tested as a mediator in the model. The results of analysis can be found in Table 4.

Table 4.

Leader efficiency as a mediator of relationship between *Leader soft competencies* and *Team work effectiveness*

predictors	s.e.	t	p	F	df1;df2	R2	p
Model 1							
<i>Leader soft competencies</i>	0.0589	13.9245	<0.001	193.891	1;176	0.5242	<0.001
Model 2							
<i>Leader soft competencies</i>	0.0627	4.7299	<0.001	68.4083	2;175	0.4388	<0.001
<i>Leader efficiency</i>	0.0554	3.9548	<0.001				

Source: own study.

The obtained research results showed that the built regression model with the mediator was valid and statistically significant ($F(2,175) = 68.4083$, $R^2 = 0.4388$, $p < 0.001$). Furthermore, *Leader efficiency* were a statistically significant mediator of the model ($p < 0.001$, $\text{coeff.} = 0.3898$, $\text{se} = 0.0485$). To confirm it, the Sobel test was calculated ($Z = 3.8$, $p < 0.001$), which confirmed that *Leader efficiency* significantly carries the influence of an independent variable to dependent variable. The obtained model showed that *Leader efficiency* is a mediator of relationship between *Leader soft competencies* and *Team work effectiveness*. Therefore, hypothesis H4a can be accepted.

Second mediation model was built to verify the H4b for *Leader technical competencies* as an independent variable and *Team work effectiveness* as a dependent variable. *Leader efficiency* was tested as a mediator in the model. The results of analysis can be found in Table 5.

Table 5.
Leader efficiency as a mediator of relationship between *Leader technical competencies* and *Team work effectiveness*

predictors	s.e.	t	p	F	df1;df2	R2	p
Model 1							
<i>Leader technical competencies</i>	0.0454	8.7632	<0.001	76.7942	1;176	0.3038	<0.001
Model 2							
<i>Leader technical competencies</i>	0.0351	0.6983	0.4859	51.1213	2;175	0.4388	<0.001
<i>Leader efficiency</i>	0.0485	8.0320	<0.001				

Source: own study.

The obtained research results showed that the built regression model with the mediator was valid and statistically significant ($F(2,175) = 68.4083$, $R^2 = 0.4388$, $p < 0.001$). Furthermore, *Leader efficiency* were a statistically significant mediator of the model ($p < 0.001$, $\text{coeff.} = 0.3898$, $\text{se} = 0.0485$) and relationship between *Leader technical competencies* and *Team work effectiveness* has become statistically insignificant ($p = 0.486$, $\text{coeff.} = 0.0245$, $\text{se} = 0.0351$). To confirm it, the Sobel test was calculated ($Z = 5.92$, $p < 0.001$), which confirmed that *Leader efficiency* significantly carries the influence of an independent variable to dependent variable. The obtained model showed that *Leader efficiency* is a mediator of relationship between *Leader technical competencies* and *Team work effectiveness*. Therefore, hypothesis H4b can be accepted.

Third mediation model was built to verify the H7a hypothesis for *Leader technical education* as an independent variable and *Team work effectiveness* as a dependent variable. *Leader technical competencies* and *Leader efficiency* were tested as the mediators in the model. The results of analysis are presented in table 6.

Table 6.

Leader technical competencies and Leader efficiency as a mediators of relationship between Leader technical education and Team work effectiveness

predictors	s.e.	t	p	F	df1;df2	R2	p
Model 1							
<i>Leader technical education</i>	0.1732	4.0703	<0.001	16.5677	1;161	0.0933	<0.001
Model 2							
<i>Leader technical education</i>	0.1154	-0.9869	0.3252	36.9619	2;160	0.3160	<0.001
<i>Leader technical competencies</i>	0.0500	8.4343	<0.001				
Model 3							
<i>Leader technical education</i>	0.0740	-0.7140	0.4785	32.3927	3;159	0.3793	<0.001
<i>Leader technical competencies</i>	0.0384	1.0740	0.2844				
<i>Leader efficiency</i>	0.0505	7.5386	<0.001				

Source: own study.

The obtained research results showed that the built regression model with the mediators was valid and statistically significant ($F(3,159) = 32.3927$, $R^2 = 0.379$, $p < 0.001$). Furthermore, *Leader efficiency* is a statistically significant mediator of the model ($p < 0.001$, coeff. = 0.3809, se = 0.0505). However, although *Leader technical competencies* is a statistically significant mediator of the model 2 ($p < 0.001$, coeff. = 0.4218, se = 0.0500), which was also confirmed by the Sobel test ($Z = 3.65$, $p < 0.001$) that confirmed that *Leader technical competencies* significantly carries the influence of an independent variable (*Leader technical education*) to dependent variable (*Leader efficiency*)), it is not statistically significant mediator of the model 3 ($p = 0.2844 > 0.05$, coeff. = 0.4213, se = 0.0384). The obtained results showed that the hypothesis that was not formulated in the paper (that the technical competences of the leader mediate the relationship between his technical education and efficiency) could also be adopted. Summarizing all above, we can observe the full mediation here and hypothesis H7a can be accepted.

Fourth mediation model was built to verify the H7b for *Leader technical experience* as an independent variable and *Team work effectiveness* as a dependent variable. *Leader technical competencies* and *Leader efficiency* were tested as the mediators in the model. Table 7 presents the results of the analysis.

Table 7.

Leader technical competencies and Leader efficiency as a mediators of relationship between Leader technical experience and teamwork effectiveness

predictors	s.e.	t	p	F	df1;df2	R2	p
Model 1							
<i>Leader technical experience</i>	0.0526	15.7211	<0.001	247.1542	1;170	0.5925	<0.001
Model 2							
<i>Leader technical experience</i>	0.0777	-2.2522	0.0256	41.1098	2;169	0.3273	<0.001
<i>Leader technical competencies</i>	0.0723	7.3406	<0.001				
Model 3							
<i>Leader technical experience</i>	0.0509	-2.3787	0.0185	35.6087	3;168	0.3887	<0.001
<i>Leader technical competencies</i>	0.0536	2.2322	0.0269				
<i>Leader efficiency</i>	0.0496	7.4466	<0.001				

Source: own study.

The obtained research results showed that the built regression model with the mediators was valid and statistically significant ($F(3,168) = 35.609$, $R^2 = 0.389$, $p < 0.001$). Furthermore, *Leader technical competencies* and *Leader efficiency* were a statistically significant mediators of the model ($p = 0.0269$, $\text{coeff.} = 0.1196$, $\text{se} = 0.0536$) and ($p < 0.001$, $\text{coeff.} = 0.3697$, $\text{se} = 0.0496$) respectively. Additionally, the Sobel test was calculated ($Z = 6.65$, $p < 0.001$) for the first part of mediation model, which confirmed that *Leader technical competencies* significantly carries the influence of an independent variable (*Leader technical experience*) to dependent variable (*Leader efficiency*). Therefore, hypothesis H7b can be accepted. Partial mediation can be observed here.

4. Discussion

Leaders of the projects (project managers, project owners, scrum masters, technical leaders) are responsible for meeting the project objectives according to assigned them roles in order to achieve successful project completion (DiVincenzo, 2006; Baca, 2007; Gillard 2009). They play the crucial role in this process (Fioravanti et al., 2020). In their day-to-day operations they work with various groups of project stakeholders trying to reconcile their requirements. One of the most important tasks in their work is to ensure the effectiveness of the project team. A literature overview showed that project leader should be equipped with both hard and soft skills (Sampson, 2007; Van Ingen, 2007; Gillard, 2009; Magano et al., 2020), however those 'hard' skills are understood rather as an ability of schedules or budgets creating, conducting risk analyses, scenario analysis making, fighting against scarcity of resources, and rapidly changing technology etc., than technical know-how. However specificity of IT projects imposes specific requirements on the project leaders forcing them often to manage technical challenges. From that point of view technical competencies in IT should be needed. Responding to this demand the paper was devoted to analyzing the role of technical, IT related education and technical experience (in programming) of the leader in shaping of the team work effectiveness in IT projects.

The results show that there is no direct correlation between the leader's technical IT related education or the leader's technical experience and the team's efficiency. However, it is still worth to have a leader with technical IT related education and technical, directional experience, because the leader's hard competencies are correlated to them, although leaders experience are twice as important as formal education of leaders. Thus, if there is a choice between a leader with technical IT related education and a leader with technical, directional experience, then latter is a better pick as regression analysis showed that experience has bigger impact on hard skills than education. It seems that technical experience may have more impact on hard competencies, compared to formal technical education, because experience gives the leader

more chances to encounter practical real-life problems compared to theoretical problems tackled during formal education.

It has been shown that there is indirect relationship between the dependent variable (team work effectiveness) and independent variables (technical education and technical experience in IT of a leader), and the mediators of this relationship are leader's technical competences and the leader's efficiency.

Comparing soft and hard skills of the leader's it turns out that the leader's efficiency is much stronger correlated with the leader's soft competencies than hard competencies. The same goes for the team's effectiveness that is much stronger correlated with the leader's soft- than hard competencies. This results clearly confirms universally accepted thesis on the importance of soft skills for management success (Konarski, 2008; Smółka, 2008; Mitchell et al., 2010; Kazak, 2017). However, it does not mean that the leader's hard (technical) competencies are useless. There is still a correlation between the leader's hard competencies and the leader's efficiency or the team's effectiveness, although weaker than in the case of soft skills. Considering the effectiveness of the project team as a success in the role of project manager, it must be underline that it cannot be attained with a technical skill set only. However, technical skills are being recognized as one of the minimal requirements for a project IT manager. They are built mainly by experience, and to a lesser extent also by formal education.

5. Conclusions

The purpose of the paper was to investigate the relationship between technical (directional in IT) education and experience of a leader, and team work effectiveness in IT projects, recognized as one of the predictors of the project's success. The results showed that although there is no direct correlation between the leader's technical IT related education or the leader's technical experience in IT and the team work effectiveness, it is still worth to have a leader with technical, directional experience and formal education in IT, because the basic relationships being under study is mediated by leader's technical competencies and leader's efficiency in the implementation of managerial roles. The obtained results also highlighted the role of the leader's soft skills in shaping the effectiveness of the project team's work.

The performed research contributes to the body of academic knowledge on of human resources and project management literature confirming that among various groups of factors determining team work effectiveness in IT projects both soft and hard (technical) competencies are important. The obtained results contribute to practice of management by demonstrating the meaning of the technical education and experience of a leader for team work effectiveness in IT projects. This can be of practical importance when recruiting team leaders. HR departments,

apart from paying attention to very important nowadays soft skills, should also verify the experience and technical skills of potential candidates.

However, the performed research has some limitations. The analysis is based on a limited number of cases in particular groups and only in one business context. It should be treated rather as a pilot study and verified in further research. In order to generalize the results in future research larger samples should be collected.

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RISK MANAGEMENT IN SOCIAL PROJECTS

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Purpose: The purpose of this article is to propose risk management recommendations for social projects taking into account their specificities by analysing and evaluating the ways in which social project risks are managed in the literature and applied in practice.

Design/methodology/approach: Both literature and empirical research have been used to provide an analysis of how risks of social projects are managed. The literature research, consisting of a literature review, will be contrasted with the results of the qualitative research carried out in the form of a single embedded case study. The result is a proposal in the field of project risk management for social projects.

Findings: An analysis of the way in which social project risks are managed has made it possible to identify the interdependencies that exist in this area and to identify areas of social project risk management that are particularly in need of improvement.

Research limitations/implications: The research is worth continuing by increasing the number of social project investigated in order to gain a broader perspective related to the risk management of social projects and to improve the proposed recommendations.

Practical implications: The research led to the development of a diagram of the steps needed to be taken in social project risk management and how to automate it through the creation of a prototype project risk management tool.

Social implications: The main aim of social projects is to achieve social change. This can take the form of creating new opportunities and spaces, resolving situations that hinder well-being and social development, as well as raising awareness and bringing about changes in the way society thinks. A prerequisite for the fulfilment of these objectives is the success of the project achieved through its correct implementation across all elements. One of these elements is effective and efficient risk management.

Originality/value: The article expands on the number of studies related to social project risk management and draws attention to the very limited amount of literature slanting on this topic. In addition, it presents its own solutions for social project risk management.

Keywords: social project, risk management, case study.

Category of the paper: Research paper, Conceptual paper.

1. Introduction

This article deals with the issue of risk management of social projects and aims to propose recommendations in this regard on the basis of an analysis and evaluation of the ways in which risk management of social projects is carried out, taking into account their specific characteristics. The topic of project risk management is particularly important in the aspect of project management, however, in the case of social projects it can be considered insufficiently explored, as indicated by the small number of literature items (literature review was made in the first half of 2022). The relevance of social projects in everyday life should be emphasised. Their main motivation is to develop and improve the well-being of society, instead of focusing on the profit of the project implementer. Social projects are designed to raise awareness, create new opportunities and create an environment conducive to the potential of a territory.

In order to achieve the purpose formulated in the article, literature research and empirical research, in the form of qualitative research, were used, in which the EcoDevelopment Foundation, operating mainly in Poland, especially in and around Wrocław, was selected as the object of the research. The literature research, among others: (Cairampoma-Caro et al., 2022; De Lima, Caldana, 2021; Moraes et al., 2021; Silviu, 2016) made it possible to identify good risk management practices and to identify areas in particular need of improvement in project risk management, taking into account the specific nature of social projects. Empirical (qualitative) research, on the other hand, focused on the identification and assessment of the risk management of social projects in the studied research object, the EcoDevelopment Foundation. The qualitative research strategy used is the case study, which covers the various projects implemented by the Foundation, and therefore case study type was defined as a single embedded case study. The research as a whole provided direction for the creation of improvements and allowed for the development of risk management recommendations for social projects taking into account their specificities. For the purposes of this article, a social project is understood as a unique endeavour aimed at achieving social change, with specific time and resource constraints, implemented under assumptions of financial rationality. A project risk, on the other hand, is an event occurring as a result of operating under uncertainty, which can generate both threats and opportunities to project objectives.

2. Research methodology

The research carried out includes both literature and empirical research. This section is mainly devoted to the methodology of the empirical research performed on the selected research object, i.e. the EcoDevelopment Foundation and its projects. The results of the empirical

research will be compared with the results of the literature research on risk management of social projects in order to propose our own recommendations in this field. A single embedded case study was chosen as the empirical research strategy.

2.1. Research strategy

There are various research methods used in the social sciences. The main determinant for the choice of a particular form of research is the structure of the questions posed by the researcher. Groups of questions can be determined by establishing the objectives that the questions define. The basic categories are the questions: "Who?", "What?", "How?" and "Why?". The choice of research method should be based on what we want to achieve. The "Who?" and "What?" questions support the conduct of exploratory research to develop hypotheses and assumptions for further verification. Research methods in this category can be used to determine the effects caused by a phenomenon or the magnitude of its occurrence. The "How?" and "Why?" questions, on the other hand, extend conclusions about the extent and frequency of phenomena by identifying relationships and tracing the phenomena over a given period. This means that the research is exploratory in nature, and the choice of a method to assist in obtaining answers to questions formulated in this way will allow the research results described in the article to be fully valid (Yin, 2015; Creswell, 2014).

The chosen research strategy belonging to the exploratory methods is the case study. It is based on data sets from the present concerning a person, a group of people or an individual. The case study is used to investigate a complex phenomenon in the environment in order to better understand it. It allows the use of a number of techniques to gather both quantitative and qualitative data, so that the researcher gains a deeper insight into the issue at hand (Roberta, Heale, 2017) The use of this research form is unlikely to allow the manipulation of relevant behaviour. The case study has the advantage of being able to use direct observation of phenomena, analysis of documents, artefacts and interviews with the participants under study. Because it draws data from a variety of sources, it allows one to look at many variables of interest to the researcher (Yin, 2015).

According to Robert K. Yin, the case study can be used in different types. The two basic groups are the single case studies and the multiple case studies. Single case studies focus on considering only one case. This is useful when the case is unusual, exploratory or, on the contrary, very common and recurring. A multiple case study should be constructed when it is intended to cover more than one case. These are definitely more extensive and resource-intensive studies, where each of the highlighted cases should be treated as a separate experiment. Both single and multiple case studies can be based on different numbers of units of analysis. A distinction is made between holistic approaches, which allow a global view of the problem at hand, and embedded approaches, which focus on additional sub-units and operational details.

The chosen research strategy is an single embedded case study.

2.2. Selection of case study

The choice of the embedded variant of the single case study (where the units of analysis are the projects of the subject) will result in the research results being related to the general way in which projects are managed in the studied object, i.e. the EcoDevelopment Foundation. A holistic view is necessary, so the research cannot focus solely on one selected project. In order to obtain as much information as possible about the projects implemented and to fully understand the way in which project risks are managed, care was taken to include a variety of data collection sources and stakeholders involved in the research. The research participants were selected based on their role within the foundation and during project implementation. They range from board members, project coordinators, those performing substantive tasks to those supporting project implementation. Due to the small size of the organisation chosen as the object of the research, the roles taken on by its employees intermingle. Consequently, a given project team member may have responsibilities for more than one project role.

2.3. Data collection methods

Data collection for the research is based on building a database from a variety of sources. The best approach is to use as many sources as possible. This increases the quality and broadens the scope of the case study. Obtaining a convergence of information from different sources will result in a more convincing conclusion to the completed study.

The analysis of the collected data was based simultaneously on the information contained in the documentation received from the Foundation and the conclusions resulting from the interviews conducted. The elements of the documentation are: the statute of the EcoDevelopment Foundation (the document constituting the basis for the activities of the Foundation) and the application form for one of the implemented projects (a description and plan for carrying out the project according to the template imposed by the financing institution). Regardless of the form, all the interviews conducted refer to the way projects are managed, with risk management specified. The face-to-face interviews have one respondent, while in the focus interview more than one respondent provided answers.

The result of the analysis of the empirical research will be a synthesis of information regarding the manner of project management at the EcoDevelopment Foundation with the specification of project risk management. This synthesis will be followed by a reference of the results obtained to the overall risk management of projects, taking into account the specificity of social projects on the basis of literature solutions. The final step will be to construct a proposal for risk management recommendations for social projects.

As already mentioned in chapter 2.2, a variety of stakeholders were asked to participate in the study. In an effort to identify how project risks were managed at the study, they were asked to participate in interviews. The interview structure has been divided into two parts in order to get a complete picture of how social projects are managed at the Foundation. The first part

refers to project management in general, while the second part focuses on risk management. The full structure of the interviews is presented in Table 1.

Table 1.

Structure of interviews conducted as part of the research

	Project management processes	Questions
Part I: Project management at the EcoDevelopment Foundation	Initiating projects and obtaining funding	How are projects initiated? Is it usually driven by systematic needs (e.g. strategy, business plan), situational needs (e.g. changes in regulations, technologies) or are they spontaneous initiatives (new ideas)? At what point are project funding decisions made?
	Assigning roles in projects	How are project team members selected? Is this influenced by factors such as, for example, the size of the project, the field of interest of the project? On what basis is the project coordinator selected?
	Project planning process	Are project planning tools being used? Who is responsible for project planning? Are there more people responsible for different parts of planning? (i.e. planning schedule, resources, scope of work, budget) What are the subsequent planning phases? Are scheduling tools used? Are time reserves for specific tasks taken into account? Is a critical path for the project drawn up? In what form is the schedule recorded? e.g. Gantt chart How and who is responsible for determining the resource requirements of the project? (human, tangible and intangible) What tools are used to estimate project costs? How is the project budget drawn up, who is responsible for it and who approves it?
	Monitoring and controlling the progress of the project	How is the course and level of tasks in the project controlled? Who is responsible for it?
	Summary and evaluation of completed projects	Are project evaluations carried out? What methods are used to evaluate projects?
Part II: Project Risk Management	Risk management	What is the approach to term "risk"? Is risk classified as a negative or also a positive event? Who is responsible for risk management? Are tools used to identify risks? If so, which ones? For example, is a risk register used, consisting of a list of risks with their description, probability of occurrence and magnitude of impact? Is a risk assessment carried out? Are any tools used, e.g. a risk matrix? If risks are assessed - are they then prioritised? How are important and less important risks handled? What strategies in risk management can be taken? Are the actions to be taken in the event of a risk or to avoid/minimise it developed?

Source: Own elaboration.

3. Results

Research carried out at the EcoDevelopment Foundation showed that the foundation does not have internal rules and instructions for project risk management. The actions taken, for the Foundation, are usually based on the experience of the project coordinator. Mostly, responses to risks are not planned, but developed on an ongoing basis when the risk arises. According to members of the EcoDevelopment Foundation, this has to do with operating in a dynamically changing environment, which is confirmed in the literature on community organisations. Particularly highlighted are the frequent changes occurring in the political and legal environment of social organisations. (Peter-Bombik, 2019) The members of the EcoDevelopment Foundation attribute to it the characteristic of flexibility and constant readiness to adapt to the environment. All social organisations are characterised in this way. They have the ability to react quickly to problems and to recognise social needs (Marciszewska, 2019).

Social projects are usually carried out by organisations that do not have enough money to carry them out, which is why projects are mainly funded by public institutions. Using the example of the research object, it can be seen that the way the project is managed is influenced by the requirements set by the grantor. Typically, a grant application must be developed as part of the project planning, which must follow the structure of the application form developed by the funding institution concerned. The sample form (Fundacja EkoRozwoju, 2015) and the interviews carried out show that, in most cases, a foundation has to carry out a more or less detailed risk analysis. It includes the identification of risks and the development of activities to deal with them. It does not include risk assessment and classification, which is recommended in the literature on risk management of social projects. This is an important aspect of risk management, as the prioritisation of risks will aid decision-making on how to proceed in a risk situation (Domański, 2014).

Respondents in the interviews cover a variety of roles in the projects, but their answers did not turn out to be very divergent. The differences that emerged are due, among other things, to their experience. The analysis of the answers made it possible to identify the main problems: the lack of systematisation of activities increasing the probability of project failure in the case of less experienced coordinators and differences in approach to project evaluation and assessment. Project evaluation and assessment is not a formally required stage of project management for organisations and is often a neglected aspect dependent on the will of the project coordinator.

Based on indications from the literature, it is possible to distinguish the stages that make up the decision-making process of social project risk management. These are: establishing the context for risk management, identifying risks, assessing risks, decision-making, acting on decisions made, and controlling and improving (Head, 2002) The information was related to

project risk management at the EcoDevelopment Foundation. Table 2. presents to which the research object meets the recommendations on risk management of social projects.

Table 2.

Degree of fulfilment in which the EcoDevelopment Foundation has met the literature recommendations on risk management of social projects

Risk management phase of social projects	Fulfilment of the risk management phase by the EcoDevelopment Foundation		Degree of fulfilment	
Establishing the context for risk management	The Foundation has a defined approach to the management of risk in projects. It accepts its presence to such an extent that it considers it an integral part of all projects undertaken. Often, the sense of social mission outweighs the fear of the appearance of risks. The foundation's premise is to remain flexible and able to adapt quickly. When risks arise, it takes action to both minimise losses and maximise possible benefits.		3	
Identifying risks	The structured identification of risks only occurs when preparing a grant application to an institution with related requirements. Within the foundation, the identification of risks takes an unstructured form and depends entirely on the experience of the project coordinator and its members.		2 - structured identification of risks occurs according to the requirements of the financing institution	
Assessing risks	Analysis of risks in terms of probability of occurrence and degree of impact	Prioritisation of risks	Analysis of risks ...	Prioritisation of risks ...
	Internally, the Foundation does not analyse risks in terms of their probability of occurrence and the degree of their impact on the project. The risk analysis is created in a descriptive form depending on the requirements of the financing institution. However, numerical values for the levels of the mentioned categories, i.e. probability of occurrence and degree of impact, are rather not developed.	Risks are not prioritised. Where risks are identified, no attempt is made to assess their impact on the project. A fairly detailed description of the risks is given when required by the funding institution.	2 - depending on the requirements of the financing institution, a risk analysis is carried out (usually in descriptive form)	1 - risks are not assessed and classified
Decision-making	Decisions are always being made about how to respond to risks. However, these usually only occur when a risk arises. Preventive actions are planned in advance when required by the project's financing institution. Nevertheless, there are risks that are recurrent and the response to them is generally accepted. However, all decisions taken are analysed on a project-by-project basis.		2 - a decision is not taken in advance unless required by the financing institution. Inside the foundation, decisions are taken at the stage of project implementation and risk occurrence	

Cont. table 2.

Acting on decisions made	The EcoDevelopment Foundation takes action according to the decisions made. Roles in projects often intersect, but everyone has specific responsibilities. The project coordinator has the main influence on project risk management. His or her task is to ensure that any corrective actions taken are carried out correctly and lead to the planned results.	3
Controlling and improving	The EcoDevelopment Foundation is constantly observing the changing environment. It is in constant readiness to take action in situations of threat or opportunity. It does not plan risk-related activities in advance, but constantly monitors and adapts to changes in the environment during project implementation.	3

Note. Degree of fulfilment: 1 - completely not met, 2 - partially met, 3 - completely met.

Source: Own elaboration.

On the basis of Table 2. it is possible to detail areas that require some improvements related to project risk management at the EcoDevelopment Foundation as an exemplary organisation implementing social projects.

Particular attention should be paid to the recommendations on identification and risk assessment. In the case of identification, the recommendation has been partially met. This is due to the fact that projects funded by public institutions are required to identify risks, but there are no procedures or guidelines for this within the Foundation. Risk assessment, on the other hand, consists of two elements, i.e. risk analysis in terms of probability of occurrence and the degree of impact and prioritisation of risks. The risk analysis is partly fulfilled as it is usually required by the funding institution. It takes a descriptive form and is unlikely to include the quantification of probability values and the degree of impact of risks on the project. In contrast, risk classification is completely unfulfilled during project implementation. Both the interviews and the analysis of the documentation did not reveal any attempt to prioritise risks.

Another aspect, only partly fulfilled by the EcoDevelopment Foundation, is the decision-making regarding the actions to be taken in a risk situation. It is intended that decisions should be made before the risk occurs. However, the specific nature of the EcoDevelopment Foundation and the way in which it implements projects means that the necessary actions to be taken are not determined in advance. This occurs only when required by the financing institution at the stage of creating the application form.

The other literature recommendations are fully met by the research object.

The degree of both completely fulfilled, partially fulfilled and completely unfulfilled recommendations is due to the specific nature of social organisations. They have a shaped approach to risk, which is a consequence of their missionary nature. The main reason for action is to meet social needs regardless of possible risks. The lack of structured identification and categorisation of risks is a result of the desire for limited formalisation in organisations of this type. On the other hand, the greatest asset of social organisations, including the

EcoDevelopment Foundation, is their ability to adapt. They constantly observe the changing environment and try their best to adapt to it. (Marciszewska, 2019) Nevertheless, the introduction of certain improvements could increase the efficiency of the activities carried out and the course of project taken.

4. Discussion and practical implications

This section will present recommendations for risk management of social projects in general. The development of improvements was led by conducting literature research in the field of social projects and risk management, taking into account their specific characteristics, as well as research relating to the specific case of project risk management on the example of the research object, i.e. the EcoDevelopment Foundation.

When constructing recommendations relating to the risk management of social projects, it is important to take into account their specific characteristics. Organisations implementing social projects usually avoid internal formalisation. Their activities are focused on fulfilling the mission and achieving the intended social change. Communication between team members is based on mutual respect and trust. In addition, project roles often intersect as a result of a rather flat organisational structure.

Implementing social projects involves constantly observing and adapting to the environment. Organisations undertaking such projects tend to be flexible and able to cope with sudden and unforeseen events.

The recommendations developed will address, in particular, the risk project management phases included in Table 2. and considered as partially met or completely not met. These are: the timing of decisions related to the risk response and its identification and assessment, consisting of analysis and classification.

4.1. Recommendations – risk identification and assessment

Risk identification and assessment is particularly important in risk management. It provides the basis for decision-making in the next steps. In addition, it provides a broader view of the materiality of events that may occur during project implementation.

In the case of external funding of a project, a reference to risk is usually required at the stage of structuring the application to the funding institution. Depending on the structure of the application form, it may require the use of other tools. Therefore, the recommendations created must be as simple as possible and be as compatible as possible with the structures of the application forms. This is in order not to introduce over-complicated and formalised guidelines that hinder the work of implementing a social project.

Identification and assessment of risks are consecutive phases of risk management in projects. It is important that risk assessment consists of two parts, i.e. risk analysis and risk prioritisation. The tools chosen to support risk management are the risk register and the risk matrix. The risk register facilitates the identification of risks and enables the first phase of risk assessment to be carried out, which is the analysis of risks in terms of their probability of occurrence and the degree of impact of the risk on the project. It can then be used as a basis for further risk assessment using the risk matrix. It allows risks to be ranked in terms of importance, taking into account their analysis.

The risk register can take the form of a table, the basic elements of which are: the name of the risk, a brief description, the probability of the risk occurring and the value of the degree of impact on the project objectives (Wysocki, 2014). It has been proposed to extend the structure of the risk register with an additional element related to the source of the risk. This is intended to systematise and facilitate the identification of risks when constructing the risk register. Sources of risk refer to the areas in which risk can be sought and are based on the categories of risk occurrence distinguished by Robert K. Wysocki. These include: technical risks, project management risks, internal (organisational) risks and external risks. The proposed sources of risk do not have a rigid framework. Depending on the needs of the organisation, it can modify their division.

In addition, a list of the most common risks for social projects is proposed, taking into account the categories listed. The risks listed are the result of literature and empirical research. It should be emphasised that the creation of a list of risks should take into account both threats to the project and opportunities. The proposed list of risks will in the following be referred to as the baseline list (related to threats). It should start with the identification of risks and be modified depending on the scope of activities performed in the project. The baseline list includes:

- technical risks (introduction of the new technological tools required, the problem with the technical infrastructure needed for online meetings, increasing outreach by holding meetings in a hybrid format),
- project management risks (loss of a critical team member, carrying out too many activities not foreseen in the schedule),
- internal (organisational) risks (problem in building a team with the required competences, incorrectly estimated costs per task in the project),
- external risks (political and legal changes, sudden reductions in revenues, disengagement or conflict with project collaborators, publicity of the issue through those around the organisation).

Already at the stage of constructing the risk register, its alignment with the risk matrix should be taken into account. Therefore, the following levels of risk probability and the degree of impact of the risks on the objectives have been proposed.

Levels of probability of risk occurrence:

- low (risk is unlikely to occur),
- medium (risk may occur from time to time - occasionally),
- high (occurrence of risk is certain, may occur many times).

Levels of the degree of impact of the risks on the objectives are as follows:

- low (there is little impact of the risk on the objectives),
- medium (risk can affect the realised objectives to a noticeable extent),
- high (the impact of the risk on the objectives is very high).

The created risk register is the basis for the next step, which is to classify risks in terms of importance using the risk matrix tool. The design of the matrix should form a 3x3 matrix. The heading for the columns of the matrix is the probability of the risk occurring, while the rows are the degree of impact of the risk on the objectives. The levels defined for the probability value and the degree of impact must be consistent with the levels proposed at the risk register construction stage. An example of the structure of the risk matrix is presented in Table 33.

Table 33.

Example of risk matrix structure

		PROBABILITY		
		High	Medium	Low
DEGREE OF IMPACT	High	Critical	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Acceptable

Source: Own elaboration based on (Trocki, 2012; Wysocki, 2014).

Based on the matching of risks to the relevant configurations, risk importance levels are created. The highlighted risk levels are relevant to the project threats. The levels created are:

- acceptable - risk whose occurrence can be accepted and no corrective action taken,
- low - the risk does not require additional procedures, routine actions are sufficient,
- medium - risk requires the development of specific actions to respond to its occurrence,
- high - risk requires constant monitoring and preparation of a response to its occurrence,
- critical - risk not acceptable at all, requires immediate action, possible need to involve higher levels of management.

The risk matrix created can support further decision-making. Assigning risks to categories suggests which risks should be addressed with the highest priority. For risks classified in this way, actions (responses) can be created that should be taken before or when the risk occurs. Some risks, such as acceptable risks, can be ignored at the project planning stage.

The responses developed are designed to reduce the negative impact of the risks on the project (in the case of threats) (or to maximise the benefits in the case of opportunities, when considered in risk management).

Constructing the risk matrix in a handwritten manner can create many errors due to the time-consuming nature and the need for high concentration. For this reason, an improvement is proposed in the form of a simple automation of the risk categorisation.

Organisations implementing social projects do not usually use very sophisticated technology, so the proposed solution is based on a Microsoft Excel spreadsheet. The application is often used for simple calculations and budgeting, so it can also be useful for categorising project risks.

Excel offers the possibility of simple programming using the Visual Basic for Applications (VBA) language. This allows for the automation of the determination of risk categories after entry into the risk register. An excerpt from the main interface of the sample application is shown in the Figure 1.

SOURCE	NAME	DESCRIPTION	PROBABILITY	IMPACT	RISK CATEGORY
Technical Risk					
Project Management Risk					
Internal Risk					
External Risk					

Figure 1. Excerpt from the interface of an application that automates risk classification.

Source: Own elaboration.

The application interface is divided into two parts. The lower part, representing a table, contains all the information entered into the risk register and a risk category column. The risk category refers to the risk levels that are determined by comparing the probability of a risk occurring and its degree of impact on the objectives pursued. For example, the level for the probability of a risk occurring and the degree of impact of the risk on the objectives can be described using a scale from 1 to 3.

For the level of risk probability, the scale given means: low (1), medium (2), high (3). For the level of impact of the risk on the objectives pursued, the scale given means: low (1), medium (2), high (3).

This first part of the interface is designed to allow the user to enter data on project risks. At the same time, it supports the identification and assessment of risks by providing a tool for constructing a risk register. On the other hand, the upper part of the application interface consists of function buttons. The names of the buttons indicate their functionalities:

- Choose risks (displays forms where the user can select the risks of interest from the base list divided into categories).
- Display risk categories (shows the importance categories assigned to the risks in the Risk category column, i.e. Acceptable, Low, Medium, High, Critical).
- Clear risk categories (deletes data from the Risk category column).
- Clear all (deletes data entered in the table excluding risk sources).

The proposed simple way to automate risk classification allows for a more streamlined workflow and reduces the possibility of error. In addition, the use of the tool does not require advanced Microsoft Excel skills. Creating an electronic risk register makes it easy to edit and store for long periods. Each register created in this way can serve as a basis for constructing another one for a similar project. The tool allows risks to be quickly prioritised and presented clearly and transparently. There is no need for additional analysis comparing the probability of a risk arising with the degree of its impact on the objectives pursued. The result obtained using the tool can lead directly to risk response planning.

4.2. Recommendations – decision making related to risk response

The decision-making stage determining the risk response is closely linked to the prior identification and categorisation of risks. The development of the risk response should be done taking into account the prioritisation of risks determined by their category. The simplest way is to draw up tables consisting of two elements, i.e. the name of the risk and a description of the risk response. To automate these activities, it was proposed to extend the functionality of the tool presented in chapter 4.1 by adding more sheets by risk category. It was decided to group the risk categories as follows:

- Critical and High.
- Medium.
- Low and Acceptable.

An example of a tool interface for creating responses to risks in the Critical and High categories is shown in the Figure 2.

RISK	RESPONSE

Risk Classification: Critical and High | Medium | Low and Acceptable

Figure 2. Example of response development interface for Critical and High risks categories.

Source: Own elaboration.

The tool has a panel with the following function buttons:

- Display Critical and High risks (retrieves risks of the appropriate category from the previously constructed risk register, then places the names of the risks in the Risk column).
- Clear all (removes data from the worksheet).

The worksheets for creating responses for risks in the Medium, Low and Acceptable categories are analogous.

The proposed tool is very simple to use and does not require advanced skills in using a Microsoft Excel spreadsheet. On the other hand, it can streamline work and increase transparency related to the assignment of risks to specific categories of importance. The consequence of using the tool when developing a risk response is to reduce the likelihood of error, especially when a large number of risks are identified.

This tool should be available to every member of the project team for the duration of the project. Not only one person should work on its development for the project. The effectiveness and correctness of the risk identification is higher when it is created as a result of a conversation between team members performing different functions and having different roles in the project. However, the project coordinator should have control over the changes made to the tool. Moreover, he/she is responsible for identifying and deciding on the risk response and controlling changes in the environment.

5. Conclusions

When creating the recommendations for risk management of social projects, special attention was paid to the simplicity of their application. The solutions were intended to streamline the work without introducing excessive formalisation. A prototype of a tool was created that supports the processes of identifying risks, analysing risks in terms of their probability of occurrence and degree of impact on the project, classifying risks in terms of importance and making decisions on how to respond to risks.

Given the need to systematise risk management, it is possible to propose the next steps to be taken for effective risk management of social projects. Figure 3. shows the developed diagram.

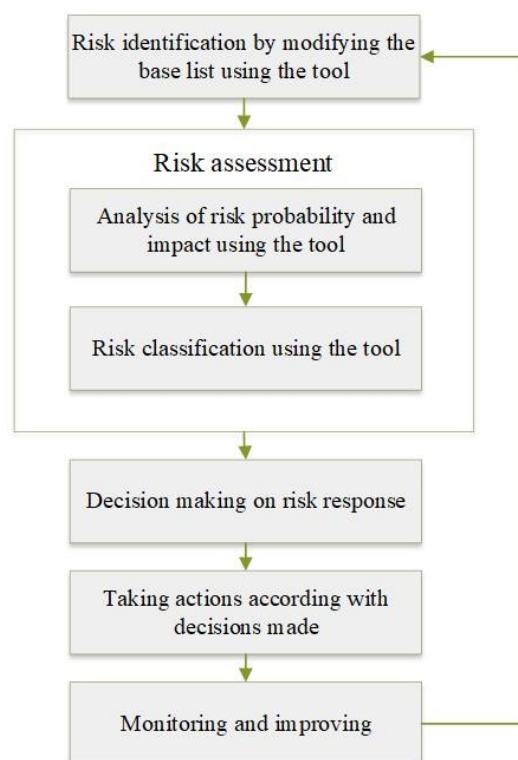


Figure 3. A diagram of the proposed risk management of social projects.

Source: Own elaboration.

The diagram is a graphical representation of the proposed social project risk management recommendations described in Chapter 4.

The identification of risks with the tool is based on the selection and modification of risks included in the baseline list. Using the baseline list reduces the chances of overlooking a significant risk, especially for less experienced project coordinators. In addition, the list can be modified according to the needs of a particular project.

Note that the risk assessment is based on the principles of constructing a risk register, but it has been automated through the proposed tool. Performing the analysis and classification of risks is straightforward, requiring no special skills in using Excel or performing risk assessments.

An important aspect in risk response decision-making is to make it as early as the project planning stage. This does not mean that one can neglect to observe changes in the environment throughout the course of the project. Adaptation and adjustment are inherent in social projects and should occur at every stage of the project.

6. Research limitations and further works

The creation of risk management recommendations for social projects was guided by the ease of their implementation and application in organisations implementing social projects. A basic requirement was to avoid excessive formalisation and highly complex methods. The created prototype of the automation tool is only a proposal for a solution that can be modified and extended as needed. The usefulness of the overall recommendations for social project management was assessed from the point of view of the research object. The feedback highlights the positive impact of the solutions on streamlining work, by reducing effort and systematising project risk management. However, the research is worth enriching by gaining a broader perspective among a larger number of organisations implementing social projects. This could influence the observation of additional unaddressed aspects and the improvement of the proposed solutions for social project risk management.

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MODELLING OF PROFESSIONAL COMPETENCES IN HEALTH CARE UNITS – PRELIMINARY ASSUMPTIONS

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Purpose: The aim of the article is to present the theoretical assumptions of the model of professional competencies in health care units. It was assumed that competences are a multidimensional concept and require an integrated approach that allows for the construction of a competency model that reflects their real complexity. A list of professional competencies will be presented, which will be subject to empirical verification in the course of future research by the authors in order to identify key competencies.

Design/methodology/approach: The proposed lists of professional competencies (six domains) was created and are based on the analysis of healthcare competencies models - the study of the literature - and the Authors' observations of the analyzed entities.

Findings: Presented model of professional competencies in health care units contains six domains with sub-competencies. The importance of assessing competences is undeniable. Competence recognition offers a way to develop workforce planning and career opportunities of practicing medical staff. Having an instrument that identifies existing competences and those that need to be acquired becomes significant for distinguishing the singularity of actions for a professional practice which is safe, humane and with no risk to the client, the medical staff or the health care organization.

Originality/value: An identification the professional competencies of health care units managers significantly shaping competences of such organizations especially relevant in pandemic time.

Keywords: professional competencies, modeling, health care units.

Category of the paper: Conceptual paper.

Introduction

The concept of competence became broadly known when American social psychologist David McClelland started using it at the turn of the 1960s and 1970s. He stated that knowledge contents were good predictors of academic performance, but not necessarily of job performance. According to McClelland the best predictors of outstanding on-the-job

performance were underlying, enduring personal characteristics that he called competencies. Furthermore competencies are constituted by knowledge and skills, as well as personal characteristics or self-concepts, traits and motives. His studies were oriented towards the effectiveness in reaching goals by people, employees in particular, as a result of their proper motivation (McClelland, 1973). Since then many definitions of competences have been formulated.

Currently, the role of competencies become more significant in the context of services market (Walsh, Beatty, 2007), mostly human-based services, such as health care services. Therefore there is a continuing interest in competences at organizational and at individual level. Yet the concept of competence is still difficult to be defined by researchers, theorists and managers (Sanchez, 2002). Additionally it's hindered by the interchangeable use of the terms 'competences, competencies and competency' (Cooper et al., 1998). Table 1 presents different definitions for the term competence, according to various authors.

Table 1.

The concept of competence - background review

Author(s)	Year	Definition of competence
Boyatzis	1982	an underlying characteristic of a person' stating it could be motive, trait and skill
Prahalad and Hamel	1990	the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies
Nordhaug and Gronhaug	1994	work-related knowledge, skills and abilities
Sanchez et al.	1996	the ability to sustain the coordinated deployment of assets in ways that help a firm achieve its goals
Dooley	2004	Competency-based behavioural anchors defined as performance capabilities needed to demonstrate knowledge, skill and ability (competency) acquisition
Sturman	2005	It refers to a judgment about whether a person is able to provide informed consent
Van Der Vleuten and Schuwirth	2005	the ability to deal with a complex professional task, integrating relevant cognitive, psychomotor and affective skills
European Parliament and the Council of the European Union	2008	the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development
UK nursing practice, the Nursing & Midwifery Council	2008	the skills and ability to practice safely and effectively without the need for direct supervision
Sharpless and Barber	2009	the status or quality of being adequate or well qualified, demonstrates ability or may have a legal definition (that is, being legally qualified to take some action)

Competency may be defined in terms of underlying characteristics of people that are causally related to effective or superior performance in a job, generalizing across situations and enduring for a reasonably long period of time (Boyatzis, 1982). Therefore Boyatzis concentrated on individual domain. Some authors however consistently use 'competency' when referring to occupational competence (Sanchez et al., 1996). Definitions have become increasingly work based, vocational and applied in nature as the concept of competence has been adopted by managers and government policy makers. The idea of competence has even been removed from the individual domain and applied to 'the organization' in the form of 'core competence'. The term was coined as an important organizational resource that could be exploited to gain competitive advantage (Campbell, Sommers Luchs, 1997; Nadler, Tushman,

1999). In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy' (European Parliament Council, 2008). Given the difficulties in agreeing a definition of competence, it is perhaps surprising that the concept has been so widely adopted.

Several reviews have revealed that competence is closely related to performance, and that these concepts are associated with much confusion (Meretoja and Isoaho, Leino-Kilpi, 2004).

This terminological confusion often reflects conflation of distinct concepts and inconsistent use of terms as much as different cultural traditions. However, some differences are attributable to different epistemological assumptions (Pate, Martin, Robertson, 2003) and the rationale for the use of competence often determines the definition. As claimed by Dooley et al competency can be considered as a subset of itself (Winterton, Delamare-Le Deist, Stringfellow, 2006). Then according to Sharpless and Barber many questions about competence remain unanswered, and these include several which are fundamental (e.g., what competence means, how best to measure it, and how it develops). This current lack of firm answers is likely due to the number of central theoretical issues that underlie the construct of competence (Sharpless, Barber, 2009). It is indeed surprising that the concept of competences has been adopted so widely given the difficulties in defining it. As the term "competence", often classified as a "fuzzy" concept, it is characterized by numerous approaches and schools dealing with this phenomenon. As a result, there is no single universally recognized definition of competence. However, among the components of competences mentioned in various terms, three are dominant: knowledge, skills and attitudes. Yet, they create 'flat' images and do not fully reflect what competence actually is. In response to contemporary challenges related to the use of competencies in everyday management practice, it becomes necessary to search for a multidimensional competence model.

Competency identification systems need to identify both – personal (professional and managerial) competencies and organizational competences (Boam, Sparrow, 1992). This article is focused on identification of the professional competencies of medical personnel and health care units managers. Healthcare systems are complex therefore, competent medical staff are essential to provide care of quality. The awareness and competences of the personnel engaged within health care organizations, including patient orientation and demands, high standards of medical services performed are becoming more and more essential.

The article assumes that professional competencies are a combination of skills, knowledge, attitude, and behavior that a person requires to be effective in a wide range of jobs, and various types of organizations, in addition, may be a source of sustained organizational performance (Abd-Elmoghith, Abd-Elhady, 2021). Basing on the analysis of competencies models – the study of the literature – and the authors of this papers observations of the analyzed entities the list of professional competencies was created, as this article focuses on the identification of those competencies of medical personnel.

The aim of the article is to present the theoretical assumptions of the model of professional competencies in health care units. It was assumed that competences are a multidimensional concept and require an integrated approach that allows for the construction of a competency model that reflects their real complexity. A list of professional competencies will be presented, which will be subject to empirical verification in the course of future research by the authors in order to identify key competencies.

Professional competences in healthcare entities - models review

The literature on competences assessment can be analyzed from different perspectives. The assessment of competences in the engineering universe is something relatively new compared to other disciplinary areas such as medicine and education (Souza, Lima, 2020).

Much change has been expected of healthcare organizations in recent years. As a result of literature studies the increase of investigations on the professional competencies considering its development, construction of profiles guided by areas of medical staff specialties, evaluations based on the expertise of specialists and the validation of the content of instruments used in health care can be observed.

Team for Research on Hospital Management "Avicenna" of the Jagiellonian University as a result of research identified 13 competencies of medical staff, which were divided into three groups of interpersonal and social competencies, i.e. threshold, desirable and expected competences: communication, resistance to stress, empathy, assertiveness, optimism, availability, responsibility, regularity, accuracy, openness, creativity, perseverance, willingness and motivation to constantly improve knowledge and skills (Kęsy, 2013). Threshold competencies include communication skills. In addition to the ability to build messages so as not to aggravate the asymmetry of information between the staff and the patient, empathy is essential for medical workers. This group also includes regularity (which is not only a basis for improvement at work, but also in the field of medical knowledge, permanent learning) and openness (allowing to shorten the distance between the patient and the staff). Competencies, usefulness and facilitating the performance of duties for medical employees include responsibility and assertiveness focused on the ability to argue, justify the diagnosis, organize the treatment process, etc. Another desirable competence is resistance to stress, optimism and accuracy. The remaining competencies are included in the expected group, which are not necessary at the positions of medical employees, but significantly improve the quality of work.

Professional competencies of medical staff have been defined by R.M. Epstein and E.M. Hundert (Epstein, Hundert, 2002) as the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served. Professional competencies build on a foundation of basic clinical skills, scientific knowledge, and moral development. They include a cognitive function (acquiring and using knowledge), an integrative function (availing biomedical and psychosocial data in clinical reasoning), and moral function (the willingness, patience, emotional awareness). Such competencies are developmental, impermanent, and context-dependent and depend on habits of mind. Such approach to competencies is similar with the detailed typology of competencies often cited in the literature proposed by G. Cheetham and G. Chivers (Cheetham, Chivers, 1996, 1998): cognitive competencies, functional competencies, personal (behavioral) competencies, ethical competencies, and meta-competencies (connected with the ability to deal with uncertainty).

In the model of professional competencies of medical staff in Polish Emergency Medical Units was adopted the proposition of Paramedic Association of Canada (Paramedic Association of Canada, 2011) with assumptions of concepts described above.

The Paramedic Association of Canada (PAC) established the National Occupational Competency Profile (NOCP) to create national standards for education programs, and to provide a tool to assist paramedic regulators establish common workplace standards and enhance labor mobility.

In proposed model there were established eight domains of professional competencies of medical staff employed in Polish Emergency Medical Units: Professional Responsibilities;

Communication; Health and Safety; Assessment and Diagnostics; Therapeutics; Integration; Transportation; Health Promotion and Public Safety.

In the first domain – Professional Responsibilities Competencies – were listed: functioning as a professional; participating in continuing education and professional development; possessing an understanding of the medicolegal aspects of the profession; recognizing and complying with relevant Polish legislation; functioning effectively in a team environment; making decisions effectively; managing scenes with actual or potential forensic implications.

The second domain – Communication Competencies – referred to: practicing effective oral and written communication skills; practicing effective non-verbal communication skills; practicing effective interpersonal relations.

In third domain – Health and Safety Competencies – were distinguished such competencies as: maintaining good physical and mental health; practicing safe lifting and moving techniques; creating and maintaining a safe work environment.

In the fourth domain – Assessment and Diagnostics Competencies – were specified: conducting triage in a multiple-patient incident, obtaining patient history, conducting complete physical assessment demonstrating appropriate use of inspection, palpation and percussion, assessing vital signs, utilizing diagnostic tests.

The fifth domain – Therapeutics Competencies – referred to: maintaining patency of upper airway and trachea, preparing oxygen delivery devices, delivering oxygen and administering manual ventilation, utilizing ventilation equipment, implementing measures to maintain hemodynamic stability, providing basic care for soft tissue injuries, immobilizing actual and suspected fractures, administering medications.

The sixth domain – Integration Competencies – raised: utilizing differential diagnosis skills, decision-making skills and psychomotor skills in providing care to patients, providing care to meet the needs of unique patient groups, conducting ongoing assessments and provide care.

The seventh domain – Transportation Competencies – referred to: preparing ambulance for service, driving ambulance or emergency response vehicle, transferring patient to air ambulance and transporting patient in air ambulance.

The last domain – Health Promotion and Public Safety Competencies – distinguished: integrating professional practice into community care; contributing to public safety through collaboration with other emergency response agencies; participating in the management of a chemical, biological, radiological, nuclear and explosive incident.

Seven domains have been identified that represent the broad categories of professional activity and concerns that occur in the general practice of dentistry (Plasschaert, Holbrook, Delap, Martinez, Walmsley, 2005). They are interdisciplinary in orientation: Professionalism, Communication and interpersonal skills, Knowledge base, information handling and critical thinking, Clinical information gathering, Diagnosis and treatment planning, Establishment and maintenance of oral health and Health promotion.

Next model of professional competencies includes interdisciplinary domains, such as (Cowpe, Plasschaert, Harzer, Vinkka-Puhakka, Walmsley, 2010): Professionalism, Interpersonal, Communication and Social Skills, Knowledge Base, Information and Information literacy, Clinical Information Gathering, Diagnosis and Treatment Planning, Therapy: Establishing and Maintaining Oral Health, Prevention and Health Promotion.

Forensic nursing is a global and relatively young profession that combines nursing care and juridical processes. Forensic nurse as a professional who liaises between the medical profession and criminal justice system, including forensic evidence collection, criminal procedures and legal testimony. There were established eight domains of their professional competencies (Koskinen, Likitalo, Aho, Vuorio, Meretoja, 2014): work role, diagnostic functions, managing situations, helping role, therapeutic intervention, teaching-coaching, ensuring quality.

Being able to intervene in the health-disease process taking responsibility for the quality of nursing care / care in its different levels of health care, with prevention, promotion, protection and rehabilitation actions to the health, in the perspective of integral care in both individual and collective levels was pointed by researchers from Brazil in validation of the competence profile proposal for the training of nurses (de Souza Cioffi, Ribeiro, Ormande Jr., 2019).

Another example of competencies model was created in Scotland. The study was aimed to produce develop and draft the competences and the clinical skills of neonatal nurses at different levels. As a result seven key factors were identified: 1. communication reports, 2. professional development; 3. health and safety; 4. development of services; 5. quality; 6. equality, diversity and rights; 7. responsibility for the patient care (Greig, Grigio, Kerr, 2006).

Very interesting research regarding evaluation of the perception of clinical competencies by nursing students in the different clinical settings was conducted. The model included factors such as: Helping Role, Teaching – Coaching, Diagnostic Functions, Managing Situations, Therapeutic Interventions and Ensuring Quality (Notanircola, Stievano, Pulimeno, Icorossi, Potrizzo, Gambalunga, Rocco, Petrucci, Lancia, 2018).

In Italy the professional competencies model of neonatal/pediatric nurse, identified 42 competencies including activities but also ability, predisposition and personal skills. It should underlined that there are different perceptions among the different professionals, but the nurses who work in close contact with newborns and their families feel that they have to answer for their actions primarily to infants and parents. This indicates a great responsibility towards the patients and family (Alfieri, Alebbi, Bedini, Boni, Foà, 2017).

In Finland other research was conducted that resulted with competencies profile of gerontological nursing students (Tohmola, Elo, Mikkonen, Kyngäs, Lotvonen, Saarnio, 2022). The matter was explored also in other countries (Bahrami, Purfarzad, Keshvari, Rafiei, 2019) and conclusions were analogous. Because it is important to ensure that nurses (especially those from the younger generations) are attached to gerontological nursing and interested in working in this field, efforts should be made to strengthen the motivation and raise the field's profile (Tohmola, Saarnio, Mikkonen, Kyngas, Elo, 2022).

The highly qualified nurses in Intensive Care Units are responsible for the management of the entire nursing process in a critical area, such as analyzing the care and the assistance needs in critical area, and planning and coordinating the development and the implementation of the care training pathway. Furthermore, the nurse has to guarantee and promote the care continuity and the integration between different areas, in a continuous interaction with the other healthcare experts (Alfieri, Mori, Barbui, Sarli, 2017).

Another specific area of professional competencies is mass casualty incidents and disaster. It also suggests a knowledge gap between different professional groups, which calls for adjusting such general training, to at least, the weakest group, while special tasks and mission can be given to other groups within the training occasion. (Goniewicz, Goniewicz, Włoszczak-Szubzda et al., 2021).

Another very interesting issue was referred by Spanish researchers. According to them (Gutiérrez-Rodríguez, García Mayor, Cuesta Lozano, Burgos-Fuentes, Rodríguez-Gómez, Sastre-Fullana, de Pedro-Gómez, Higuero-Macías, Pérez-Ardanaz, Morales-Asencio, 2019) the definition of specialization areas and advanced practice and what this may mean to the general medical nursing profession should be structured around three keystones: the level of complexity of the care to be provided (marked by level of dependence, complexity and vulnerability), the needs for care coordination (agents who simultaneously provide the services, transitions between levels, frequency of interactions, environments where care is provided) and lastly scope of practice (determined by the depth and breadth of knowledge required, the complexity of the service to be provided and the degree of autonomy in decision making).

Health authorities, which must give an immediate response to the needs of citizens in terms of improving the quality of services, ensure recognition of professionalism through the identification, description and promotion of technical knowledge and skills present in an organization. Competencies management forces the facility to consider the knowledge as the true patrimony of the organization itself: this heritage must therefore be known, promoted, spread, developed and protected. That refers to various organizational levels.

An original model of professional competences in healthcare entities

The proposed model of professional competences in health care units was created as a result of studies of the literature of the subject conducted by the Authors and many years of direct observations of Agnieszka Krawczyk-Sołtys (as a consultant) in these entities (Krawczyk-Sołtys, 2018a, 2018b, 2019, 2021, 2022, Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2022).

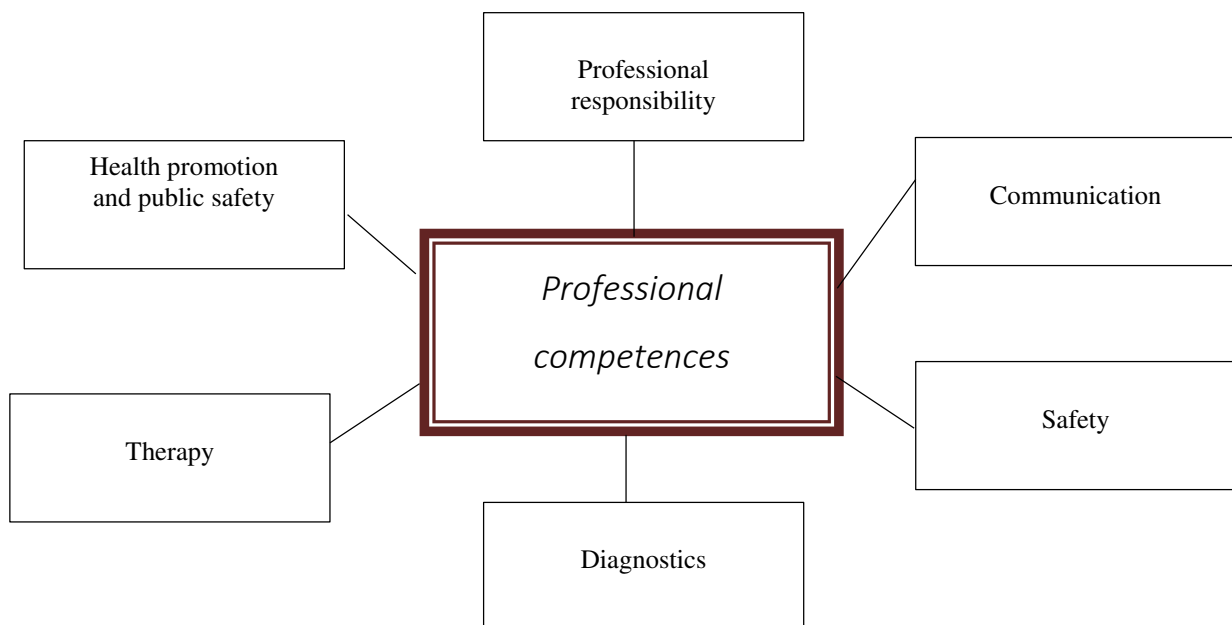


Figure 1. Model of professional competences in health care units. Source: own study.

Presented model of professional competencies in health care units (Fig. 1) was created by Authors basing on the assumptions of the models presented above. It contains six domains which capture the dynamics and complexity of health care unit's manager's role and reflect the dynamic realities in health leadership today.

Among Professional Responsibilities were distinguished such competencies as: functioning as a professional, participating in continuing education and professional development, possessing an understanding of the medicolegal aspects of the profession, recognizing and complying with relevant Polish legislation, functioning effectively in a team environment, making decisions effectively and managing scenes with actual or potential forensic implications.

First of all functioning as a professional seems to be fundamental, especially in professions where employees come into contact with people who are in difficult and stressful situations, and these are often the patients of health care units and their relatives. That's why maintaining patient dignity, reflecting professionalism through use of appropriate language, dressing appropriately, maintaining appropriate personal interaction with patients, maintaining patient

confidentiality, participating in quality assurance and enhancement programs, promoting awareness of emergency medical system and profession, behaving ethically are so important. Also participating in continuing education and professional development are considered as necessary competencies and that includes developing personal plan for continuing professional development, self-evaluating and setting goals for improvement, as related to professional practice, interpreting evidence in medical literature and assess relevance to practice. Complying with scope of practice, recognizing the rights of the patient and the implications on the role of the provider, including all pertinent and required information on reports and medical records, in other words possessing an understanding of the medicolegal aspects of the profession is another important professional responsibility.

As practicing in health care units must be carried out in accordance with the law - recognizing and complying with relevant Polish legislation, therefore functioning within relevant legislation, policies and procedures is recognized as the next professional responsibility. So is working collaboratively with partners, accepting and deliver constructive feedback (functioning effectively in a team environment), employing reasonable and prudent judgement, practicing effective problem-solving, delegating tasks appropriately (making decisions effectively) and collaborating with law enforcement agencies in the management of crime scenes, complying with ethical and legal reporting requirements for situations of abuse (managing scenes with actual or potential forensic implications).

The second domain – Communication Competencies – refers to three competencies: practicing effective oral and written communication skills, practicing effective non-verbal communication skills and practicing effective interpersonal relations. The first one manifests itself through delivering an organized, accurate and relevant report utilizing telecommunication devices, delivering an organized, accurate and relevant verbal report and patient history, providing information to patients about their situation and how they will be cared for, interacting effectively with the patient, relatives and bystanders who are in stressful situations, speaking in language appropriate to the listener, and using appropriate terminology, recording organized, accurate and relevant patient information. The second one basically means employing effective non-verbal behavior, practicing active listening techniques, establishing trust and rapport with patients and colleagues, recognizing and reacting appropriately to non-verbal behaviors. Both factors are important elements of communication necessary to develop effective interpersonal relation, which is the third component of communication, which includes treating others with respect, employing empathy and compassion while providing care, recognizing and react appropriately to persons exhibiting emotional reactions, acting in a confident manner and assertively as required, employing diplomacy, tact, discretion and conflict resolution skills.

In third domain – Health and Safety Competencies – were distinguished such competencies as: maintaining good physical and mental health (developing and maintaining an appropriate support system, managing stress, practicing effective strategies to improve physical and mental health related to career), practicing safe lifting and moving techniques (practicing safe biomechanics, transfer patient from various positions using applicable equipment and/or techniques and emergency evacuation techniques, securing patient to applicable equipment) and creating and maintaining a safe work environment (assessing scene for safety, addressing potential occupational hazards, conducting basic extrication, exhibiting defusing and self-protection behaviors appropriate for use with patients and bystanders, practicing infection control techniques, cleaning and disinfecting equipment and work environment).

The fourth domain of professional competencies is Assessment and Diagnostics Competencies and the fifth – Therapeutics Competencies. In case of these domains particular competencies are not being specified, because depending on the department, urgency of situation, ect. they are different.

The sixth domain – Health Promotion and Public Safety Competencies – raised another qualities such as: integrating professional practice into community care (participating in health promotion activities and initiatives, injury prevention and public safety activities and initiatives, working collaboratively with other members of the health care community, utilizing community support agencies as appropriate), contributing to public safety through collaboration with other emergency response agencies (working collaboratively with other emergency response agencies and within an incident management system) and participating in the management of a chemical, biological, radiological, nuclear and explosive incident.

Conclusions and Further Research

The more specific abilities could be considered subdivisions of a ‘major competencies’ and are termed ‘supporting competencies’. Achievement of a major professional competencies requires the acquisition and demonstration of all supporting competencies related to that particular service or task. The presented above model of professional competencies might be found useful to meet all actors’ needs such as: patients and their relatives, medical staff, health care units managers, health care national system.

The importance of assessing competences is undeniable. Competence recognition offers a way to develop workforce planning and career opportunities of practicing medical staff.

The literature review conducted clearly highlighted the need to create a valid, reliable and easy-to-use tool to identify the professional competencies of medical staff to support the knowledge transfer.

It is worth emphasizing that it is people and their knowledge and skills that are considered the key resource of the organization. There is also a clear shift of emphasis on the qualitative aspects of human resources as strategic element of the functioning of organizations that strive to develop the competencies of their employees. At the same time, the employees themselves acquire and improve competencies, thus increasing their value and importance on the labor market. This trend is a response to the increasing requirements for both employees and employers.

As health care units function in constantly changing environment, some of the competencies are considered to be crucial in the terms of managing those changes. G. Boak in his research (Boak, 2008) defined seven competencies important in this process: understanding complex social systems, achieving results, working collaboratively, understanding the perspectives and motivations of others, establishing systems and structures, orchestrating the team and maintaining self-belief and self-management. And it can be stated that professional competencies as much as managerial ones can be key factor in managing change as well as in every day functioning of health care units.

As much as the issue of competencies and their importance in the management of healthcare entities arouses more and more interest, yet this area is not fully developed. Therefore, it seems necessary to conduct empirical and literature research in this area, which will enrich scientific knowledge, rationalize the research methodology, as well as allow to formulate recommendations for practice.

The medical staff practicing at competent level should be able to master tasks related to their specialty area and have the knowledge, skills and evidence-based knowledge to perform daily practices capably in changing clinical situations. Health care practice on competent level should be theoretically well-grounded and autonomously well-planned and carried out. Competent medical staff is supposed to be encouraged to commit to the strategic goals and

values of the health care organization. They should: share their professional expertise as part of a multi-professional team, committed to continuous reflection and improvement of their own professional competence, motivated to guide and to support co-workers and improve the processes of patient care (Meretoja, Lindfors, Kotila, 2019).

Having an instrument that identifies existing competences and those that need to be acquired becomes significant for distinguishing the singularity of actions for a professional practice which is safe, humane and with no risk to the client, the medical staff or the health care organization. Therefore evaluating the performance by competences becomes essential for managers and training centers, since it contributes to the identification of gaps in knowledge, skills and attitudes of professionals, by promoting the elaboration and implementation of strategies for their development (Soares, Leal, Rodrigues Resck, Pedreschi Chaves, Henriques, 2019). Competency statements can also be used as a reference point in the accreditation processes.

The article highlights areas that need closer attention in the future therefore the further research will be conducted by the Authors.

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SITUATIONAL STUDENT RESEARCH PROJECTS MANAGEMENT

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Purpose: To propose a framework for choosing a project management approach for student research projects, taking into account the individual objectives of the advisor and the student, their personalities, the project type, and its environment. The proposed approach should increase the success rate of student research projects.

Design/methodology/approach: Student research projects are characterized, and the relevant literature is reviewed. The theory concerning recent project management developments that could be potentially useful for student research projects is presented. A case study is analyzed. On the basis of the case study and the literature findings, a conceptual framework for the selection of a student research project management approach is proposed.

Findings: It was found that student research projects, although apparently nonproblematic, need a conscious, individualized, situation-based selection of project management approach in order to assure a high success rate, according to the individual success understanding of project stakeholders.

Research limitations/implications: The proposed framework is a conceptual one. It was developed on the basis of theory and under consideration of student research projects in one area and homogenous culture. Further research is needed to add new aspects to the approach, expand it to other research areas and cultures, and validate its usefulness in practice.

Practical implications: Higher education institutions should promote project management knowledge among teachers and students, and conscious decision-making on the way student research projects will be performed. They should elaborate tailor-made frameworks for student research project management.

Social implications: Student research projects, if managed improperly, may cause students and advisors dissatisfaction and stress. The approach we propose may, in the long term, increase the quality of life of students and advisors.

Originality/value: The framework supporting the conscious selection of the way student research projects are managed, comprising recent developments in project management and taking into account the specific features and environment of each individual project, is an original contribution of the paper. It is addressed both to student project advisors and students themselves, as well as the managers of higher educational institutions.

Keywords: student research project, research project success, research project management.

Category of the paper: research paper.

1. Introduction

Student research projects, undertaken above all in the form of bachelor, master, and Ph.D. theses, possess all the features of projects. They have a specific goal, are unique, consume resources (as a minimum, the work hours of the student and the advisor, but other resources may also be necessary, depending on the area of the research) that are limited, and are time-related. They are also of high importance for at least one of their stakeholders: the student, but fairly often for the advisor as well. For the student, the student research project is the final step of an education phase and may decide about their future career. For the advisor, such projects may constitute an important contribution to their scientific achievement. Student projects may also bring tangible results to the organizations they are performed in. And still, the management of such projects has not received much attention in the scientific literature. We can mainly find tutorials on personal time management and communication with the advisor (e.g., Lee, 2019), with little reference to project management, especially to the recent developments in this area - like Agile management, stakeholder management, metrics-based management, multicriterial success understanding, situational project management, etc. One may have the impression that these projects are seen as being less important than projects implemented by an organization with legal personalities, as being uniquely "private," small, non-problematic projects with little impact on society. They are implemented in massive quantities over the whole world without much attention from mass media (apart from plagiarism cases), and thus seem to be smoothly manageable so that the research on them is not necessary.

And yet, without researching the issue systematically, we are unable to verify the truth about their alleged problemlessness, we cannot evaluate their success degree, and we cannot identify any success factors in order to improve the implementation of this project type. Of course, we face the problem of defining the success of a student research project. According to the current view on project success (Davis, 2014), we have to take various criteria into account set by the main stakeholders, not just the criteria based on time, scope, and quality. Being on time (i.e., in our case, graduating in time) may not be the only success criterion of the main stakeholder, the student. Also, the advisor may have other success criteria. For the student, additional success criteria may be a low level of stress during the preparation of the thesis, a high degree of usefulness of the thesis in the future job, a high degree of general satisfaction, a medium degree of difficulty in the work, etc. For the advisor, success criteria may comprise the "distance" between the thesis and a possible ready paper to be published in a reputable scientific journal, a low amount of time they have to spend with the student and on the thesis correction, etc. In a student research project, there may also be other key project stakeholders, e.g., the organization that is the object of the research, which will have their own goals and, thus, their own success criteria.

The authors of this paper represent two student research project main stakeholders: the student, who completed her research a few months ago, and the advisor. The advisor has over 30 years of experience in advising students on their research projects. This experience shows that there may be various ways of understanding the success of a student research project on both sides, apart from the quality (measured by the final mark) and timeliness, which are the most evident criteria. As a result, the student research projects are often not seen as successful as they could have been seen if they were treated more as “serious” projects and were managed more professionally. The students or the advisors often are not completely satisfied with the outcome and the course of the project (too much stress, too many conflicts, too many unspoken resentments, too little usefulness of the outcome for the future on both sides, etc.).

In fact, approaches to the management of “real” projects, especially research projects in general, should be systematically applied here, as student research projects are research projects which can often be classified, from the point of view of their stakeholders, as projects of high importance and complexity and involving various interests. And for research projects, the use of recent project management approaches is recommended (Pirro 2019), so they should also be considered for student research projects.

Additionally, student research projects have their own specific features. Some of them (like small size and impact) facilitate their management, but others may make it more difficult. We formulate the hypothesis that the following reasons (in addition to failure factors which we encounter in “normal” projects, led in organisations) may be responsible for the situation that the recent findings in project management are not applied to student research projects and these projects are not as successful as they could be:

- The problem of accidental project manager (Darrell, Baccarini, 2020). In the public sector, also in higher education institutions, the nominations to project managers are often based not on project management competencies but on the position held in the institution or on the fact that a person has been granted a budget for the given project. This problem is paramount in the area of student research projects. Advisors are nominated merely on the basis of their academic position. As a result, one of the two main project stakeholders, the person who is considered to play the role of project manager, usually has no or little expertise in projects and their management. And it is common knowledge that project management is crucial for project success (Munns, Bjeirmi, 1996). Although the student may also be a kind of “accidental project team member” who does not know much about projects, it happens more and more often that the student knows more about project management than their advisor because of their student jobs.

- The fact that the advisor and the student usually do not know each other. In organizations people have a chance to have worked together for some time or to get someone's opinion on the project manager or on the members of the project team. In the world of higher educational institutions, the couple "advisor-student" usually meet just before they start implementing the project. Thus, the project course may be burdened by the lack of proper communication and trust, strengthened by the position and power difference.

The appropriate project management methodology should be the first and most important choice to make in every project, also in student projects. Thus, the objective of this paper is to propose a set of recommendations that should help the advisors and students to implement their common projects in such a way that project success, according to their own personal definitions, is as probable as possible. The recommendations will be based on the existing literature on student research projects and recent developments in project management, summarised in section 2, on a case study described in section 3, and on the experience of the authors. The recent developments in project management to which we will refer here are above all: metrics-based project management, Agile and hybrid project management, stakeholders management, and situational project management.

The latter notion, the situational project management, is especially important for the approach proposed here. In (Lehamnn, 2016) it is claimed that there is no universal project management methodology, good for all the projects in an organization, and that project management approach should be adapted to each project individually. Lehamnn gives in that generally, the contrary is believed: organizations all over the world proudly announce the implementation of uniform methodologies for all their projects. However, he gives examples of projects for which this approach has led to project failures: one and the same methodology proved itself to be perfect for one project and improper for another one. This has happened even for apparently similar projects, from the same industry and of comparable size, implemented in the same culture and even led by the same project manager. We consider thus justified to propose an approach specifically designed for student research projects, which will be flexible and will be further adaptable to each specific situation in which the couple "advisor-student" may find themselves in.

2. Materials and methods

2.1. Metrics-based project management

According to Kerzner, a project cannot be managed effectively without metrics and accompanying measurements that can provide complete or near-complete information about a project's chances of success (Kerzner, 2013). To explain the essence of project metrics in

a transparent way, the literature proposes the simplest definition of a project metric: A metric is a measure of the phenomenon that is being measured. Kerzner formulates the following statements, which further clarify the essence of metrics:

- If a phenomenon in a project cannot be measured, it cannot be managed.
- The phenomenon that gets measured gets done.
- We can never really understand anything fully unless it can be measured (Kerzner, 2013).

Metrics inform project stakeholders about the status of the project. Stakeholders need to be confident that the right metrics are being used and that the measurement provides a clear and true representation of the state of the project. Metrics can determine whether it is feasible to undertake or continue a particular project and whether certain actions need to be taken.

Metrics must be well-defined, and guidelines for their use must be fully accepted by those who will use them. A project management program through metrics should be designed and implemented so that the project team begins to consider metrics as the basis for activities that support project management excellence and overall organizational improvements. Data provided by a system of metrics can only become the basis for informed analysis if there is consensus on what is happening and what should be happening in projects (Kerzner, 2013).

Defining a metric requires answering several key questions concerning the measurement:

- What should be measured?
- When should it be measured?
- How should it be measured?
- Who will do the measuring?

and concerning information gathering and reporting:

- Who will collect the information?
- When will the information be collected?
- When and how will the information be reported? (Kerzner, 2013).

Metrics can change during each phase of the project lifecycle and from project to project. Metrics should be closely linked to project success factors and project success criteria for each particular project.

In the literature, the concepts of success factors and success criteria are interrelated, and many authors (Wateridge, 1998; Cooke-Davies, 2002; Koutsikouri et al., 2008; Jugdev et al., 2005; Rohman et al., 2015) suggest defining the concepts of project success criteria and project success factors as follows:

- Success criteria are dimensions for assessing whether a project has succeeded or failed.
- Success factors are variables (conditions) that increase the probability of project success.

The role of project metrics is to measure, during project implementation, to which extent the conditions enforcing project success (success factors) are fulfilled, and if the predicted values of project success criteria are satisfying. If the metrics values are unsatisfactory or exhibit a worrying tendency in time, relevant measures and steps have to be undertaken.

It has to be underlined that metrics do not have to describe undoubtedly and easily measurable aspects, like time and money-related issues. Equally important are metrics representing human mood, satisfaction, and similar soft project aspects. Such metrics are nowadays relatively easy to implement thanks to modern technologies (e.g., we can ask project stakeholders to systematically click on smileys on their smartphones) and indispensable in the modern approach to project success evaluation, which involves both hard and soft criteria.

2.2. Agile and hybrid project management

The Agile approach is an alternative to the traditional (waterfall) approach to project management. In the latter, the phases of initiation, planning, execution, and closure follow one another, and, in the ideal case, they should not overlap. In the Agile approach, these phases overlap and keep on returning. Agile development practices (known usually as just the Agile approach) is a term for a range of approaches and practices related to project management, based on the Agile Software Development Manifesto and the twelve principles that underlie it. Agile defines the values and principles that guide project teams without defining processes (Highsmith et al., 2001).

The most relevant characteristics of the Agile framework are based on the systemic approach of context, simplicity, ease of learning, and methodical components such as iterative, incremental, collaborative work, and adaptability to environments. Key ideas of Agile are as follows:

- people and interaction are more important than processes and tools,
- a working product is more important than comprehensive documentation,
- cooperation with the customer is more important than agreeing on the terms of the contract,
- being ready for change is more important than following the original plan.

Agile project management attempts to make project execution flexible and open to changes in the environment and the project scope. Agile requirements tend to be primarily functional and reasonably informal (Boehmand, Turner, 2005). There are several principles of Agile, out of which we present the ones that are most important for the following part of the paper:

- The highest priority is to satisfy the customer through early and continuous delivery of a valuable product.
- Changing requirements are welcome, even late in development. Agile processes harness change for the customer's competitive advantage.

- We should deliver subsequent versions of the product frequently, in intervals from a couple of weeks to a couple of months, with a preference for shorter intervals.
- The most efficient and effective method of conveying information to and within the project team is face-to-face conversation.
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly (Highsmith et al., 2001).

The great advantage of using Agile methodologies is not only fast delivery of the final product but also continuous adaption on the basis of feedback. Agile supports collaboration and continuous planning, as well as continuous learning. When using Agile, the focus is on planning, implementation, and final delivery of the product.

However, the Agile approach is not a solution for all projects. It is true that, in many cases, it is considered to be better and more efficient than the traditional waterfall approach. On the other hand, as it is described in Belling (2020), a pure Agile approach would not have chance to be helpful in certain types of organizations and projects. For example, in bureaucratic organizations, where the decision-making process is long and complex, Agile project management would be difficult or even impossible to implement. Also, in the case of projects where high investments have to be made in the initial phase – whether financial or mental investment is meant here – an Agile approach will not be adequate. In order to make the right investments, the whole project has to undergo a holistic and fairly detailed planning process. In order to use both the advantages of the Agile approach and the waterfall approach and to eliminate their weaknesses, hybrid approaches are proposed, with various degrees of agility and rigidity (Reiff, Schlegel, 2022). There exists a variety of hybrid methodologies; thus a careful selection process is recommended, according to the indications proposed in the literature (Reiff, Schlegel, 2022).

2.3. Project typologies

As we read in (Lehamn, 2016), the choice of project management approach should be carefully adapted to the project and organization type, thus to the specific situation in which it should be used (situational project management). This is a very important problem: various project types require various approaches to their management – one and the same approach may prove to be perfect for one project and lead to a failure in the case of another project (see (Lehamn, 2016) for examples). For this reason, it is important to be aware of the type of project we are going to manage. Project typologies may be helpful here. There exist different project typologies, one of the recent ones was proposed in (Lehamn, 2016). The author distinguishes, among others, the category couples listed below. The divisions are not crisp: a project may belong at the same time to both categories from each couple, but to different degrees.

- “1st” and “nth” projects: projects which are very different from all the projects implemented in a given organization or by a given group/person so far, and those that show a lot of similarities to previous projects;
- “blurry” and “focused” projects: projects with fuzzy or blurry requirements or final product specification and those with a detailed, apparently definitive specification;
- “greenfield” and “brownfield” projects: a greenfield project is built on virgin ground, literally or metaphorically, with little history related to the project area and product and with few stakeholders, while a brownfield project is implemented in an environment with some history and many stakeholders, and various interests that might be an obstacle to smooth project implementation.

Obviously, there exist numerous other project typologies. One of the best-known was proposed in (Turner, Cochrane, 1993). It distinguishes between projects with ill-defined goals and methods, ill-defined goals and well-defined methods, well-defined goals and ill-defined methods, and well-defined goals and methods. If we combine both typologies, we can arrive at categories like 1st (nth) project with respect to the goals, like 1st (nth) project with respect to the methods, etc. Each category may require another approach to project management.

2.4. Student research projects

Student research projects take on the form of the preparation of bachelor, master, or Ph.D. theses. The primary aim of a student research project is to develop the individual student's ability to conduct independent research (Sharp et al., 2002).

Supervision of student projects can often require a significant mental effort from the supervisor to be effective for the students. While supervising one or two students, it is relatively easy to remember the context of each student's work from one meeting to the next. However, with a large number of students, the mental complexity of the supervision becomes significant (Brodtkorb, 2019).

Tengberg (Tengberg, 2015) reports on Agile development methods applied to the supervision of Ph.D. theses and focuses on using short planning phases of around two or three weeks, called – as in the Scrum approach (The 2020 Scrum Guide™, 2020) - sprints. His argument is that using agile methods in supervision will decrease the Ph.D. completion time. Another researcher reviews usage cases of the Agile approach at university level for interactive learning (Dewi, Muniandry, 2014).

The requirements for the successful completion of student research projects are, in some respects, difficult to establish. In particular, the amount of originality needed and the extent to which generalization of the results is possible may be unclear. At the very least, the conclusions which are reached must be validated. Certainly, the contribution to the knowledge of a student thesis should be of some significance, particularly in view of the fact that it is likely to serve as a reference work (Sharp et al., 2002), but it still has to be taken into account that this usually is the first research work for the student.

The academic space where student projects are implemented implies certain difficulties determined by the lack of expertise of students and advisors in project management, coupled with the magnitude of the responsibility. Difficulties are evidenced concerning the selection of the methodology and the designation of roles, the acquisition and administration of resources, and the management of time in compliance with the acquired commitments (Abuchar, Simansa, 2021).

3. Case study

The case study relates to the master's thesis prepared and successfully defended by one of the authors of the present paper. The thesis topic was 'Metrics for measuring research and R&D projects'. The aim of the master's thesis was to propose a way of measuring the progress of research and R&D projects. The objective was achieved through an extensive literature review, the development of a specific case study, and questionnaires and interviews with the manager of a partially failed research project.

The research objective attainment started with the answers to the following research questions:

- What factors influenced the partial failure of the selected research and development project?
- Could problems with the project have been identified before they occurred, and how?
- What metrics could have helped to identify problems that occurred in the project before their occurrence?

Conducting a qualitative study aimed to point out the specifics of the selected R&D project, identify the problems and difficulties encountered in its implementation, and to identify the factors of its partial failure. The final result of the thesis was an initial concept for measuring research and R&D projects, its verifications using the selected project, and the final version of the concept. The result of the qualitative research carried out in the thesis was an attempt to define metrics measuring the chances of success of a research project during its implementation and indicating potential problems.

The work on the thesis started apparently according to the waterfall model, as there was a precisely defined sequence for completing the thesis parts. The schedule of the work was clearly defined, with the theoretical parts having the highest priority. Dependencies between the project work elements were clearly defined. It was not entirely known, however, what results were to be expected; the expected outcomes remained only roughly described. There was no certainty as to what conclusions would be reached because they depended on the results of the questionnaires and interviews.

A strict schedule was worked out for the development of the case study, the creation of the interview and questionnaire forms, the conduct of the interviews, and the development of the audio materials, but it turned out that in reality, it was not possible to adhere to such a rigid timeframe. The schedule changed a lot, and these changes and their consequences could only be analyzed once the project had been completed.

Collaboration with the advisor was performed via the Zoom platform and email. The most important issues were discussed during numerous consultations on the Zoom platform. These consultations took place at a frequency of one to two weeks, depending on the stage of the work in progress and its difficulty. The frequency of the online meetings also depended on the work actually carried out, as their topics covered the parts of the work where problems and difficulties arose. The duration of the meetings was not set beforehand; it depended on the course of the conversation; the meetings ended at the moment when the thesis author's vision seemed to be clarified, and the next steps were explained.

It is worth noting, however, that the author's vision for her master's project work began to change strongly the moment the actual research on the case study (questionnaires, interviews) began. The vision of the final product gradually established itself during the Zoom meetings.

At this point, the number of Zoom meetings relatively increased, and due to the uncertainty about the results, the traditional approach changed to an iterative approach to managing the project and creating the final product on an ongoing basis. Frequent meetings with the supervisor on the Zoom platform and emails incorporated elements of sprints, which are central to the Scrum approach (The 2020 Scrum GuideTM, 2020).

The Agile approach, to which the initial waterfall approach evolved, allowed the thesis author to deliver subsequent elements of the thesis faster and more frequently, to consult and clarify uncertain and unclear elements in the research work more frequently, and to adjust the next steps of research and development of the final product. The aforementioned advantages of this approach have resulted in greater flexibility to adapt to change and a constantly evolving final product. An iterative approach to the delivery of successive parts of the research, which focuses on ongoing editions that take into account the supervisor's feedback and the thesis author's reflections, was observed to be very effective.

In summary, the effectiveness of applying Agile project management to the student project is worth highlighting. The possibility of correcting actions during each iteration increased the speed of response to change and adaptability to the specific environment in which the research was conducted. On the other hand, it was advantageous to begin the project according to the waterfall approach because a considerable amount of preparations had to be met: preparation of the case to be analyzed, of the persons to be interviewed and questioned, of the questionnaire and interview schemes. These elements had to be ready at the beginning, and it would have been impossible to modify them after each iteration.

Referring to the project typology described in section 2.3, we have to state that the project, with respect to the goal, was rather a “1st” project also for the advisor, which strongly contributed to the fact that at the beginning the end result was not clear and the vision was

frequently changing. It was thus also a "blurry" project with respect to the goal. The goal was ill-defined, but the methods (interviews, questionnaires) were well-defined, which is why the waterfall approach to the planning of methods was possible in the initial stage. It was also a "greenfield" project, thanks to which there were practically no stakeholders interested in disturbing its course.

Referring to section 2.2, where the problem of the agility and rigidity degree in hybrid approaches to project management is discussed, it is worth noticing that in the case of the student project discussed here, a high amount of mental and time investment was needed in the initial stage – the research methods had to be carefully planned. For this reason, a pure Agile approach would not have been possible, and a hybrid approach was necessary.

Referring to the problem of project success understanding, here, the student was interested in preparing a high-quality thesis, which would allow her to apply successfully for a Ph.D. position. The prerequisites for the Ph.D. position comprised publications in practically any scientific journal; thus the aim of the student was to prepare a thesis that would give rise to rapid publications in student conference proceedings. The advisor was rather interested in more ambitious publications in reputable journals, but she accepted the objective of the student as a compromise.

Additionally, after the analysis of the selected student project, it is worth stating that the course of student research projects can be improved and the problems and risks encountered in their course eliminated by applying the following improvements:

- Focusing more on the principles of the Agile project management approach: reduce the sections of work sent to the advisor for checking, which will eliminate the problem of waiting for the responses: checking a smaller section takes less time. In addition, smaller sections of the work will help to detect errors early and to react to them quickly.
- Increasing the frequency of meetings so that questions and ambiguities are dealt with immediately.
- Balancing the number of students advised by the advisor and their teaching load so that the advisor is available more frequently.

4. Proposal of an approach to student research projects management

We propose here a situational approach to the choice of project management method for student research projects. Thus, we list the points to be considered by the couple "advisor-student", or, in case of communication difficulties, by each of the two stakeholders individually, in order to choose the final approach, tuned in a discussion, where a compromise should be reached before the project starts.

Table 1.
Indications for the choice of management method for student research projects

Aspect of the project	Selected issues to be addressed
Project type	<ul style="list-style-type: none"> • “1st”-“nth” project for the advisor: if the project has a lot of unknown elements also for the advisor, a higher initial investment in the planning has to be made, but the initial plan has to be considered as potentially changeable (a hybrid approach); • “blurry” – “focused” projects and ill/well-defined goals projects: if the objective and the product are to a great extent blurry, a more Agile approach should be adopted, with a high frequency of meetings; • "greenfield"- "brownfield" project: if the student research has to be performed in an organization where the student research activities or the student presence may interfere with everyday operations or disturb anybody for any other reason, the advisor has to take care of adequate stakeholder management before the project starts.
Expertise in project management	<ul style="list-style-type: none"> • if the advisor is an experienced project manager and the student is not knowledgeable in this area, the advisor should introduce basic project management elements into the project, obliging the student to study them; • if the student has some experience in project implementation and the advisor does not, the student should make an attempt, respecting the existing power distance and the advisor's personality, to propose the application of project management elements they found useful (e.g., iterations, frequent meetings, etc.), and the advisor should be open to the proposals; • if none of the two is knowledgeable in project management, the advisor should study the basic elements of project management (basic scheduling principles, risk management, stakeholder management, etc.) in order to be able to better help the student to reach success in the project.
Project success criteria and measurement of their achievement	<p>The advisor and the student should talk about their mutual project success criteria. In other words, the questions “what do you expect from the project? what is most important to you?” should be asked mutually, and the project management method should be selected, taking these answers into consideration. If the student is mainly interested in graduating on time and the advisor in an ambitious work, it may be even better to break the project in time and let the student search for another advisor. In the case of less conflicting success criteria, a compromise has to be searched for (like in the case from section 3, where the compromise was found as to the reputation of the journal in which the results were to be published).</p> <p>Once the success criteria have been set, project metrics to measure their achievement chances should be decided upon individually by the advisor and the student. Examples of metrics are: “frequency with which the student sends the intermediate results,” “the quality of the intermediate results,” “the delays with respect to milestones” (for the advisor), “the time-to-answer of the advisor to the questions of the student,” “the clarity degree of the advisor's answers and corrections” (for the student), etc. Troubling values of the metrics would require some actions, like a conversation between the student and the advisor.</p>
The object of the research	<p>If the object of the research may pose some difficulties, special care has to be taken of this by the advisor before the project starts. For example, if the student has to conduct research in an organization, this organization or its individual members may become stakeholders with a negative influence on the project. For example, they may give the student low-quality answers in interviews and questionnaires, as the student has no power and no tangible importance to them but only takes their time.</p> <p>Additionally, if the organization in which the proper research is to be performed is highly bureaucratic, a waterfall approach should be preferred, with a lot of effort put into initial project planning and stakeholder analysis, including the resolution of all the formal and rigid procedures challenges.</p>

Cont. table 1.

Degree of relation symmetry, degree of trust	<p>Relations between the student and the advisor are of utmost importance, and the two project stakeholders, if they have not worked together before, should try to get to know each other and clarify the roles and expectations. Of course, the relationship will never be fully symmetrical because of the power distance between the student and the advisor. But the degree of this asymmetry can vary. For example, a student who has worked in an Agile team is used to collective decision-making and to the freedom to make their own proposals. This can be of advantage to the success of the student research project; thus the student may try to get out to which degree the advisor would be ready to enter into such a relationship.</p> <p>Mutual trust should be built in consecutive meetings, even if the traditional approach is used. Both sides (independently) should define metrics to control the quality of the relationship. Examples of metrics are level of stress during the meetings, degree of satisfaction with the answers (for the student), degree of compliance to the remarks, and openness in the formulation of the questions (for the advisor).</p>
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In the case of the project presented in section 3 (which was a 1st - for both the student and the advisor - project in respect to the goal, with a blurry objective but with well-defined methods), the methods tools (interviews and questionnaire forms) had to be made precise at the very beginning, which demanded an initial considerable mental and time effort. That is why it was chosen to perform detailed planning of the methods, but the result of the project remained undefined and was made specific in subsequent interactions. As it was a “greenfield” project, with no difficult object of research (the interviewee and responder were a colleague of the advisor), no stakeholder management was required on the part of the advisor. The student and the advisor agreed on the success criteria, finding a compromise. They thus decided that one of the objectives was to prepare a high-quality thesis, meriting a very good mark and able to be defended within the earliest deadline set by the university, and to create results worthy of being presented in a student paper at a student scientific conference. Thus the advisor was constantly measuring the quality of the intermediate results from the point of view of the timely termination and the publication chances in the selected journal type. The asymmetry of the relation was gradually, but of course only partially reduced in the numerous online meetings, where the student was developing self-confidence in the formulation of her own original proposals.

Conclusions

In this study, we propose to apply the situational approach to the management of student research projects. The situational approach means that the method of project management is selected for each specific case, taking into account the features of the project, its stakeholders, and the environment. In our approach, we emphasize the need to take into account recent developments in project management that can turn out to be advantageous to the student

research project. We should not be misled by the apparent simplicity of student research projects (a tiny team, usually composed of two persons, low importance for organizations and society, low consequences of failure for organizations and society, low interest of mass media, short duration, etc.). The mere fact that, usually, the project advisor is a so-called "accidental project manager", and the existence of a high power distance between the advisor and the student constitute important failure factors of student research projects. On top of that, we face the frequent problem of the two basic stakeholders not knowing each other before the project, as well as of the variety of project success criteria both sides may have, more or less consciously. All this is intensified by the normal challenges and risks of research projects (Klaus-Rosińska, 2019).

Our proposal consists in considering various aspects of each research project during a meeting with the advisor and the student, and choosing consciously the way they will perform the project together, making use, if appropriate, of recent developments in project management, like metrics-based project management, stakeholder management, various project typologies, Agile and hybrid approach, etc.

Certainly, our proposal has numerous limitations. First of all, it has to be tested in actual student research projects in various higher educational institutions in various countries (because cultural differences may be an issue too), and further developed (in our proposal certain aspects influencing the choice of the management method have certainly remained unnoticed). Secondly, there are human factors that may be an obstacle to the implementation of the approach, especially the personality of the advisor and of the student. Also, the domain of the research may influence the approach: the authors of this paper come from the field of management, which certainly has limited their vision. We are, however, certain that our, or a similar approach, may increase the quality of student research, and it will do so in a sustainable way: allowing us to consider also the student's and the advisor's stress and tiredness level, their satisfaction, and their wellbeing. In the modern approach to project management, these soft aspects should, among others, constitute project success criteria and be measured by relevant metrics. In the long term, our approach may thus contribute to the wellbeing of society and the quality of research.

Our approach should be taken into account by the management of higher education institutions and be the object of seminars and training, both for advisors and students. Organizational frameworks for choosing the management method for student research projects should be developed. This investment will certainly pay itself off in the form of increased research quality, as well as the satisfaction of both advisors and students.

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DROPSHIPPING IN THE AGE OF THE INTERNET – DOES IT REALLY WORK IN CRISIS?

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Purpose: The main goal of this article is to present the dropship model to consider its advantages and disadvantages and find out, is it accurate way to develop business in short time under some uncertainty.

Design/methodology/approach: Most important problems and critical success factors of dropshipping model, and then assessing their mutual influence on each other were discussed. Costs that a start-up company running its business must incur were analyzed. In order to convince what kind of effects the online store may expect, simulations of requirements and costs on dropshipping platforms were conducted.

Findings: Dropshipping business model is quite risky and should not be treated as a panacea in times of crisis. Online stores, if they think about significant profits, must focus on finding their niche, building responsive websites and rely on a solid information system.

Originality/value: Simulation of costs of dropshipping business model under some uncertainty can be really helpful to start-up company running its business.

Keywords: management, dropshipping, business management, solving problems with uncertainty, supply-chain management.

Category of the paper: Research paper.

1. Introduction

In the period from 2007 to 2009 a worldwide economic and financial crisis has began. A large number of companies were looking for savings, e.g. by converting cost units within the organization. At that time very great interest of various outsourced services aroused, including warehousing goods or employing self-employed workers. This phenomenon has also emerged recently as a result of the influence of COVID-19 virus pandemic situation on global economy. Massive efforts were made to look for ways to reduce the risk and properly manage the enterprise in conditions of uncertainty. It is no wonder that the concept of dropshipping has

become very popular again. As we observe on worldwide Web search interest over time (Fig. 1) this order fulfillment method is currently experiencing an upswing

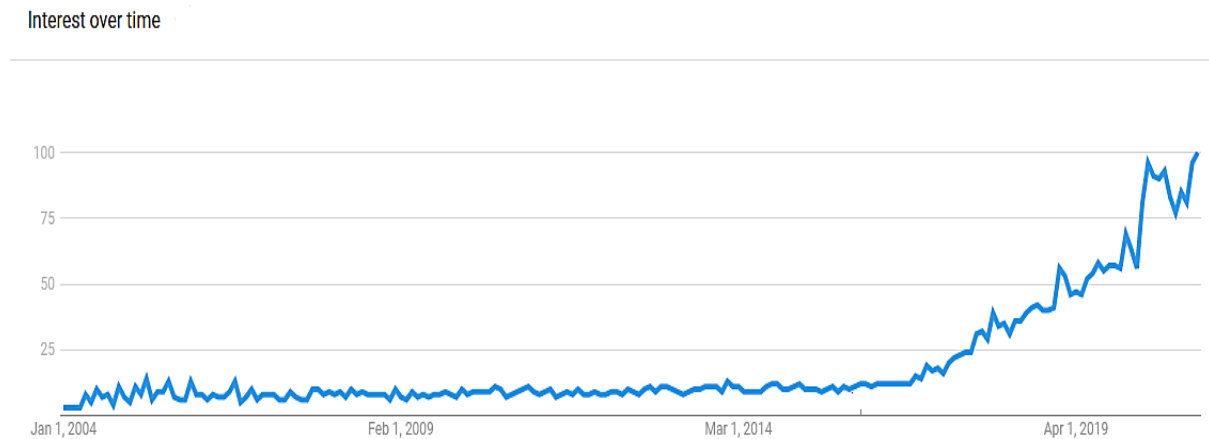


Figure 1. Dropshipping – worldwide Web search interest over time starting from 2014.

Source: own work based on: (<https://trends.google.com/>), access: February 2021.

According to Grand View Research report the global dropshipping market size was valued at USD 102.2 billion in 2018 and is expected to register a CAGR of 28.8% from 2019 to 2025, especially in case of following industries: toys, hooby & DIY, furnitures & appliances, food and personal care, electronics and fashion. What is the reason? The main goal of this article is to present the dropship model, consider it's advantages and disadvantages and find out, is it accurate way to develop business in short time. Last, but not least does it actually work during any economic crisis?

One of the pioneer writers of this concept – Aaron Kiely (Kiely, 2018) defines it as follows: in dropshipping, customers place products orders via online transactions. The paper considers how this concept works in the Age of Internet, where many online stores sell purchased product, and redirect the sales order to a third-party supplier, who then ships the order directly to the customer. The online store thus becomes a broker of sale, and the price the customer pays is obviously higher than the purchase price of the good offered by the whosaler. The broker earns on the margin - taking into account the cost of purchase and advertising, but doesn't bear the costs of goods' storage and shipping.

As shown in Fig. 2 dropshipping is an order fulfillment method that does not require a business to keep products in the warehouse. Instead of that, the store sells the product, and passes on the sales order to a third-party supplier (often manufacturer of goods), who then delivers the order drirectly to the customer.

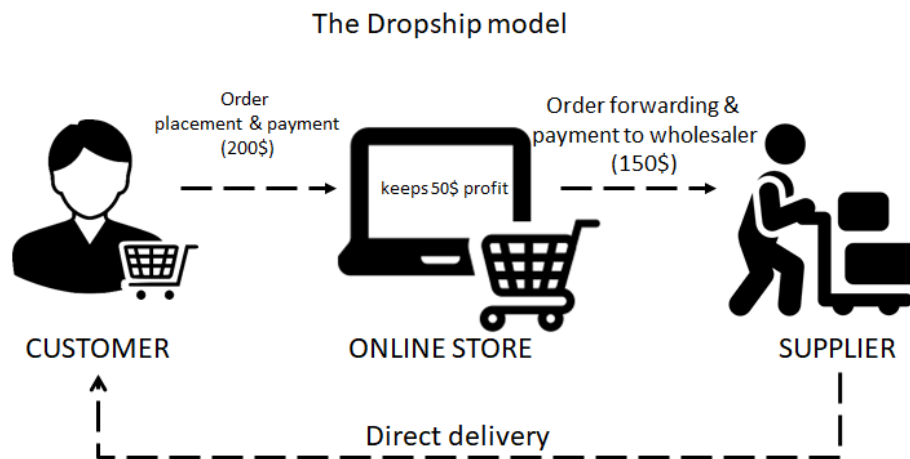


Figure 2. The Dropship model.

Source: own work based on: (<https://www.oberlo.com/blog/amazon-dropshipping-guide>), access: February 2021.

Dropshipping gives the opportunity to develop your own business practically without capital or at a difficult moment for the enterprise, wanting to minimize costs, so it is a particularly good solution for small enterprises or startups. This concept is also a good idea in conditions of high uncertainty, when it is difficult to predict what will happen tomorrow, and company managers want to reduce logistics costs. It also allows you to focus and take care of the appropriate online store marketing strategy and product promotion.

However, dropshipping is not always a best way to generate sales revenue quickly, especially when we take into account all obstacles, threats and disadvantages. E.g. we cannot forget about competition - on the market we will find many sales brokers who offer similar products, often even ordered from the same drop-shipping wholesalers. Margin is always around 20% of manufacturer price, so how you can compete with other sellers and earn some money at the same time? The customer has contact only with the online store, often not even knowing who the real supplier is. If the quality of the products is bad and the customer wants to make a complaint, problems arise. Of course, everything must be approached in the right way, but it requires commitment and smart business decisions. Let's discuss advantages and disadvantages of dropship model and find out does it really work?

2. Advantages and disadvantages of dropshipping – does it actually work?

In order to analyze the advantages and disadvantages of dropshipping, as well as determine whether it is an effective way of business development, especially in conditions of uncertainty, it is worth considering the most important problems and critical success factors, and then assessing their mutual influence on each other. The identified elements important for the dropship model are presented in the tables below:

Table 1.
The dropship model – main problems (PROB)

PROB no.	PROBLEM name	PROBLEM description
PROB1	Low profit margins	On one hand, it is possible to reduce inventory and shipping costs, but on the other hand returns are low (~20% margin). This means it's crucial to ensure the right traffic on the website and take care of a large number of orders, because most of the money goes to the supplier anyway. It's necessary also to remember about the costs of maintaining the website, advertising, marketing, hiring employees to support the business
PROB2	Strong competition	Dropshipping does not require a lot of capital at the beginning, which is unfortunately associated with a lot of competitors, what is especially visible in the case of popular industries. The greater market player, the lower prices and richer the product portfolio
PROB3	Lack of control over supply-chain	Unfortunately, in this logistics model, dropshippers are very heavily dependent on suppliers and have practically no control over what the wholesaler is shipping. This can make communication very difficult. If any problem appears (e.g. return, complaint) – finding solution may take longer, because the online store basically can only serve as a sales broker
PROB4	Lack of branding	In dropshipping we have to separate the act of purchase from the brand of purchased goods. Unfortunately, customers become more attached to the second one. It is also crucial in maintaining constant traffic on the website, so quite problematic issue may be placing a new product of an unknown brand to the offer
PROB5	Issues with order processing	Wrong item sent to customers, delays, poor quality products or damaged deliveries, wrong order quantity, items out of the stock, wrong order settlement – the list of potential issues can be really long and as a dropshipper you are not responsible even half of it, but you have to deal with your customers and try not to lose their trust
PROB6	Boring and unuseful website	Website design is critical to your sales performance, so it's important to match it with your offer. It is also worth paying attention to the customers' needs. The website should also be useful in terms of collecting information about user behavior. The security of data and easy check-out (also as a guest without creation a profile) are also important issues
PROB7	Selection of wrong platform to promote online stores their offer	We make online purchasing decisions more and more often based on the opinion or recommendation of the community. It is worth including social media to promote your online store or products offered there. Rapidly we have an access to professional tools and algorithms that can support our marketing strategy development. It may attract more customers without without spending a lot of money
PROB8	Bad customer support and negative feedback	The role of sale broker does not end with the shipment of the product. Often, customers still need huge support. In dropshipping client is not able to contact the supplier directly and definitely needs help here. Lack of support means that we do not have sufficient knowledge about the needs and inquiries of our customers - no wonder we lose them without even knowing why...

Source: own work.

Table 2.
The dropship model – main critical success factors (CSF)

CSF no.	CSF name	CSF description
CSF1	Implementation of a responsive website (e-commerce store)	Implementation of a website tailored to mobile devices and desktops. In this case, the best solution will be to choose and implement a responsive website. In addition, an essential element of such website is the creation of graphics that will be adapted to mobile devices (because nowadays most of the traffic is generated via smart phones)
CSF2	Implementation of an information exchange system - customer-store and store-supplier communication	When a store has multiple suppliers, the dropshipping model is difficult to apply, so this is a key issue. In addition, communication with the customer should take place not only using traditional methods (chat, newsletter), but also e.g. web-push notifications, which allows us to send recommendations, special offers, information about prices and discounts, product availability reminders about abandoned transactions, etc. - "churn factor" will decrease and also it will be possible to carry out retarget and remarketing campaigns, as well as increase customer loyalty
CSF3	Product knowledge management	Creation of accurate product descriptions. In addition, monitoring and collecting data about the demand for a given product or completely new goods (just added to the offer) should be one of the key issue on store's website
CSF4	Implementation of a loyalty program for key customers	The implementation of the loyalty program will enable key customers to purchase products with discounts, which will contribute strong store-customer relationship
CSF5	Creating marketing campaigns - custom feeds and dynamic re-marketing	In order to support the building strong customer relationship and achieve better sales results (e.g. at least 2 products per customer during one transaction), it is necessary to create appropriate marketing campaigns tailored to the current trends. Creating custom feeds taking into account the customer profile and complementarity of products is extremely important here
CSF6	The use of recommendation systems of well-known social media	Promoting products in posts and advertisements on Facebook or Instagram can be very useful, creating a community of online store's customers can also improve sales results. Sales groups interested in specific products can be further very helpful to promote items (social listening phenomenon)
CSF7	Creation of customer profiles and their opinions	In order to examine the quality level of the services provided by the store and to begin (if necessary) their improvement, it is crucial to know exactly what kind of customers we are dealing with. The surveys will allow us to collect opinions on offered products. At the same time, it is worth making sure that the purchase path is relatively short - the fewer steps customers have to take, the greater the probability that they will finalize it, a quick login to the account will definitely be the key to success here. Sharing the opinions of satisfied customers is equally important

Source: own work.

Table 3.

The dropship model – cross table of critical success factors (CSF) vs problems (PROB)

	PROB1	PROB2		PROB3	PROB4	PROB5	PROB6	PROB7	PROB8
CSF1		X					X		
CSF2				X		X			X
CSF3					X	X			
CSF4									X
CSF5	X	X			X		X	X	
CSF6								X	
CSF7				X		X	X		X
X - CSF may contribute elimination of the problem (PROB)									

Source: own work.

As you can see, there are many ways to solve the key problems in dropshipping. Nevertheless, the advantages and disadvantages of this logistics model must be taken into account. The undoubted advantage is that there is no need to involve large initial capital – initial costs to run business are rather low (see Chapter 3). Depending on the supplier we cooperate with, we can also have an access to a wide range of products, which makes our offer much more interesting to customers. The only thing we need as a dropshipper is an interesting website, we do not have to worry about costs of storing and shipping goods or maintaining inventories. We can also easily update the product catalogue. On the other hand online store is only the sale broker and this has its consequences. The biggest disadvantage (as our calculations below present) we have to propose customer relatively high price and still we can expect very low margin at the same time. So even medium-level profit is associated with considerable involvement to keep right website traffic (e.g. how to increase number of visitors or number of daily orders?). This often requires additional tools to implement our marketing strategies – like social media advertisements. Additionally, it is difficult to build your own brand, especially when the risk related to the quality of the goods and the service of the order is quite high. Due to low initial costs and relatively easy access to dropshipping wholesalers, we can also expect strong competition. Is it the optimal idea for a business in crisis? It depends - if we want only minimize costs, it can work. However, when at the same time we expect significant profits - here you should be more patient and, above all, work very hard to attract more customers and follow their purchase decisions. An important element here is an efficient information system. However again, It is hard to resist the impression that we are heavily dependent on suppliers and their pricing policy as well.

3. Online store costs simulation based on dropshipping platforms

To assess whether the dropshipping model is actually profitable, we should analyze first all costs related to the launch such business. Costs that a start-up company must incur were analyzed, taking into consideration on the example of a small enterprise operating in Poland.

These expenses can be divided into two groups - first: initial costs - related to running a business, and the second to its maintaining. According to Comănescu (Comănescu, 2020) in the first group we can include:

- costs of registering a company (in the case of a sole proprietorship in Poland, around 700 PLN = ~200\$¹)
- Internet domain purchasing (in case of the most popular Polish hosting company nazwa.pl starting set includes domain+additional basic services around 400 PLN = ~100\$).

Then we should take into account the costs of cooperation with a dropshipping wholesaler (like Ali Express Dropship, Alibaba, BigBuy Europe, Salehoo,Shopify, Ptakonline, Ab Pl, A-LAN, DROPCOM, EKOHURT, GaryLand, VivaB2B) and maintaining an online store. How to calculate them? First of all it is heavily dependent on the scale of our product range and terms of cooperation. According to Chodak (Chodak, 2008) we should definitely take into account the demand of our products, which can be calculated using following formula:

$$D_i = \frac{c * A_i}{M^e} \quad (1)$$

where:

D_i - demand for a given item (number of orders for the i -th assortment item),

A_i - expenditure on advertising of the i -th item in the assortment,

M - percentage margin, which is the ratio of the store's selling price to the price specified by the supplier,

e - price elasticity of demand,

c - conversion rate, determining the percentage of people who clicked on the sponsored link and purchased goods and can be calculated as:

$$c = \frac{1}{10} * (1 - M) + \frac{1}{10} \quad (1)$$

Of course total demand (D) is the sum of individual demand of assortment items (n):

$$D = \sum_i^n D_i \quad (2)$$

Chodak (2008) mentioned also that costs of maintaining of online store in dropshipping model can be divided into 3 subgroups:

Marketing costs (MC), defined as:

$$MC_i = \frac{B}{CPC} * \frac{\frac{S}{x_i^{S+1}}}{\sum_i^n \frac{S}{x_i^{S+1}}} \quad (4)$$

¹ Dependent of course on current currency rate.

where:

MC_i - the number of purchased clicks for the i -th position,

B - daily budget for sponsored links,

CPC - cost per one click,

x - assortment item number, it reflects the relevance (importance) of a given product for the store,

s - Pareto distribution shape parameter.

Internet costs (IC), calculated using following formula:

$$IC = HC + n * sc + d * \frac{D}{k} \quad (5)$$

where:

IC - Internet costs,

HC - Hosting costs,

sc - cost of service of one assortment item,

n - number of assortment items,

d - cost of a single order,

k - average number of assortment items in one order.

Operating costs (OC) - all fixed costs incurred by the store that are not included in other categories

To summarize total costs of maintaining dropshipping business (TC) can be calculated as a sum:

$$TC = MC + IC + OC \quad (6)$$

and of course potential profit based on formula:

$$P = \sum_i^n (PP_i - SP_i) - TC \quad (7)$$

where:

P - profit from sale of goods,

PP_i - purchase price of the i -th product,

SP_i - selling price of the i -th product,

TC - total costs.

In order to convince what kind of effects the online store may expect, we conducted some simulations of requirements and costs on dropshipping platforms. Here are some results.

Frist calculations are based on the following assumptions:

- only small company, which wants to run its online store were taken into consideration,
- on average, out of every 100 visitors to our store 2 people will place an order,

- the average order value will be \$45 (with at least 2 products),
- margin is 2x, which means it's necessary to charge customers double the price which online store pays the supplier,
- on average it costs you \$0.35 to attract one visitor to our site.

According to Oberlo dropshipping traffic calculator - to earn 1000\$ in 5 days it will be necessary to attract 2000 visitors and achieve 40 orders per day. It seems quite difficult and disproportionate to the potential gains.

In turn Salesource (product price calculator for Shopify and AliExpress dropshipping) allows us to calculate potential profits taking into consideration product purchase price and shipping costs. E.g. when we assume that wholesaler price will be 20\$ (+5\$ of shipping costs), it turns out that recommended retail price should be even higher, than our first assumption – almost 70\$! Final selling price may vary slightly, but Salesource recommend staying within the price range for optimal sales results (between 58.63\$ and 79.33\$). Additionally we should remember about cost per acquisition (CPA) which will be equal 23\$ to promote our product, because in the dropshipping business model, most of this money is going to be spent driving traffic to our online store website via paid advertising. It will be even increased, when we decide to use Facebook ads or in case of luxurious item. Profit is simply what is left after all expenses have been taken away from the total revenue – in this case we can expect 21\$. In the table below calculations for other product purchase prices were presented (shipping cost is the same, but of course it's depended on supplier conditions).

Table 4.

Product price calculation in the dropshipping model

Product price \$	Recommended retail price \$	CPA \$	Profit \$	Price range \$	Total product price \$
45.00	112.49	37.50	24.55	95.61-129.35	50.00
100.00	209.99	70.00	34.99	178.48-241.48	105.00
1500.00	3009.99	1003.33	501.66	2558.48-3461.48	1505.00

Source: own work based on salesource.io.

4. Summary

The major aim of this paper was to present the dropshipping model, consider its advantages and disadvantages and find out, is it accurate way to develop business in short time and answer the question does it actually work during any economic crisis, because recently we observe again increased interest in this issue. Beginner dropshippers need to understand that this logistics model is not just another 'piece of cake' concept - it is a full-time business that requires patience, consistency and a lot of hard work. Moreover, this type of business activity is quite risky and should not be treated as a panacea in times of crisis. It is certain, however,

that dropshipping will continue to develop in e-commerce. Online stores, if they think about significant profits, must focus on finding their niche, building responsive websites and rely on a solid information system.

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SCORES AND OPINIONS ABOUT CAR MAINTENANCE AND REPAIR SHOPS AS AN EXAMPLE OF WORD-OF-MOUTH MARKETING IN DIGITAL SOCIAL NETWORKS

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Purpose: Identification of scores and opinions about licensed car maintenance and repair shops in Radom on the basis of the word-of-mouth message in digital social networks.

Design/methodology/approach: Licensed car maintenance and repair shops located in Radom were selected for the research. There are 20 of them. In order to identify a word-of-mouth message about them, data available in Google Maps were used – both numerical scores and opinions. Total amount of 3561 entries was considered. A mixed quantitative-qualitative approach was assumed: the statistics of scores were analysed quantitatively, while the content of the posted opinions was analysed qualitatively.

Findings: Average scores for all car maintenance and repair shops are included in the interval $\langle 4,0; 4,6 \rangle$. The total weighted average score is 4,3. A sharp polarization among opinions was stated, resulting in dividing them into two groups: clearly positive and clearly negative ones. On one hand, opinions encompassing substantive marks of overall high service level, professionalism, competence and quickness in delivering services, contact and information, as well as friendly atmosphere and staff friendliness dominate among the positive ones. They are often posted by loyal customers, who repeatedly take advantage of the services. On the other hand, clearly emotional opinions, expressed as a result of a single incident of not fulfilling customer expectations in a blatant way or neglecting them dominate among negative ones.

Research limitations/implications: Research concerning a limited geographical region. Research should be treated as a pilotage.

Practical implications: Information concerning scores and opinions about car maintenance and repair shops can make a starting point for identifying the areas of service quality which demand improvement.

Originality/value: An innovative assessment of service quality in car maintenance and repair shops performed with the use of word-of-mouth data available in a digital social network.

Keywords: service quality, car maintenance and repair shop, word-of-mouth, social network.

Category of the paper: research paper.

1. Introduction

Exploitation of cars involves the necessity of performing a number of maintenance and repair activities. The average period of possessing a car by one owner is extended, what increases the demand for spare parts as well as technical and repair services (Auto Expo, 2014). It is particularly important in the reality of the Polish market in which the majority of the vehicles is old, with large mileage and very often in unsatisfactory technical condition. We are facing a problem of appropriate quality of services consisting in technical maintenance and repair of the said cars (Lotko, Lotko, 2016; Lotko, Lotko, Korneta, 2018). Delivery of the high quality of services is an important matter and at the same time a challenge posed to the service industry, including the automotive industry (Huang, Huang, Chen, 2003; Elistina, Naemah, 2011; Kankam-Kwarteng, Acheampong, Amoateng, 2016).

In the information society, the access to the high quality information is crucial for the functioning (McLuhan, Zingrone, 2001). The Internet has become an important tool which supports the management of an enterprise, a factor of creating the image of an organization and the element of the realization of economic processes supported by the Web 2.0 solutions (Zieliński, 2008). Web 2.0 is the kind of an approach towards communication in the Internet considering the change of the recipient's position, who becomes a rightful participant of the dialogue – there is a transition from a passive observer to an active co-author or author (Kaczmarek-Śliwińska, 2011). Therefore a contents consumer becomes also their producer (Chandler, Munday, 2011). Web 2.0 covers the Internet services allowing the users to cooperate and exchange information online via the Internet societies websites (Austin, Doust, 2008; Jakubowicz, 2011).

The possibility of expressing in the Internet the opinions about a company, offered products or services or of reading the opinions of other persons in this matter is today obvious. The fact that it becomes a basis for numerous consumer decisions is emphasised by a number of marketing practitioners as well as researchers (Borbis, 2020; Sadowski, 2020; Engler-Jasieczek, 2012; Radziszewska, 2013; Sanak-Kosmowska, 2020). The fact that the consumers are heard has changed the global economy. Democratization of the Internet has forced the enterprises to start an open and direct dialogue with consumers and the consumers themselves have been changed into prosumers. The active consumers by way of public presentation of their own opinions and experience with products or services affect other clients. In the information societies the users have begun to exchange information, and in particular recommend or to the contrary advise against certain goods and services (Ślęzak, 2019).

Being inspired by the above observations, in this study the author identified the scores and opinions concerning the authorised car maintenance and repair shops in Radom based on the word-of-mouth marketing in digital social networks, in particular among the Google Maps users. The research question was Q1: What are scores and opinions about car repair and

maintenance shops present in the Google Maps service? In the paper, it was answered with the use of a mixed quantitative-qualitative approach.

2. Word-of-mouth marketing as the tool of informal communication in social networks

A special kind of power of the consumer in the market is the power of reference which consists in recommendations made by the consumer to other persons of a given manufacturer and his offer. The term (*word-of-mouth marketing* – WoM) introduced by E. Rosen, called also as a virus marketing and defined as the use of interpersonal contacts network in the marketing strategies, should be considered. The word-of-mouth marketing is in other words the sum of all comments concerning a given product or service announced with the use of any communication channels in a specific period of time (Rosen, 2003). A. Budzanowska-Drzewiecka (2015) defines WoM as an informal interpersonal communication of consumers about their experiences with the market offer. Information about new products and services is very often spread among potential consumers with the use of the networks of interpersonal contacts, the majority of which remains at first sight invisible and in fact beyond recognition. It suffices to consider how big role in the making of the purchase decisions is played by the opinion of the environment – the family, experts, leaders in order to come to the conclusion that the interaction and contact has always been at the first place in marketing.

A huge role of the word-of-mouth marketing stems from three fundamental causes. They may be shortly characterized as (Kelly, 1998):

- information overload („clients do not hear you”),
- scepticism (distrust of customers, particularly important by the use of electronic channels),
- vicinity (customers live close to each other and they have introduced new tools used to transmit information such as e-mail, discussion letters, etc.).

The overload means an excess of information, which may deprive even the best marketing message from its power among many other. Scepticism is a learned realism of the customers who less frequently believe in advertisements, personal sale or any other way of recommending the product. Vicinity is the interaction and mutual contact between the customers. They often make purchase decisions very unwittingly and base on the well-known, mutual opinions. As one of the causes of interpersonal communication, the decrease of the risk is mentioned. Consulting with others significantly reduces the risk of making an improper decision (Sanak-Kosmowska, 2020; Lotko, 2008).

To sum up, the word-of-mouth marketing consists in the use of the net of customers' contacts, their social position and access to the media in a way allowing for the spread of information with the use of the net of interpersonal contacts (Lotko, 2008). Therefore the customers begin to perform marketing functions for the organization. In particular it is possible thanks to the network communication technologies, mainly thanks to the Internet services. The existence of social networks, creation of contents by the users, data repositories, collective intelligence and openness are the characteristic features of the modern Internet (O'Reilly, 2005).

The development of the Internet and social media has changed not only the way of communication between the enterprises and the market, but it has also revolutionized the customers' behaviours and their mutual relations. The customers dispose of a huge resource of marketing information and they knowingly and actively use it. They also are the creators of the contents, opinions and recommendations placed in the network. Thanks to this, their role as the participants of the process of market communication has changed drastically. The customers are no longer merely passive recipients of the contents, but they are active co-authors of the marketing message (Radziszewska, 2013). The role of the recipients in the communication process changes. We are dealing with the transition from the passive observer to the active co-author or author (Kaczmarek-Śliwińska, 2011). The Internet marketing gives the special possibility of orienting the actions towards the recipients connected with other elements of the social structure (Jankowski, 2007). This fact has also been used in this study.

3. Specificity of cars technical maintenance and repair

The services of cars technical maintenance and repair are rendered by the service stations and car repair shops. There are around 19,5 thousand independent car repair shops registered in Poland, as well as over 1.5 thousand authorized service stations, i.e. ASO (SDCM, 2017). Therefore ASO constitute around 8% of all considered units. A considerable majority of authorized car repair shops performs all kinds of repairs (over 62%), and the range of their services is constantly extended. However some of them specialize in the narrow field, for example in electricity and electronics or in the engine main repairs. Since 2004 the number of the independent car repair shops has been slowly but systematically decreasing. Nevertheless the number of the car repair shops associated in the independent car repair shops network increases and the existing car repair shops increase the employment (SDCM, 2017).

In order to provide proper technical conditions of the vehicles, a specialist services connected with their technical service and repair are required. In the opinion of the authors the following factors influence the particular rank of the quality of these services (Lotko, Lotko and Korneta, 2018):

1. Universality and massive character (almost everybody takes advantage of their services, for example in Poland there are almost 39 million visits annually, i.e. on average more than 1 visit per every citizen).
2. Complexity of the serviced product (a car is composed of a several thousand of parts).
3. Technological advancement of the product (in the automotive industry the newest solutions are applied within the scope of mechanics, electronics, robotics, IT, telematics) that require from the car repair shop the access to appropriate information and possessing of the advanced specialist knowledge by the employees that reach far beyond purely mechanical problems.
4. Poor technical condition and advanced age of the number of used vehicles in Poland where the average age of a car is 15 years, whereas 75% of the vehicles has over 10 years of age and more (Newsweek, 2016).
5. Faint awareness of the users of the vehicles within the scope of technical matters and their influence on the comfort of the use of a vehicle, its durability and safety in the road traffic.
6. Explicit distinction between customer service and performance of the service and repair works during the completion of the service process.
7. Requirement of a fast and accurate diagnosis of a defect before starting the repair procedure (Włodarczyk, Janczewski, 2011).
8. Necessity of the performance of the maintenance and repair works according to the procedures of the vehicle manufacturers.
9. Significant impact of a proper performance of services on the safety of the road traffic.

Due to the above reasons the considered matter has been deemed crucial for the economic practice and it deserves scientific elaboration.

4. The state of the art in the literature

In the recent years the matter related to the one discussed in this paper has been the subject of rather small number of publications. The carried out bibliography query revealed publications concerning the quality of services provided by the car repair shops, and in particular the definitions of its dimensionality (for example Elistina, Naemah, 2011; Berndt, 2009; Berndt, Herbst, 2006; Izogo, Ogba, 2015; Stavanović, Stanojević, Nedić, 2013; Kankam-Kwarteng, Acheampong, Amoateng, 2016; Schneider, 2012). Their authors attempted to explore the essence and multidimensionality of the quality of the above mentioned services. Publications mainly include the proposals of individually established and tested measurement instruments. However in these papers no measurement of the level of quality has been carried

out, much less no data stemming from the word-of-mouth marketing has been applied in the electronic social networks.

The researchers noticed that the automotive industry and services connected with it develop dynamically and competitively. They emphasise the particular weigh of performing marketing activities which could increase the loyalty towards the brand and could create among the customers the intent of repeated purchase. The word-of-mouth marketing plays a very important role as it significantly influences the loyalty of the customers (Wijaya et al., 2022).

In the dynamic business environment the participants of the market must adapt their actions in order to attract, keep and care for the customers. In literature the key role of the post-purchase service and support of the buyers is emphasised. The authors proved the existence of the relation between the quality of the post-purchase services, satisfaction of the customers, their loyalty and the informal marketing message created by them (Nasir, Adil, Dhamija, 2021).

The word-of-mouth marketing is particularly effective in case of negative message which very often substitutes the submitting of formal complaints (Halstead, 2020).

Other authors claim that the increase of the meaning of the word-of-mouth marketing is connected with the development of the digital social networks. Due to this reason developing relations between the customer and the brand, creating the attachment and loyalty towards the brand should be the priority challenge, also in the automotive market. This is confirmed by the integrated model of relations between the brand and the customer (Consumer-Brand Relationship – CBR), dedicated to this market (Kaufmann et al., 2019).

In the next researches the authors proved that communication in the social media significantly influences the values of the brand (*Consumer-Based Brand Equity* – CBBE). It has been discovered that the promotion of the automotive brands in social media and the positive message of the word-of-mouth marketing positively influence the value of these brands (Adetunji, Rashid, Ishak, 2018).

The next researchers proved that in the automotive industry, the consumers driven by the striving to satisfy the information needs, are motivated to create an informal marketing message. This is observable above all in the electronic environment (Kwan, 2018).

Other authors analysed the quality of the services within the scope of maintenance and repair of the cars. In the elaborated model, they presented the influence of the quality of the maintenance services, perceived integrity and convenience on the consumers' satisfaction. What is more the authors also discovered the impact of the satisfaction and trust for the brand on the informal marketing message as well as the mediation effect of the satisfaction from the provided service exerted on the relation between the quality of the services and word-of-mouth marketing (Jain, Singh, Kaushik, 2019).

It has been also discovered that the selected brand attributes, above all recognisability, emotionality, proficiency and quality influence the creation of recommendations. A number of brands associated with a considerably positive informal marketing message, have significantly increased its value in time (Luo, Baker, Donthu, 2019).

The literature review presented above shows that the issue of the word-of-mouth marketing for the services provided by the car maintenance and repair shops is slightly popular among the researchers and it has been hitherto elaborated only in fragments. Three basic research streams have been identified, in which the authors mainly concentrate on:

1. The essence and dimensionality of the quality of services provided by the car maintenance and repair shops.
2. Structural models which identify factors influencing the creation of the informal marketing message by the customers of the car maintenance and repair shops.
3. Attributes of the brand of the car maintenance and repair shop which initiate the word-of-mouth message and influence its value.

In the view of the above, the author of this paper assumed that this particular field of study should be developed in the direction of quantitative and qualitative analysis of scores and opinions concerning car maintenance and repair shops, which create informal marketing message in the Internet.

5. Methodology of the study

In order to identify the scores and opinions, the author selected the authorized car maintenance and repair shops located in Radom or nearby. The study covers 20 car maintenance and repair shops listed in table 1. Most frequently the car maintenance and repair shops operate as one of the dealer activity area, but not always. The opinions concerning the car maintenance and repair shops were taken into consideration.

Table 1.

List of the car maintenance and repair shops covered by the study

No.	Name	Remarks
1	A.S.R Bińkowski	Suzuki authorized car maintenance and repair shop
2	AC Cortes Mazda	Mazda authorized car maintenance and repair shop
3	AMD Auto Centrum	Skoda authorized car maintenance and repair shop
4	Dacia Radom – Karasiewicz i Syn	Dacia authorized car maintenance and repair shop
5	Dixi-Car S.A.	Mitsubishi authorized car maintenance and repair shop
6	Dixi-Car S.A.	Opel authorized car maintenance and repair shop
7	Honda Strzałkowski Radom	Honda authorized car maintenance and repair shop
8	M i R Prasek	Peugeot authorized car maintenance and repair shop
9	M i R Prasek	Hyundai authorized car maintenance and repair shop
10	MB Radom Sp. z o.o.	Mercedes-Benz authorized car maintenance and repair shop
11	Nissan Ster Radom	Nissan authorized car maintenance and repair shop
12	Optimal	Citroen authorized car maintenance and repair shop
13	Plejada	KIA authorized car maintenance and repair shop
14	Rad Motors	Ford authorized car maintenance and repair shop
15	Renault Radom – Karasiewicz i Syn	Renault authorized car maintenance and repair shop

Cont. table 1.

16	Ster Sp. z o.o.	Volkswagen, Audi and Seat authorized car maintenance and repair shop
17	Subaru ITS Michalczewski Sp. z o.o.	Subaru authorized car maintenance and repair shop
18	Toyota & Lexus Romanowski Radom	Toyota and Lexus authorized car maintenance and repair shop
19	Yorgo Jerzy Piotrowski	Ssang Yong and Isuzu authorized car maintenance and repair shop
20	ZK Motors	BMW authorized car maintenance and repair shop

Source: author's own study.

Localization of the studied car maintenance and repair shops on the map of Radom is presented in figure 1.

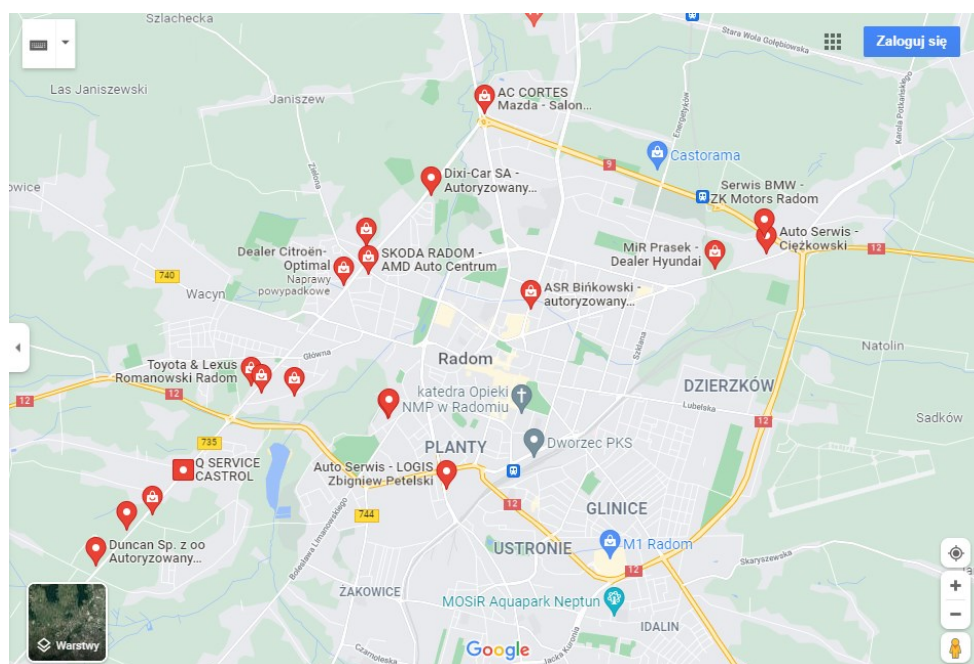


Figure 1. Localization of the authorized car maintenance and repair shops on the map of Radom.

Source: Google Maps.

In order to identify the opinions on the above mentioned car maintenance and repair shops available in the Google Maps service – both the numerical opinions and the wording of the opinions. The study covers data as of 3rd November 2022.

Google Maps is the Internet service which enables the users to search for objects, see the maps, air photos, Earth surface, 360° panoramic street views in the real time, planning of the routes of the travels. It was created and launched on the 8th February 2005. It is equipped in a free of charge service called Google My Company which gives the owners of the companies the possibility to display the name and the address of an enterprise in Google Maps and in the search engine. Presence of a company in Google Maps is preceded by the setting up of the profile on the Google My Company platform and then the company owner must fill in the business activity category, physical localization of the company, contact data and additional information. Registered users of Google services may evaluate particular companies by giving them scores (number from 1 to 5), as well as opinions – short descriptive and qualitative comments. The example is presented in figure 2.

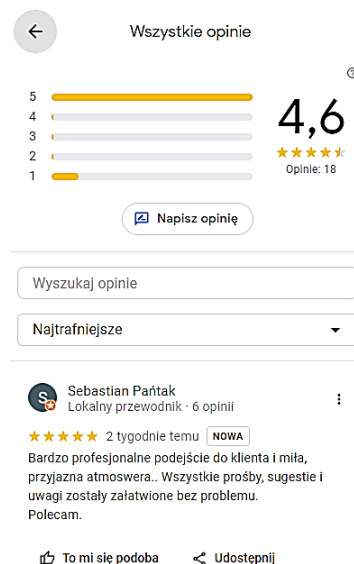


Figure 2. Exemplary sum up of an opinion on the car maintenance and repair shop.

Source: Google Maps.

Gathered data underwent a quantitative analysis – scores (average score in the 1-5 scale), as well as the qualitative analysis – wording of comments (50 lately added inscriptions for each car maintenance and repair shop: if there were less than 50, all of them were analysed). All the data used in the research is publicly available at the Google Maps service.

6. Analysis and discussion of the results

At first a quantitative analysis concerning the scores was carried out. In table 2 average scores and numbers of scores for the analysed car maintenance and repair shops are presented. The average scores of the particular car maintenance and repair shops are also presented in figure 3.

Table 2.

Average scores and number of scores for analysed car maintenance and repair shops

No.	Name	Average score	Number of scores
1	A.S.R Bińkowski	4,4	107
2	AC Cortes Mazda	4,5	140
3	AMD Auto Centrum	4,4	272
4	Dacia Radom – Karasiewicz i Syn	4,6	52
5	Dixi-Car S.A. (Opel)	4,0	280
6	Dixi-Car S.A. (Mitsubishi)	4,6	22
7	Honda Strzałkowski Radom	4,5	115
8	M i R Prasek (Peugeot)	4,3	220
9	M i R Prasek (Hyundai)	4,2	161
10	MB Radom Sp. z o.o.	4,1	271
11	Nissan Ster Radom	4,6	29

Cont. table 2.

12	Optimal	4,2	144
13	Plejada	4,6	172
14	Rad Motors	4,0	200
15	Renault Radom – Karasiewicz i Syn	4,3	225
16	Ster Sp. z o.o.	4,3	380
17	Subaru ITS Michalczewski Sp. z o.o.	4,6	69
18	Toyota & Lexus Romanowski Radom	4,6	526
19	Yorgo Jerzy Piotrowski	4,2	67
20	ZK Motors	4,6	110
Total		4,3	3561

Source: author's own study.

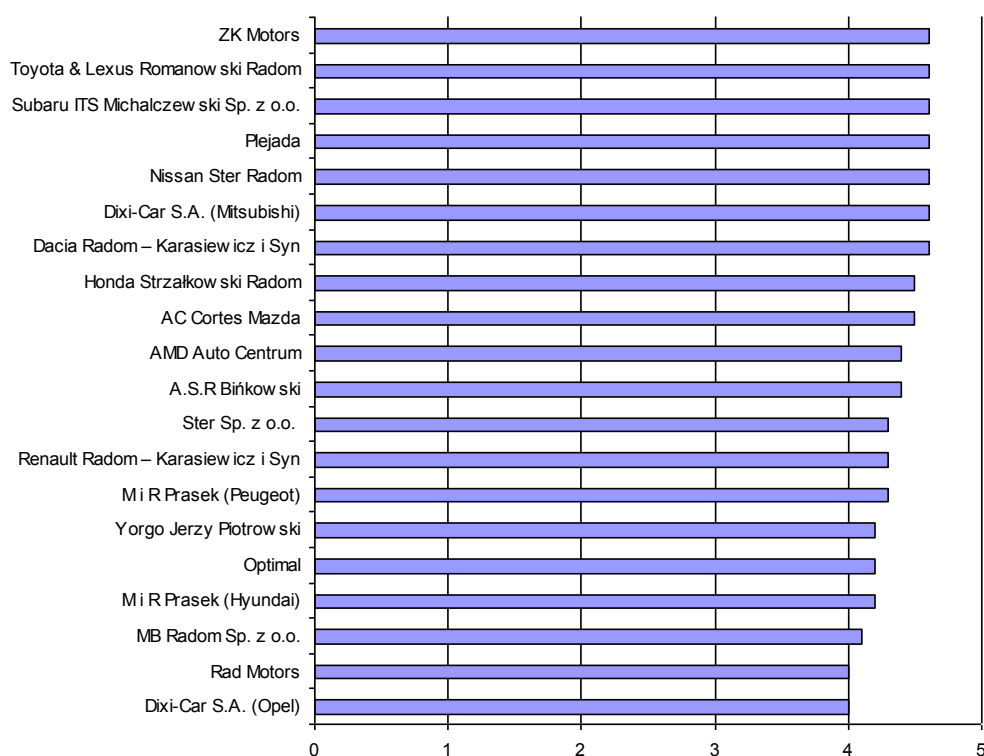


Figure 3. Average scores of the analysed maintenance and repair shops.

Source: author's own study.

On the basis of analysis of data included in table 2 it was stated that Toyota & Lexus Romanowski Radom (526), Ster Sp. z o.o. (380), and then Dixi-Car S.A. (Opel), AMD Auto Centrum and MB Radom Sp. z o. o. are the car maintenance and repair shops with the greatest number of scores (in the range 271-280 of grades). Whereas the entities with the smallest number of scores are Dixi-Car S.A. (Mitsubishi) (22 grades), Nissan Ster Radom (29), Dacia Radom – Karasiewicz i Syn (52 scores). The average number of scores is 178 of scores for one car maintenance and repair shop.

The analysis of data presented in table 2 and in figure 3 shows that the empirical area of variability i.e. the scope in which all scores, the range $\langle 4,0; 4,6 \rangle$, is included. The weighted average on the basis of all scores is 4,3. Eleven car maintenance and repair shops obtained the score above average and six below the average. Whereas for three car maintenance and repair

shops the average score is equal to the average calculated for all studied entities. Seven analysed car maintenance and repair shops is included in the group with the highest average score (4,6), whereas two car maintenance and repair shops obtained the lowest score (4,0).

Subsequently the qualitative analysis concerning the opinions was carried out. In particular, table 3 includes the selected repeated phrases or phrases characteristic for the analysed car maintenance and repair shops. They were grouped into the positive (+) and negative (-) ones.

Table 3.

Selected opinions on the analysed car maintenance and repair shops

No.	Name	Selected phrases from the opinions
1	A.S.R Bińkowski	+ Professionalism, professional service, reliability, timeliness, communicativeness, friendly atmosphere, proficiency, friendly approach towards the customer, high level of customer service. - Lack of spare parts, failure to remove the defect, differences in the set and realized prices, failure to keep the promises.
2	AC Cortes Mazda	+ fast and efficient service, friendly customer service, professionalism, professional approach towards the customer, competent customer service, engagement far beyond the standard, professional care, accuracy, accessible process, good job, reliability, hassle-free attitude. - High prices.
3	AMD Auto Centrum	+ Great service, the highest level of service, service of high level, professionalism, sobriety, nice and pleasant customer service, proficiency and timeliness customer service, cool service, super service, great advisory and super positive guys, reliable and fast service, fair advisory. - Poor service, not ordered spare parts, inaccurate assembly of tinner elements, the employee does not perform the works according to the arrangements.
4	Dacia Radom – Karasiewicz i Syn	+ Professional and nice service, specifically and positively, super service, reasonable prices, 100% satisfaction, nice service, good mechanic.
5	Dixi-Car S.A. (Opel)	+ Professional service, very nice staff, very nice service, fine service, professional approach, kindness and support. - Poor service, the worst service I have ever met, the staff does not provide the services reliably, they ignore the customer, rather unpleasant service, averagely, I don't recommend,, a bit incompetent.
6	Dixi-Car S.A. (Mitsubishi)	+ Very professional approach to the customer, favours, suggestions and remarks are served without any problem, reliable provision of services, professionalism, fast, efficiently, I recommend, nice and professional service.
7	Honda Strzałkowski Radom	+ Right direction towards satisfied customers, fast and pleasant service, fast and professional, great in every aspect, accuracy, reliable information, high level of service, problem-free, neat service, professional and pleasant customer service, thanks to them I didn't step on the mine. - Wrongly completed repair, I don't recommend, does not deserve any star, defect fixed many times without positive effect.
8	M i R Prasek (Peugeot)	+ Perfectly completed repair, fast and efficient repair, honest attitude to the customer, professional customer service, punctuality, current informing, the service did a god job, high personal culture of employees, nice waiting conditions, professionalism, express pace, care for costs, customer service and quality of the repair at the global level, fast, efficiently, punctually. - Lack of competences, shame, no solution was offered, give it a wide berth, horrible quality, long time of repair, poor communication, long deadlines, I don't recommend, relatively high prices.

Cont. table 3.

9	M i R Prasek (Hyundai)	+ Informing, sobriety, unreliable service, problem-free contact, patience and explanations from the employees, fine service, big plus, worth recommending, fast repair, pleasant customer service, professional service, fast and soundly. - Exorbitant prices, unpleasant customer service, I don't recommend, no contact, disrespect, putting off the customer, lack of competences, expensive.
10	MB Radom Sp. z o.o.	+ Maintenance works performed properly, great service, I recommend, works performed proficiently and on time, high culture of work, very nice customer service, perfect provision of service, efficiently and fast, pleasant and professional customer service, proficient service, good service. - Terrible services, price different than in the original offer, it could be much better, lack of competences, knowledge, approach to the customer, I definitely advise against the visit, give it a wide berth, disaster, there could be no lower grade given, lack of competences in service and car repair, repair deadline not kept.
11	Nissan Ster Radom	+ Very proficient service, high level of the customer service, efficient and professional service, substantial and proficient service.
12	Optimal	+ Good, nice service, fast deadlines, super service, very pleasant service, good contact, professional service, all according to the arrangements, very good service, helpful, give advice, solve difficult cases, express, professional repair, pleasant customer service, one of the best car maintenance and repair shops, very good, reliable car maintenance and repair shop. - The employees unwilling to serve the customer, long time of waiting, breaking of the promises, farce, they treat the customer as a potential enemy, they effectively advice against taking advantage of the services, prices from the outer space, lack of knowledge and experience, they condescend to do anything, unpleasant and showy customer service, I didn't like the customer service, failure.
13	Plejada	+ Everything great, great service, generally I'm satisfied, kindness, proficiency, fantastic service, very good and professional service, I definitely recommend, every time professional service, very satisfying service, cheap and friendly service, reliable service, worth recommending, excellent service. - I don't recommend, lack of competences, tragedy, long time of waiting for spare parts, definitely no, I definitely don't recommend, horrible quality.
14	Rad Motors	+ Super professional attitude to customer, professionals, nice and substantial contact, professional and reliable repair, nice and professional, fast and efficient, good service, fast and efficient service, accessible prices, professional service, fast and problem-free repair. - Absolute disaster, I definitely don't recommend, I don't recommend, the estimated time of repair is extended, the worst service, no contact, expensive, I don't recommend the service, ignoring and cheating the customer, no respect for customer, disappointment concerning the attitude towards the customer, ignoring the customer, disaster, ignoring, the worst service I have ever seen.

Cont. table 3.

15	Renault Radom – Karasiewicz i Syn	<p>+ Nice and professional service, reasonable price, service at the highest level, fast and efficient service, very good service, efficiently, on time, very nice customer service, the service was provided in a flash, high personal culture, proficiency, great customer service, problem-free contact, short time of waiting for the repair, professional and kind customer service, car fixed fast and without reservations, repair completed fast and professionally, I definitely recommend, super customer service, they show and explain everything, efficiently and problem-free, I am very glad, I recommend in 100%, highest level of advisory, service provided reliably.</p> <p>- Disaster, level below zero, give it a wide berth, too long time of repair, the service cannot fix the car, unprofessional attitude towards customer, the style and culture leave a lot to be desired, ignoring the customer, they don't care about the customer, they cannot diagnose the defect, the customer service discourage to take advantage of the services.</p>
16	Ster Sp. z o.o.	<p>+ In my opinion the service is great, the atmosphere and customer service very nice, I can honestly recommend the service, the service provided fast and solidly, wonderful and kind customer service, solid people, solid service, I am very pleased, the customer service know what's what, professionalism and advisory, the best service, I have ever visited, revelation, rapid service, attractive prices and great customer service, I recommend the service, good service, they repair cars at the highest level, professional attitude, kind customer service.</p> <p>- It could be a little bit faster, I don't recommend, no contact, give it a wide berth, I won't visit them again, definitely big minus, I don't recommend, disaster, they don't keep the promises, they don't stick to the arrangements, horror, lack of competences, huge minus, unsatisfactory level of customer service, they wash their hands of the customer and send away to the other service, lack of competences, I don't recommend, terrible customer service, they wait till the end of the warranty.</p>
17	Subaru ITS Michalczewski Sp. z o.o.	<p>+ First class service and customer service, fine prices, great contact, full professionalism, proficient customer service, they stick to the arrangements, I recommend with clear conscience, efficiently and substantially, very competent employee and advisory, great surprise, very good service, accessible prices, positive impression about the provided service, I recommend, proficiency worth recommending, good mechanics, nice atmosphere, good service with reasonable prices.</p> <p>- I don't recommend, lack of professionalism, no availability of spare parts.</p>
18	Toyota & Lexus Romanowski Radom	<p>+ I heartily recommend, professional service, high level of the quality of services, car service is a pure delight, my favourite service, I wish that the customer in every service could feel as comfortable as here, very nice and solid customer service very good contact, high standard in every aspect, I have no reservations concerning the service, high level of service, help, engagement and they respond the expectations of the customer, service worth recommending, nice and professional customer service, always kind and professional customer service, all employees engaged and helpful, high level of provided services, high personal culture, readiness to help, and advise, flexible prices, I am very satisfied, professional approach toward the customer, without delays and unexpected costs.</p> <p>- Wasted time, the service could be provided better in a garage, the car repaired disorderly, unreasonable prices, no contact, customer service a bit better than in the former political system, money extortion, parody of a service.</p>

Cont. table 3.

19	Yorgo Jerzy Piotrowski	+ Professional and nice customer service, solidly and cheap, engagement of the team, super company, I recommend, every customer is treated individually, I heartily recommend the service, proficient customer service, competent customer service, professional customer service. - Mockery, embarrassing attitude to customer.
20	ZK Motors	+ Great service, great customer service, I recommend with clear conscience, professional customer service and attitude to customer, very kind customer service, professional attitude to customer, everything explained and completed on time, professional service, modern technologies, comprehensive and professional customer service, service worth recommending, professional help, contact and advisory at the highest level, normal prices, full professionalism, kind customer service, I recommend this service, I recommend in 100%, the best service in Poland, sobriety, customer service at the highest level, fast and professional. - I don't recommend the service.

Source: author's own study.

As a result of the analysis of table 3 the following conclusions have been drawn. A distinct polarisation of opinions towards very positive (delight resulting in the engaged recommendation of a given service, e.g. *a service worth recommending, I definitely recommend, I heartily recommend, I recommend in 100%*) as well as negative (disgust resulting in the engaged advising or warning against taking advantage of the services provided by a given car maintenance and repair shop, e.g. *give a wide berth, I definitely don't recommend, I definitely advise against*) is observed. Intermediary opinions reflecting ambivalent feelings of the customers occurred very rarely (there were only several). This conclusion also clearly results from the analysis of histograms of scoring in the Google Maps service. Therefore a distinct use of the possibility to publish scores and opinions given by specific services as the tool of recommending or not, what is typical of the word-of-mouth marketing, is observed.

In the published opinions among positive definitions, substantive grades prevail, above all the ones concerning in general the high level of service, professionalism, proficiency and the speed of the provision of a given service, contact and informing as well as nice atmosphere and friendliness of the staff. They are very often published by the loyal customers who take advantage of the services regularly. Whereas among the negative opinions emotional opinions prevail expressed as a result of one incident – striking non-fulfilment by the service of the customer's expectations or ignoring the customer. Very emotional and even insulting noun definitions (*mockery, shame, parody*) are also characteristic for these opinions. In many cases the unsatisfied customers also placed a detailed description, essential description of a given case together with photo documentation.

7. Conclusions

In consequence of the carried out study and then as a result of the analysis of gathered data conducted with the use of the mixed quantitative and qualitative approach, the author of this paper came to the following conclusions:

1. Scores concerning all services are included in the range $\langle 4,0; 4,6 \rangle$.
2. The weighted average from all scores is 4,3.
3. Eleven services obtained the score above the average and six below the average. For three services the average score is equal to the average for all entities.
4. There is a distinct polarisation of opinion into positive and definitely negative opinions. The intermediate opinions are lacking.
5. Among definitions included in positive opinions substantive scores prevail, above all concerning the general high level of service, professionalism, proficiency and speed of the provided service, contact and passing of the information, as well as nice atmosphere and friendliness of the staff. Positive opinions are often published under the influence of the experience of the repeated use of the services.
6. Positive opinions are often published by loyal customers who regularly take advantage of the services. Negative opinions are often published under the influence of an impulse – single striking non-fulfilment of customers' expectations.
7. Among negative opinions, the ones expressed as a result of a single incident prevail – a striking non-fulfilment of the expectations of the customer or ignoring the customer.

The conducted quantitative and qualitative analysis of data placed in the Internet by the customers of car services allowed to prove the usefulness of these scores and opinions for the elaboration of the direction of marketing activities taken up by the marketing services. The obtained results may constitute the basis for establishment of directions and methods applied in order to improve the quality of the provided services.

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AN ATTEMPT TO THE CLASSIFICATION OF FIRM COMPETENCES

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Purpose: Among the strategic potentials of a firm affecting both market and economic outcomes achievement by the firm, as well as gaining and maintaining a long-term competitive advantage by a firm, the key importance is assigned to the firm competences. The aim of the article is to identify the premises as well as the criteria and cross-sections of the classification of firm competences.

Design/methodology/approach: The article indicates the key criteria and types of the firm competences within strategic management. An extensive literature review and an identification approach were used.

Findings: Competences should be classified using different criteria. Individual competences may significantly affect the achievement of the expected market and economic outcomes, as well as building a long-term competitive advantage of a firm.

Practical implications: The research outcomes presented in the article show the importance of the different types of the firm competences in strategic management.

Originality/value: The most important criteria of the classification of the firm competences in the area of strategic management were presented. The article is addressed both to researchers as well as managers and other business practitioners.

Keywords: competences, strategic potentials, strategic management.

Category of the paper: Conceptual paper.

1. Introduction

Within the area of strategic management in the recent years one may notice the growing significance of the so-called strategic potentials of the firm, comprising, among others, firm competences (Day, Wensley, 1988; Day, 1994; Christensen, 1996; Foss, 1996; Knudsen, 1996). Strategic potentials, which apart from firm competences also include firm resources as well as firm capabilities, are the factors affecting the achievement of the expected market outcomes (customer satisfaction, customer loyalty, market share) and economic outcomes (profit, profitability, return on invested capital) by the firm.

The expected outcomes are the result of undertaking and implementing the planned tasks by the firm, both at the strategic as well as the operational level, in accordance with the structure of the adopted goals and the firm capabilities, as well as taking into account the market, competitive and macroeconomic conditions. Such outcomes, related to the achievement of planned results, may constitute the basis for the firm success. In a situation where the market and economic outcomes achieved by the firm are more favourable than those achieved by the competitors, strategic potentials may lead to the creation of a competitive advantage of the firm.

The aim of the article is to identify the premises as well as the criteria and cross-sections of the classification of firm competences. In particular, the article indicates the most important criteria as well as types of the firm competences within strategic management.

2. The nature of the firm competences

The concept of the firm competences is perceived from two points of view (perspectives): (1) from the personal perspective and (2) from the managerial (business) perspective.

From the personal perspective competences refer to the characteristics or features of people that allow them to perform the tasks entrusted to them. The issue of competences from this perspective has been the subject of detailed consideration in the area of Human Resources Management (HRM) for many years (Dubois, 1993; Illeris 2009).

In turn, from the managerial (business) perspective, which is typical for the resource-based strategic management area, competences comprise the diverse capabilities of the firm, allowing the effective use of resources that the firm has or is able to obtain. In this case one may say about the firm competences (Matwiejczuk, 2014), and – in a broader sense – about Competence-Based Strategic Management.

Within the resource-based strategic management area it is emphasized that resources are the basis for the firm as well as strategic business units market activities. The primary condition for the effective use of resources is the development of adequate firm capabilities. Such firm capabilities create firm competences. The condition for the development of the firm competences is the integration and coordination of the firm resources and capabilities. At the same time, the firm knowledge should be taken into account as a key type of firm resources.

According to R. Sanchez and A. Heene (Sanchez, Heene, 2004) competences are the capabilities (sets of capabilities) thanks to which the firm is able to use its resources in a coordinated manner and, consequently, actively manage its resources, enabling and/or stimulating the achievement of assumed goals. J. Wallin (Wallin, 2005) points out that the firm capabilities are the result of the operationalization of the firm competences, which manifests itself in detailing and “breaking down” competences into specific capabilities.

R. Sanchez emphasises four significant criteria concerning the conditions which the firm competences should fulfil (Sanchez, 2004):

1. Competences should enable a proper reaction to the dynamic changes taking place in the firm environment as well as within the firm.
2. Competences should take into account the assumptions and elements of the systematic approach to business management and its relations with other firms.
3. Competences should contribute to value creation both for the customer and the firm.
4. Competences should take into account the holistic nature of a firm relationships with its stakeholders.

From the perspective of the resource-based strategic management area, competences are the long-term firm capabilities (sets of capabilities) for the firm resources use, involved in the implementation of the set goals and tasks of a firm, leading to the achievement of the expected market and economic outcomes by the firm, as well as to the long-term competitive advantage creation. The basis for the development of competences understood in this way is the integration and coordination of the firm resources and capabilities, taking into account the knowledge perceived as the specific type of the firm resources (Matwiejczuk, 2014).

3. Criteria and sections of the firm competences classification

In the literature devoted to the issue of competences one can find various ways of the competences classification. The criteria and cross-sections of the classification of competences refer to the levels of the competences development, concerning the assessment of the competences significance in a firm, as well as the other ways of the competences presentation, including (Mikus, 2003):

- 1) Basic dimensions of competences.
- 2) Scale of forming and developing of competences.
- 3) Specificity of competences from the tasks performed perspective, the firm perspective as well as the sector perspective.
- 4) Possibilities of competences influence on a firm.
- 5) Phases of the value creation process in which the firm competences are involved (table 1).

Table 1.*The most significant criteria and sections of the firm competences classification*

Criteria of competences classification (Author/Authors)	Types of competences
Dimensions of competences (G. Cheetham, G. Chivers)	<ol style="list-style-type: none"> 1) Cognitive competences 2) Functional competences 3) Personal competences 4) Competences concerning firm ethics and social responsibility 5) Metacompetences
Scale and level of forming and developing of competences (F. Delamare – Le Deist, J. Winterton)	<ol style="list-style-type: none"> 1) Cognitive competences (knowledge) 2) Functional competences (capabilities) 3) Social competences (attitudes and behaviours) 4) Metacompetences (knowledge improvement and development)
Specificity of competences from the perspective: <ol style="list-style-type: none"> 1) performed tasks 2) firm 3) sector (O. Nordhaug)	<ol style="list-style-type: none"> 1) Metacompetences 2) General sectoral competences 3) Firm competences 4) Standard technical competences 5) Universal (nomothetic) technical competences 6) Special (idiosyncratic) technical competences
Possibilities of the competences impact on a firm (G. Hamel)	<ol style="list-style-type: none"> 1) Competences affecting the firm access to the market and cooperation with customers 2) Competences affecting the performance of processes and activities 3) Competences enabling the forming of unique functional features of products and services
Phases of the value creation process (A.A. Lado, M.C. Wilson)	<ol style="list-style-type: none"> 1) Competences related to the inputs involved in the value creation processes 2) Competences related to the transformation of inputs incurred in the value creation processes into the outputs of these processes 3) Competences related to the outputs of the value creation processes
Significance of competences in a firm (W. Buchholz, T. Olemotz)	<ol style="list-style-type: none"> 1) Basic competences <ul style="list-style-type: none"> – Firm-wide competences – Competences covering specific processes performed by the firm – Metacompetences as learning capabilities by the firm 2) Key competences
Importance of competences in a firm/two sections of classification/ (W. Krüger, C. Homp)	<p>First section:</p> <ol style="list-style-type: none"> 1) First-order competences 2) Second-order competences 3) Third-order competences <p>Second section:</p> <ol style="list-style-type: none"> 1) Basic competences 2) Metacompetences 3) Key competences
Importance of competences in a firm (E. Zahn)	<ol style="list-style-type: none"> 1) Competences 2) Key competences 3) Metacompetences

Source: Based on: Cheetham, Chivers, 1996, pp. 20-30; Cheetham, Chivers, 1998, pp. 267-276; Delamare – Le Deist, Winterton, 2005, pp. 27-46; Hamel, 1994, pp. 11-33; Lado, Wilson, 1994, pp. 699-727; Mikus, 2003, pp. 239-240; Nordhaug, 1998, pp. 10-12.

Striving for a comprehensive approach to competences, G. Cheetham and G. Chivers list their five most important dimensions, which, according to these authors, integrate the competences of a firm and personal competencies. These dimensions make it possible to identify five groups (types) of competences (Cheetham, Chivers, 1996, 1998; Hodkinson, Issitt, 1995):

- 1) Cognitive competences, which take into account theories and concepts spanning on competences and constituting the basis for their development, as well as informal, tacit knowledge, which is of decisive importance in the formation and development of key competences,
- 2) Functional competences, which comprise the skills and knowledge of persons (managers, employees) performing the assigned tasks related to individual processes and/or functions (functional areas) of a firm,
- 3) Personal competences, related to individual characteristics, i.e. features and skills of persons, affecting their behaviour, ways of doing, as well as the methods and ways of performing the assigned tasks, including the effectiveness and efficiency of performing the above tasks,
- 4) Competences concerning firm ethics and social responsibility, as well as its managers and employees, affecting, among others, the compliance with standards and values in the process of tasks performance by managers and employees of a firm,
- 5) Metacompetences, which comprise broadly understood capabilities concerning the responding to unpredictable events, the creation of scenarios for securing and developing both existing and new competences, as well as the collection and use of the knowledge by a firm and its employees.

F. Delamare – Le Deist and J. Winterton present their own classification of competences, which is based on two main components (Delamare – Le Deist, Winterton, 2005):

- 1) Scale of forming and developing of the competences, which allows to distinguish between competences related to the tasks performed and competences related to the role of human resources in a firm,
- 2) Level of forming and developing of the competences, for which they mention the strategic level and the operational level (figure 1).

F. Delamare – Le Deist and J. Winterton point that three groups (types) of competences: (1) cognitive competences, (2) functional competences and (3) social competences are universal, that manifests itself in forming the knowledge, skills and capabilities, attitudes and behaviour of persons (managers, employees), that can be used in various assigned tasks performance. The triad “knowledge – capabilities – attitudes and behaviour” is the basis for forming and developing the firm competences using the opportunities inherent in personal competencies (Delamare – Le Deist, Winterton, 2005).

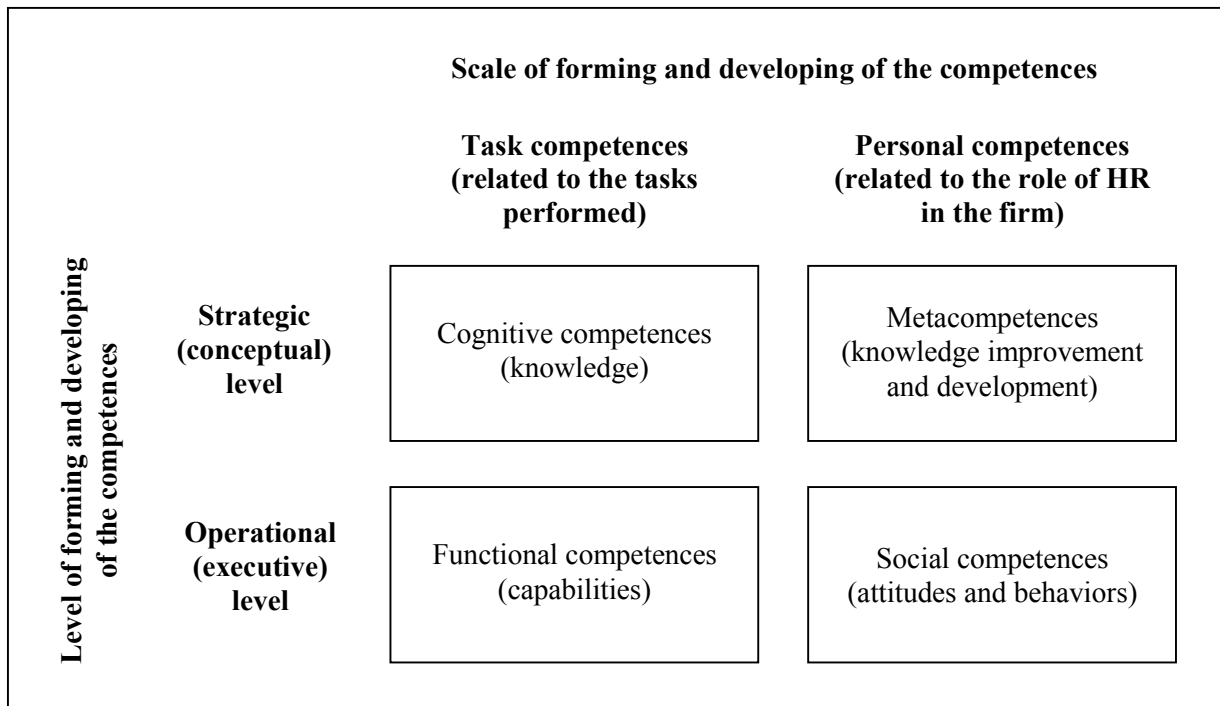


Figure 1. Typology of competences based on the level and scale of competences formation and development.

Source: Based on: Delamare – Le Deist, Winterton, 2005, pp. 27-46.

In turn, metacompetences, as pointed out by the above-mentioned authors, are characterized by different features, related primarily to the orientation of metacompetences to securing the existing firm and personal competences, as well as the development of the new firm and personal competences. Within such a point of view, metacompetences may be conventionally defined as competences leading to the development of the other competences.

Broader classification of competences is presented by O. Nordhaug, according to whom efforts leading to distinguish individual types of competences should comprise their specificity, taking into account three perspectives (Nordhaug, 1998):

- 1) Specificity of the competences from the task performed perspective.
- 2) Specificity of the competences from the firm perspective.
- 3) Specificity of the competences from the sector perspective.

Specificity of the competences perceived from the task performed perspective is understood as the degree to which individual competences are assigned to the specific tasks performance. High specificity of competences means the need to formation and/or development of the specific competences, relating exclusively or almost exclusively to a given task or group of tasks. In turn, low specificity of competences means the possibility of using relatively universal competences, i.e. competences that may relate to many, often significantly different tasks carried out by managers/employees of a firm.

Specificity of the competences perceived from the firm perspective is related to the fact that some competences may be largely or even completely limited to specific firm, while other competences may be characterized by a high degree of universality, manifested in the possibility of their use in various firms. From this perspective one may take into account several characteristics of a firm, such as mission, strategic directions of development, domain of activity, strategies and operational programs, organizational structure, organizational culture, etc., related to the market activity of a firm.

Finally, specificity of the competences perceived from the sector perspective means the need to determine to what extent the characteristics of a given sector (e.g. its potential, size, capacity, absorbency, attractiveness, innovation, etc.) require the development of specific (special) competences, and to what extent they enable the use of competences characterized by their universality.

The briefly presented perspectives allow, according to O. Nordhaug (Nordhaug, 1998), to identify six types (groups) of competences, which are presented in the figure 2.

		Specificity of the competences from the firm perspective		
		Low		High
		Specificity of the competences from the sector perspective		
		Low	High	
Specificity of the competences from the task performed perspective	Low	(1) Metacompetences	(2) General sectoral competences	(3) Firm competences
	High	(4) Standard technical competences	(5) Universal technical competences	(6) Distinctive technical competences

Figure 2. Typology of competences based on the level of specificity of the competences from the task performed perspective, the firm perspective and the sector perspective.

Source: Based on: Nordhaug, 1998, pp. 8-29.

The first type (group) of competences, i.e. metacompetences, characterized by a low degree of specificity perceived from each of the above-mentioned perspectives, can be used in the implementation of many different tasks. Thus, metacompetences, covering a wide spectrum of capabilities, knowledge and attitudes, are characterized by a relatively high degree of universality and as such determine the formation and development of other competences.

The second type (group) of competences, referred to as general sectoral competences, is primarily characterized by a relatively high adjustment to the requirements of a given sector. This means that this type of competences primarily takes into account the characteristics of the sector affecting the activities of a firm just in this sector.

The third type (group) of competences, defined strictly as firm competences, is characterized by a relatively high adjustment to the conditions and requirements concerning the activity of a particular firm. This type of competences includes (integrates) resources and capabilities that are unique comparing to other firms, and thus constituting the basis for sustainable, long-term competitive advantage creation.

The three remaining types (groups) of competences, each of which is referred to as technical competences, are characterized by a relatively high degree of specificity perceived from the perspective of tasks performed by managers / employees of a firm. The standard technical competences, universal (nomothetic) technical competences and distinctive (specific, idiosyncratic) technical competences appearing here relate especially to the operational level of management. With the increase in the specificity of these competences perceived from the perspective of the sector, and then from the perspective of the firm, their individualized character increases, manifesting itself in the possibilities of their use in the implementation of more and more strictly defined tasks (Nordhaug, 1998).

In the opinion of G. Hamel, the classification of competences should primarily take into account the broadly understood possibilities of their impact on a firm. Taking this criterion into consideration, G. Hamel distinguishes the following types (groups) of competences (Hamel, 1994):

- 1) Competences affecting the firm access to the market, as well as cooperation (proximity) with customers – these competences comprise e.g. competences in forming and developing the brand, sales, marketing, distribution, logistics or technical support.
- 2) Competences affecting the effectiveness of processes and activities, including e.g. the speed, flexibility and reliability of the processes and activities performed, assessed in comparison to competitors – this group includes, among others, competences in ensuring the required quality of products, services and customer service, order cycle management as well as inventory management.
- 3) Competences enabling the development of unique – compared to competitors – functional features of products and services, allowing for meeting the individualized preferences and expectations of customers, as well as influencing the achievement of specific benefits by customers (creating value added for the customer).

A.A. Lado and M.C. Wilson emphasize that the classification of competences should include the criterion regarding the phases (stages) of the value creation process, primarily because the value creation is to the large extent related to the creation of a firm competitive advantage. In this context, these authors list the following types (groups) of competences (Lado, Wilson, 1994):

- 1) Competences concerning the inputs in the value creation process,
- 2) Competences concerning the transformation of inputs into outputs,
- 3) Competences concerning the outputs of the value creation process.

Competences concerning the inputs in the value creation process include the integration of physical resources, organizational resources and human resources, as well as the integration of knowledge and capabilities that enable the firm to implement transformation processes, conditioning the creation and delivery of products and services that are of value to the customer.

In turn competences concerning the transformation of inputs into outputs comprise the firm capabilities allowing for effective and efficient transformation of the inputs into the outputs. These competences are co-created, e.g. through the capabilities to develop innovation, entrepreneurship, organizational culture or organizational learning.

Finally, competences concerning the outputs of the value creation process comprise all knowledge-intensive, intangible assets of a firm, such as firm reputation, firm image, product quality, service quality, or customer loyalty.

4. Conclusion

The significance of the strategic potentials of the firm, including firm competences is growing. The aim of the article was to identify the premises as well as the criteria and cross-sections of the classification of firm competences.

The research outcomes presented in the article show the importance of the different types (groups) of the firm competences in strategic management. As it was pointed in the article, competences should be classified taking into account different criteria. Different types (groups) of individual competences may significantly affect the achievement of the expected market as well as economic outcomes by the firm, and – as a result – building and sustaining a long-term competitive advantage of a firm.

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ECOLOGICAL CIVILIZATION WITH CHINESE CHARACTERISTICS – A BIBLIOGRAPHIC ANALYSIS

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Purpose: This study aims to map the development of research on ecological civilization with Chinese characteristics using the VOSviewer bibliometric analysis covering texts published until January 2023. The aim of the article is also to find elements of the economic sciences within the framework of the researched issues.

Design/methodology/approach: The article includes a review of the most popular scientific bibliographic databases of scientific texts, namely Web of Science and Scopus, and a structured literature review of the texts. The bibliographic data has been processed in the VOSviewer program.

Findings and Originality/value: Quantitative results were presented in the form of bibliometric maps, showing among others the relationship maps between watchwords and the existence of six clusters within WoS and five clusters within Scopus, as well as the presence of economic sciences in the studied area of ecological civilization and its Chinese characteristics.

Social implications: The world's environmental problems and the shared resolution regarding the implementation of seventeen Sustainable Development Goals Sustainable indicate the importance of the topic of sustainable development. China's economic development and its aspirations to become the world's leading civilization point to the need to consider the pursuit of sustainability and civilization together.

Keywords: sustainable development, ecological civilization, China, economic culture, literature review, bibliographic analysis.

Category of the paper: Research paper.

1. Introduction

China stands out on the world map as a highly populated country and an exceptionally thriving economy. They are the largest producer of coal and coal energy in the world and its largest net importer. The country is responsible for almost 1/3 of the production of greenhouse gases, mainly carbon dioxide (CO₂). Continuing the count, China is also responsible for the largest anthropogenic coal mine methane (CH₄) emissions (Zhu et al., 2022). China contributes

to marine pollution through plastic waste (Chen, Shinichiro, 2019) and soils with industrial pollution (Yuan et al., 2020). Industry in particular is responsible for the intensive exploitation of resources and the environment. The need for sustainable solutions resulting from human activities degrading the environment was mentioned in China as early as 1992 in connection with the development of an environmental protection strategy developed by the United Nations. In 1994, the environmental protection program as specified in the White Paper was published. Currently, the 14th Five-Year Plan announced in China in 2020 focuses on the need to improve the condition of the natural environment within the context of sustainable development goals. It mainly specifies two goals set for the years 2030 and 2060. The first of them is related to reaching the peak of CO₂ emissions by 2030, while the second assumes the transformation of the economy to a fully carbon-free economy by 2060.

The Chinese ideology of eco-civilization is the result of social dissatisfaction, as well as political discourse. This ideology refers to the term that is related with civilizing/civilization – wenming [文明], which is described in several ways in the literature. The first concerns the civilization policy related to the introduction in 2006 of the 12 main socialist values, the third of which is civilization. The concept of eco-civilization became plan no. 1 of China's national development strategy in 2012. It was officially adopted in 2014, and treated as a future development principle guide (Hamilton et al., 2017). Building an ecological civilization is combined with civilizing, which was also in the aforementioned 14th Five-Year Plan. The concept of wenming is also about counteracting immoral habits in Chinese society, which aims to create good citizens. It is a system of moral, hygienic and pragmatic values closely intertwined with the Confucian doctrine (Romero, 2018). In the area of sustainable transformation of the natural environment, the concept of civilizing focuses on the need to transform industrial civilization into ecological civilization. An ecological civilization with Chinese characteristics is associated with, among others, many challenges regarding the spirit of cooperation, citizen awareness, and joint commitment (Kuhn, 2019) and the implementation process (DeJong, 2019), as well as its perception as a political slogan applying socialism with Chinese characteristics (Gordon, 2018) or ecological socialism (Schönfeld, Chen, 2019). Chinese eco-civilization policy is also described as one that has the potential to become a model for the rest of the world (Hamilton et al., 2017).

To continue research on Chinese economic culture in connection to sustainable development and ecological civilization, the article attempts to conduct a structured literature review (SLR) enabling the conversion of quantitative results into bibliometric maps within the VOSviewer program. The aim of the article is also to find elements of the economic sciences within the framework of the researched issues.

VOSviewer is a program for creating, exploring and visualizing metadata network maps (Hestya Budianto, Tetria Dewi, 2022) It enables the analysis of academic data by working on files from various databases (Arruda et al., 2022) - Web of Science, Scopus, Dimensions, Lens, and PubMed. The program allows the researcher to map the search topic with specific keywords, abstracts and titles in a relatively easy way. It enables the identification of research within clusters, creating maps of relationships between topics and mapping authors' connections (Batubara1 et al., 2022). Map analysis uses the observation of nodes represented by circles, their sizes, and edges indicating the relationship between nodes and the strength of the relationship (Afandi et al., 2022) under three tabs: network visualization, overlay visualization, and density visualization.

2. Material and Methods

The study used a bibliometric analysis based on data obtained from the WoS and Scopus databases. The first contains 3,363 texts devoted to the issues of Chinese civilization and 405,329 texts devoted to sustainable development, while the second contains 2333 and 417,416 texts, respectively. Files in the Tab-delimited format were downloaded from the WoS database, CSV (Excel) files were downloaded from the Scopus database, which was then processed in the VOSviewer program. VOSviewer can only analyze the above files separately.

The selection of texts for the study began with narrowing them down to text published by the date of the study, i. e. until 2023/01/17. Texts were selected according to titles, keywords and abstracts of which the following entries appeared: *wenming* AND *ecological civilization*, *wenming* AND *environmental civilization*, *wenming* AND *eco-civilization*, *ecological civilization* AND *China*, *eco-civilization* AND *China*, and *environmental civilization* AND *China*. The analysis in both databases differed not only in the format of the obtained files but also in the options available within the VOSviewer program. Within WoS, it is possible to analyze the content of titles, and within Scopus also abstracts and keywords. The above may affect the amount of data generating the created maps. In the next stage, duplicates and texts that differed in their content from the selected issue were removed. The above resulted in undertaking the analysis of WoS - 2081 and Scopus - 1572. The selected texts were published in the following languages: English, Chinese, Russian, French, Portuguese, and Slovak. Figure 1 presents the above literature review process and the quantitative results obtained during query generation.

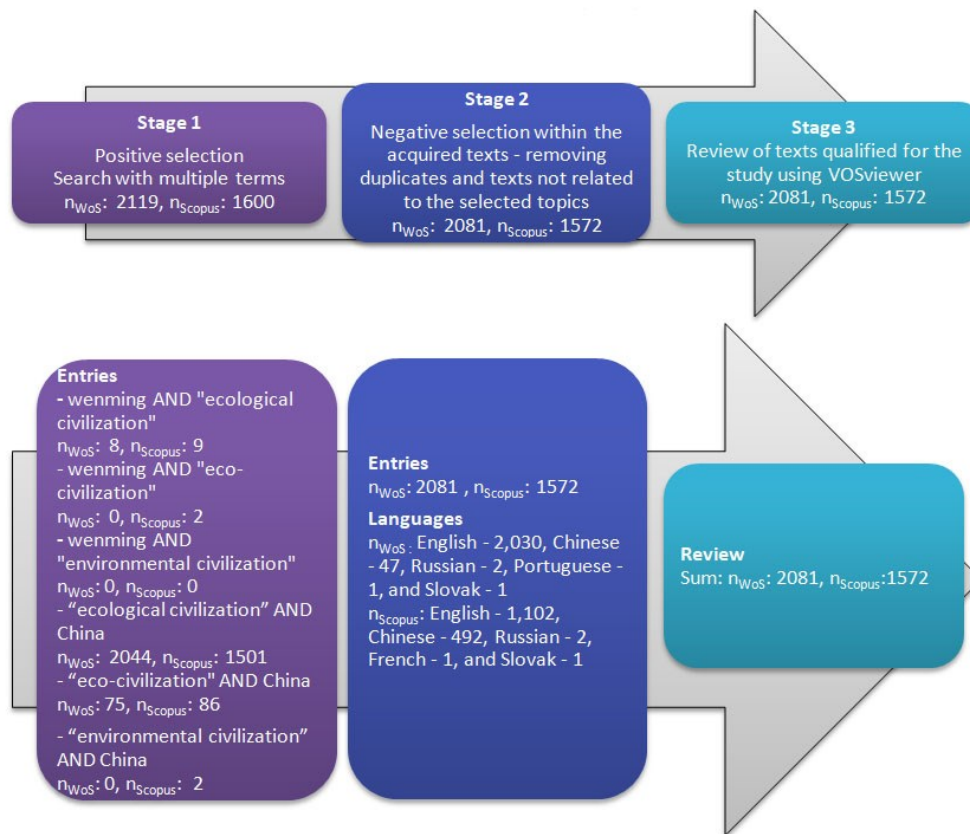


Figure 1. A structured literature review process regarding ecological civilization and China with quantitative SLR results.

Source: own elaboration.

3. Results

The analyzed journal articles from the WoS database were published between 2007 and 2023 (January). During this period, the largest number of publications appeared in print in the years 2010, 2020 and 2022. The year 2022 in particular stands out from the rest of the years in terms of research interest in this topic (Figure 2). Within this database, 695 texts were open access. The largest number of indexed texts were published in scientific journals - 1289 texts, then in conference materials - 781 texts, as books - 6, and book series - 5. They concerned mostly the following categories (over one hundred texts): development studies/sciences, water resources, social sciences interdisciplinary, energy fuel, ecology, and education research. 70 texts were classified for management, and 63 texts for economics.

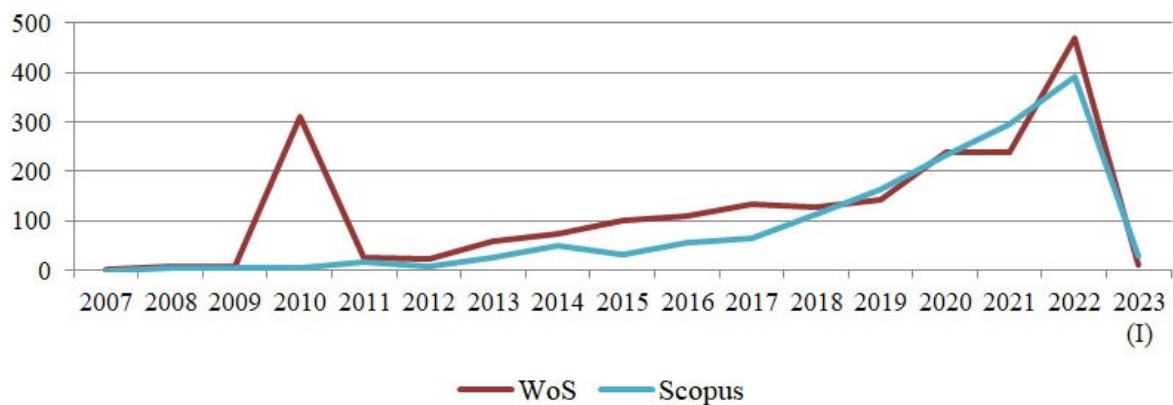


Figure 2. Number of publications related to the researched topics indexed in WoS and Scopus.

Source: Own elaboration.

According to WoS, the topic of Chinese ecological civilization is most often chosen for research by authors from China, the United States, England, Australia, Canada, and the Netherlands (Figure 3).

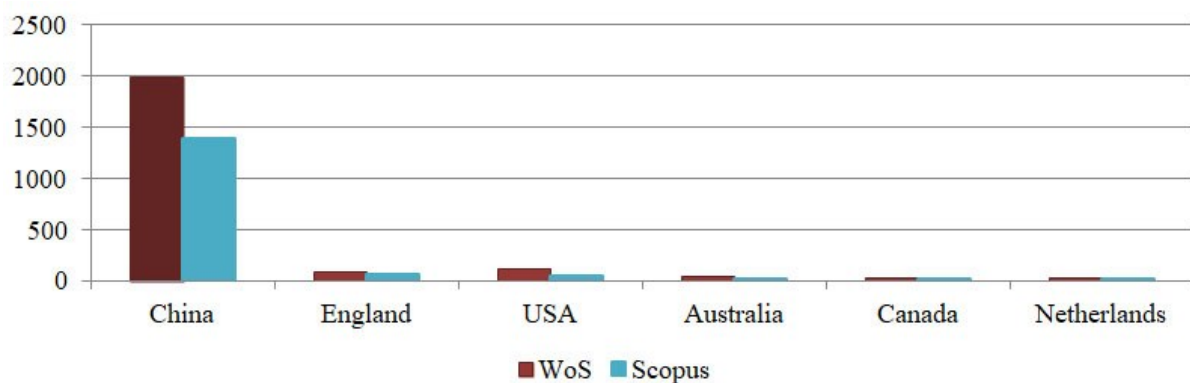


Figure 3. The nationality of the authors' of publications related to the researched topics indexed in WoS and Scopus (results appear most often).

Source: Own elaboration.

As part of the WoS database, the only active option was selected for analysis - the title and the full counting method was specified. Also the only active possibility of the number of occurrences was 10, which resulted in 5,481 terms and 69 events meeting the threshold. 6 clusters have been created: 1 (red cluster) that contained 17 items dominated by elements such as: *ecological civilization, research, and perspectives*; 2 (green cluster) with 16 items: *China, effect, evidence, and innovation*; 3 (blue cluster) with 11 items: *study, application, Yellow River, and management*; 4 (yellow cluster) with 10 items: *analysis, development, ecological civilization construction, and energy*; 5 (purple cluster) with 9 items: *evaluation, case study, city, and Yangzi River economic belt*; and 6 (turquoise cluster) with 6 items: *relationship, green development, urbanization, and economic growth*. The best studied areas (items) were *China* and *ecological civilizations*, which had the highest density. The obtained results of bibliographic coupling and density visualization are presented on Figure 4 (a-c).

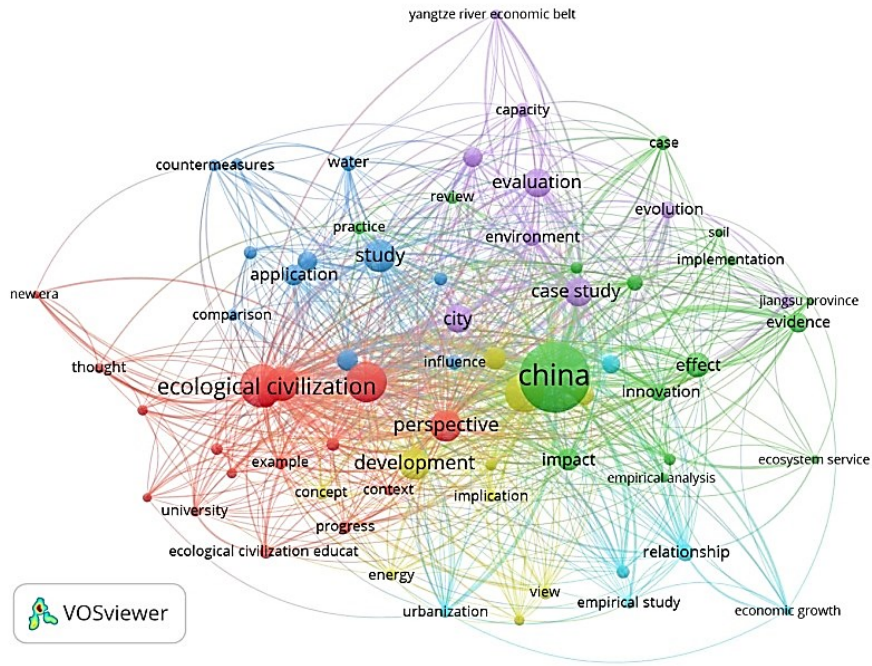


Figure 4a. Visualization Network based on WoS data.

Source: Own elaboration.

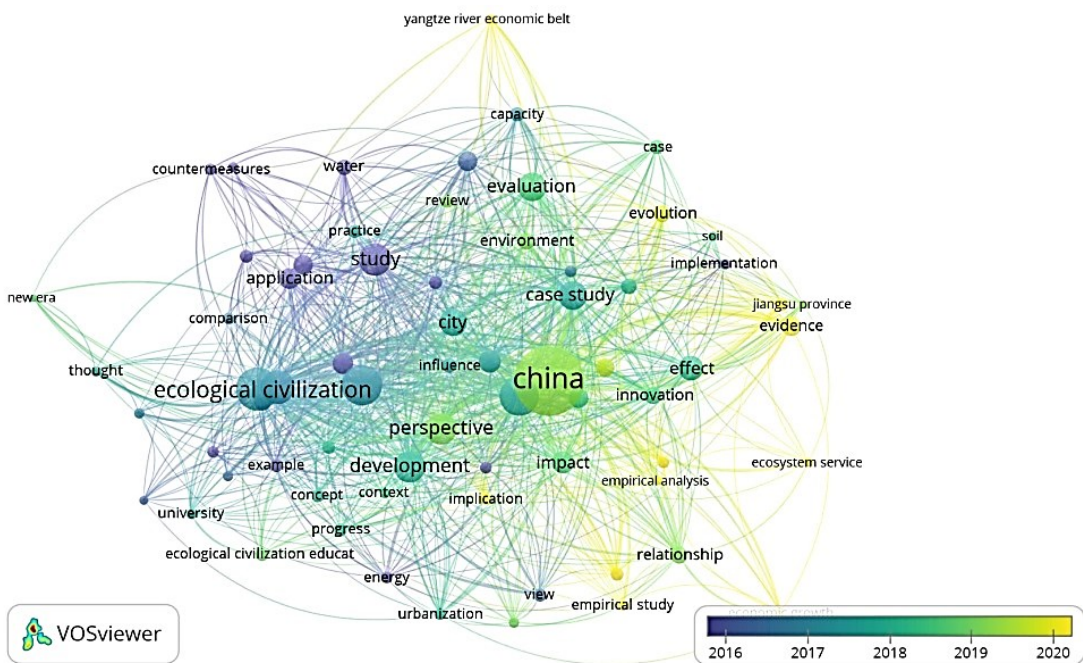


Figure 4b. Overlay visualization based on WoS data.

Source: Own elaboration.

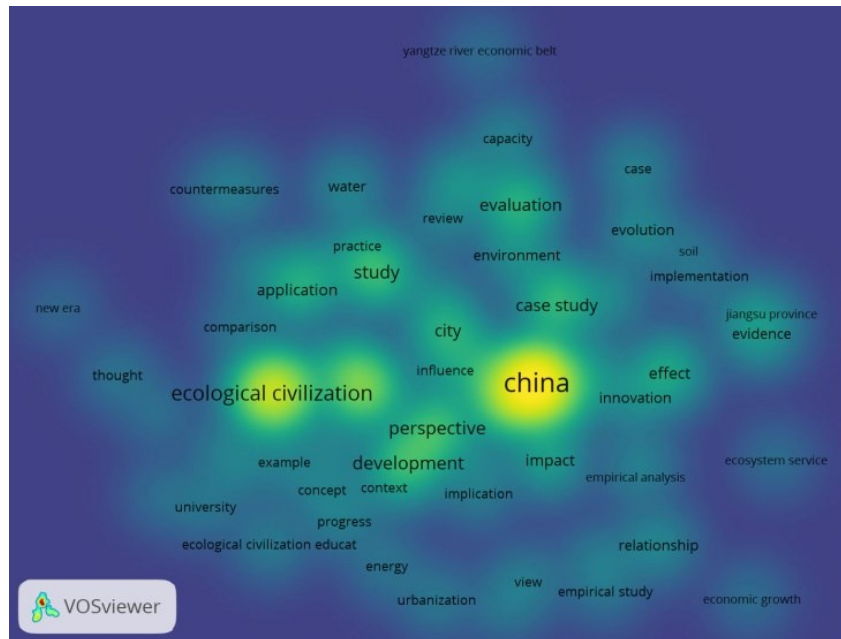


Figure 4c. Density visualization co-occurrence based on WoS data.

Source: Own elaboration.

Unlike the WoS database, in the Scopus not only the title, but also abstract options were selected for analysis and the full counting method was specified. The number of occurrences of the watchwords was marked as 10, resulting in 40,600 terms and 62 events meeting the threshold. As a result of the above, 5 clusters have been created: 1 (red cluster) that includes 12 items dominated by elements such as: *perspective*, *technology*, and *mechanism*; 2 (green cluster) with 12 items: *ecological civilization*, *development*, *construction*, and *management*; 3 (blue cluster) with 71 items: *evaluation case study*, *ecosystem service* and *Yangzi River economic belt*; 4 (yellow cluster) with 12 items: *China*, *analysis*, *region*, and *production*; 5 (purple cluster) with 10 items: *city*, *resource*, *environment*, *assessment*, *capacity*, and *water*. The results are presented graphically in Figure 5 (a-c). Among the most extensively researched items are *China*, *development*, *perspective*, *ecological civilization*, *analysis*, and *case study*. And within them, the subject, *ecological civilization* was studied the earliest and *case study* as the latest.

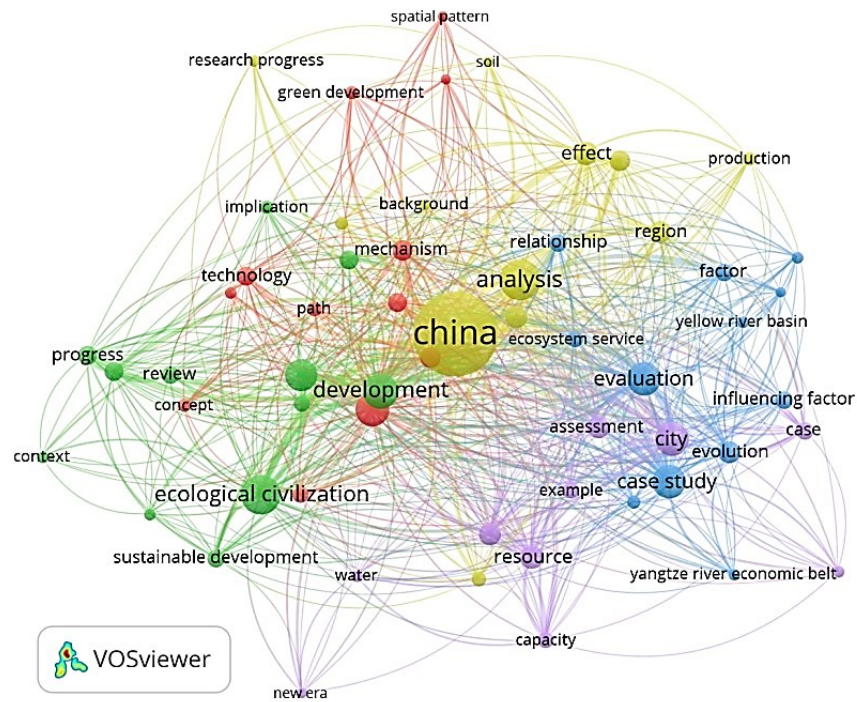


Figure 5a. Visualization Network based on Scopus data.

Source: Own elaboration.

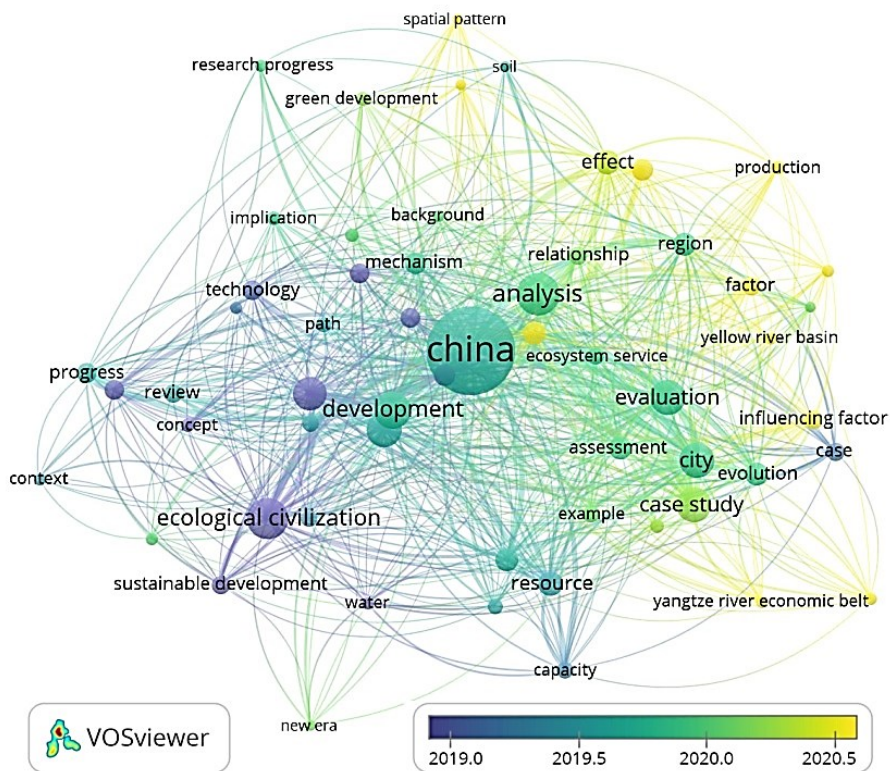


Figure 5b. Overlay visualization based on Scopus data.

Source: Own elaboration.



Figure 5c. Density visualization based on Scopus data.

Source: Own elaboration.

According to Scopus, the topic of Chinese ecological civilization is also most often chosen for research by authors from China, the United States, England, Australia, Canada and the Netherlands (Figure 3). As part of this database, it was also possible to obtain a map showing the cooperation between authors from different countries (Figure 6). Most often, this cooperation takes place between authors of Chinese origin. This diagram also shows that China is a kind of bridge between researchers focusing on the subject of ecological civilization and its Chinese characteristics.

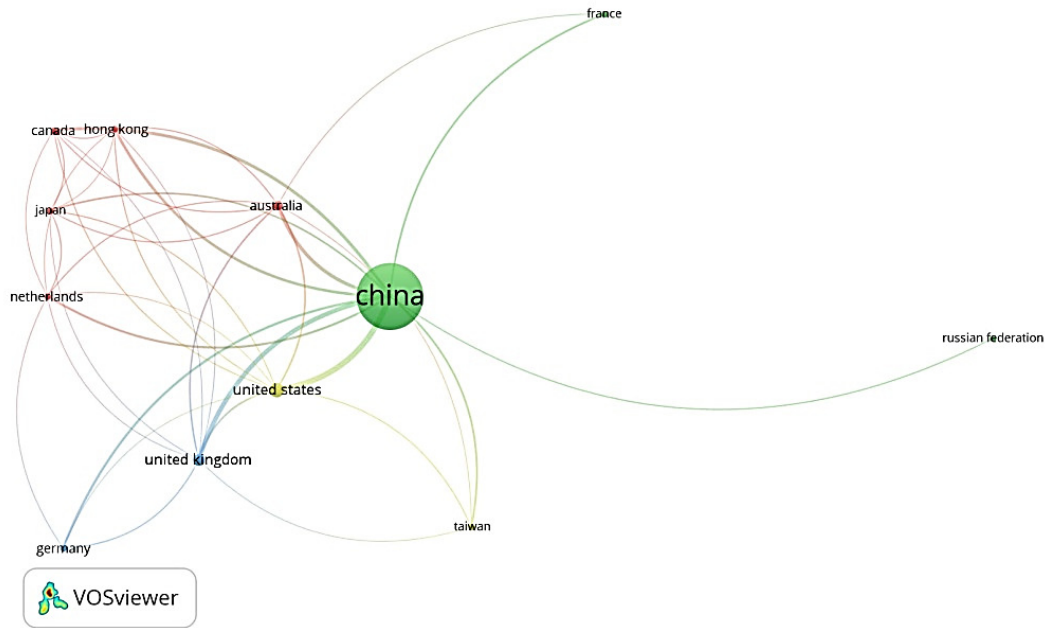


Figure 6. Map of relationships showing cooperation between authors from different countries, based on Scopus data.

Source: Own elaboration.

Within these topics, elements of economic sciences also appeared - issues related to economy (items: *economic growth* and *Yanzi River economic belt*) and management (only *management*). Their main relationships between the elements selected for the study are shown in Figure 7 (a-c) for WoS and Figure 8 (a-b) for Scopus.

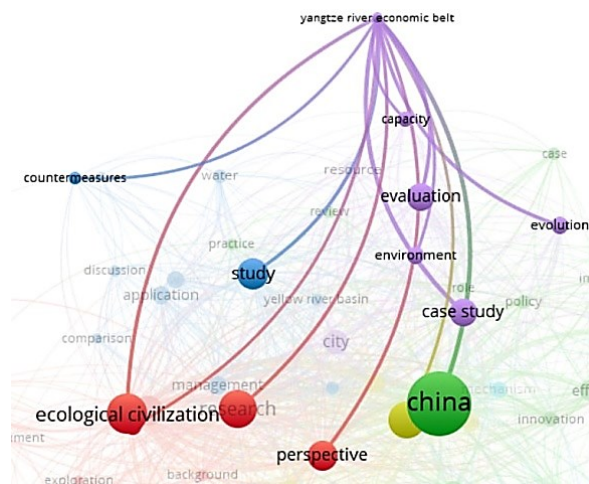


Figure 7a. Relationships between the main elements of economic sciences and other elements selected for the study based on WoS.

Source: Own elaboration in VOSviewer program.

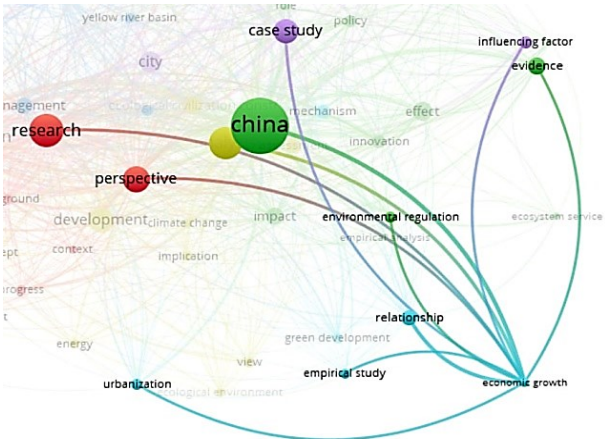


Figure 7b. Relationships between the main elements of economic sciences and other elements selected for the study based on WoS.

Source: Own elaboration in VOSviewer program.

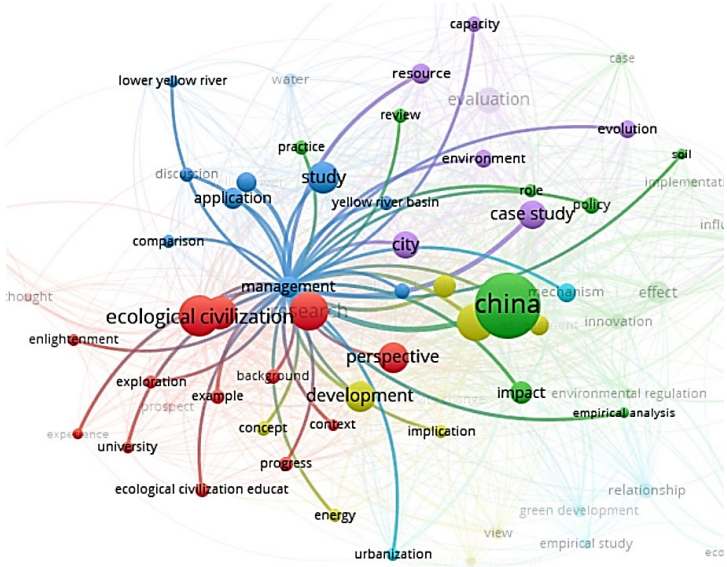


Figure 7c. Relationships between the main elements of economic sciences and other elements selected for the study based on WoS.

Source: Own elaboration in VOSviewer program.

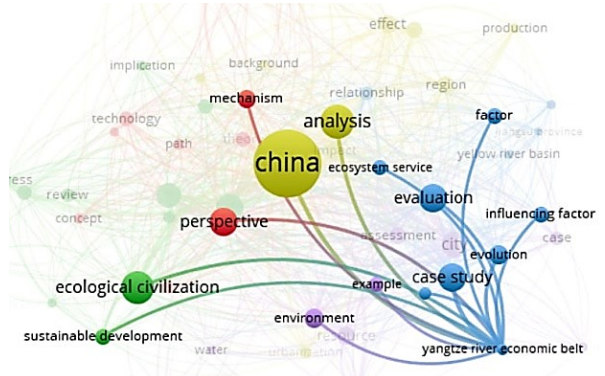


Figure 8a. Relationships between the main elements of economic sciences and other elements selected for the study based on Scopus.

Source: Own elaboration in VOSviewer program.

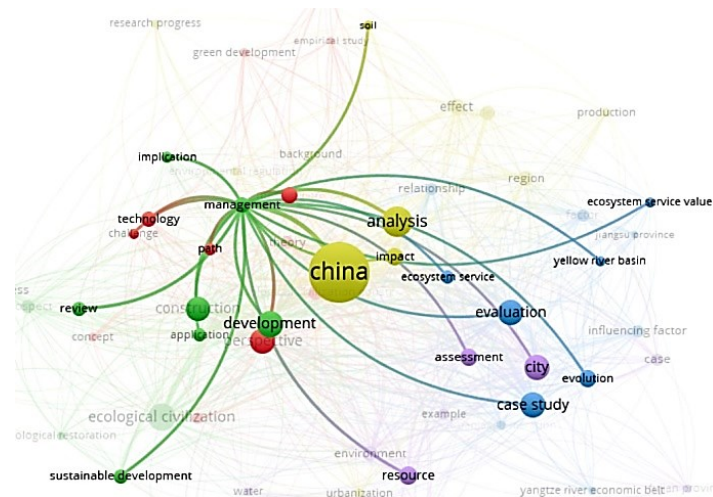


Figure 8b. Relationships between the main elements of economic sciences and other elements selected for the study based on Scopus.

Source: Own elaboration in VOSviewer program.

As part of this database, publications on the researched topics appeared in print during the period between 2008 and 2023 (January). There is a noticeable upward trend in scientific involvement in the researched subject (Figure 2). A particularly large number of publications was published in 2022. The above indicates the growing interest of researchers in the subject over the last two decades. During this period, were created 1217 articles, 211 conference papers, 96 reviews, 32 books, 8 book chapters, and 8 conference reviews. They concerned mostly the following categories (which included over a hundred texts): environmental sciences, agricultural and biological sciences, social sciences, earth and planetary sciences, engineering, and energy. 69 texts were classified for business, management, and accounting and 75 for economics, econometrics and finance.

4. Summary

The article presents the results of a qualitative analysis of 2,081 texts from the WoS database, and 1,572 texts from the Scopus database. The conducted bibliographic analysis allowed the observation that research on the subject of wenming/civilization in the context of an ecological civilization with Chinese characteristics has been conducted since 2007. It is developing intensively, especially among Chinese, English, American, Canadian, Australian and Dutch researchers. No items by Polish authors indexed for this topic in WoS and Scopus were found.

Texts referring to the disciplines of Economics and Finance, as well as Management and Quality Sciences also appear in the field of Chinese eco-civilization. Nevertheless, they are not leading, oscillating around 60-70 texts within each of the databases, which is a small part

compared to such a subject area as environmental science. The most researched areas within economic sciences include economic growth, the Yanzi River economic belt, and management. These associations are few, but it is also noticeable that the management item is the bridge to more items than just the economy item.

The trend of the increasing number of publications devoted to the issues of eco-civilization and China indicates not only the reported social and environmental need related to the unsatisfactory situation in the natural environment of the PRC, but also shows the politicization of issues of eco-civilization and changes in the world of science. Changes regarding the focus on sustainable development issues, the need to improve the current situation and the importance of increasing eco-awareness.

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IMPACT OF A PHOTOVOLTAIC INSTALLATION ON ECONOMIC EFFICIENCY ON THE EXAMPLE OF A COMPANY WITH HIGH ENERGY CONSUMPTION

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Purpose: The research objective of the work is to quantify the levels of profitability of a photovoltaic installation for a company from the clothing industry. The authors of the article answer the question of where and under what boundary conditions in Poland there is already economic justification for the construction of photovoltaic power plants producing energy for the needs of their own business activity.

Design/methodology/approach: The study was conducted using the methods of models of economic measures. These methods allowed the authors to calculate the market value of the investment with the assumed boundary criteria and to determine the economic efficiency of the investment. In addition, the authors made an analysis of the energy consumption of the company's implementation of individual manufacturing processes. The research was carried out in the period 2020-2022 on the example of a real PV installation.

Findings: Installing a photovoltaic system in production plants brings many benefits. It should be noted that each kWh produced in a PV installation makes the investor independent of the grid distributor, reduces the consumption of energy from conventional sources, minimizes the emission of pollutants into the atmosphere and favors economic development. In addition, investment in this type of installation allows for obtaining income from the sale of surplus energy produced.

Practical implications: The presented models have shown that the project of their implementation is fully economically justified and will allow investors to make a rational investment decision.

Originality/value: The contribution of this work is to obtain data that allowed the authors to indicate directions for improvement that may contribute to a more reliable assessment of the profitability of the tested installations. The proposed research can improve the planning of new industrial plants in terms of PV Installations as well as the redesign of existing ones.

Keywords: Profitability account, economic analysis, energy analysis, renewable energy sources, photovoltaic panels, energetic efficiency.

Category of the paper: Research paper.

1. Introduction

When planning an investment in a PV installation, an investor is mainly interested in both its energy efficiency and economic profitability (Niekurzak et al., 2022), (Höfer, Madlener, 2020). Investments in renewable energy sources (including photovoltaic panels) are not low-budget in Poland, but thanks to the possibility of taking advantage of non-repayable subsidies and favorable credit financing for the purchase and installation of photovoltaic panels, they may gain popularity in Poland (Derski, 2019) and (SolarPower Europe, 2023). The main reason for this is the profitability of the purchase and use of ecological systems for electricity production (Benalcazar et al., 2020). As part of the work, the authors characterized the general principles of operation of a photovoltaic system in an energy-intensive company and presented the practical application of this type of solution, based on the results of measurements made in an example company. The work is of a research and analytical nature, which is devoted to the assessment of the economic efficiency of renewable energy sources (RES) technologies and the assessment of ecological benefits from use of these technologies. The research nature of the work resulted from the need to obtain original, reliable and verified input data for the economic evaluation model. The main purpose of the work is to examine the efficiency of the photovoltaic installation in the company and to analyze the use of photovoltaics for the company from the economic point of view (Zimm et al., 2019). An additional goal is to conduct a study reflecting the actual impact of the PV installation on the company's electricity consumption, as well as to analyze the results generated by the photovoltaic system, on the basis of which the individual parameters related to electricity consumption in the described company are determined.

The conducted analysis allows for a summary of the amount of energy produced by the photovoltaic installation, energy taken from the distribution network for production purposes or the surplus of energy produced sent to the grid. It is also important to show how the system works in days when the company is not working. The last important aspect is to calculate the savings for the company on account of the electricity generated by photovoltaics and to simulate the payback period of the installation.

2. Materials and Methods

The subject of the research was a photovoltaic installation installed on the roof slopes of a manufacturing company, the diagram of which is shown in Figure 1.



Figure 1. Diagram of a photovoltaic installation.

Source: own.

In order to see the benefits of a photovoltaic installation, the authors analyzed the energy consumption of individual manufacturing processes in the company. The demand for electricity was divided into two areas. The first, requiring the most energy, was related to the textile technology, where the total demand is 1145.7 kWh. The second is for the leather technology, where the maximum demand for electricity is 327.75 kWh. In addition, the sector with the demand for electricity at the level of 207.2 kWh was specified, including other consumption (lighting, compressor, boiler room and others). In the final calculation, the total (maximum) demand for electricity, assuming that all installed devices work continuously, in the company is 1680.65 kWh. Photovoltaics in the company were created in three stages. The first installation was built with a capacity of 49.82 kWp, the second with a capacity of 309.32 kWp and the third 294.75 kWp. The installed modules made it possible to generate a total power of 653.89 kWp. As a result, all three installations have a total of 1,747 PV panels installed and have been integrated and connected so that all energy from all generators goes into production, and their total capacity is 653.89 kWp. Figure 2 shows the installed inverters.

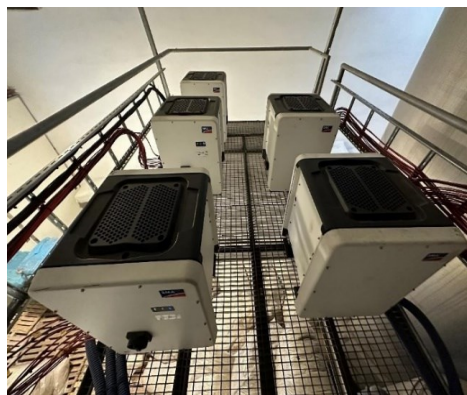


Figure 2. SolarEdge inverters.

Source: own.

The research carried out in the company consisted in collecting the results during the implementation of manufacturing processes, subjecting them to processing and analysis in order to issue recommendations on the efficiency of the operation of a given installation. Thanks to the integrated functions of the inverters, not only real-time results were obtained, but also a number of data on the history of the installation's operation from the beginning of its operation. The main two-way energy meter installed in the company's transformer station was also used for the study, from which the results of energy consumption and transmission to the grid were read. Thanks to this information, data was collected and analyzed in terms of energy production from photovoltaics, energy consumption from the grid, energy sent to the grid, and the amount of energy consumed by the company was presented, broken down into energy from photovoltaics and from the distribution grid (Niekurzak, 2021) and (Hayibo, 2019). Due to the three different PV installations, each with a different installed capacity and different operating time, all results were obtained by individual installations and for each group, individual analyzes were performed, and then a summary statement was made.

Economic investment aspects

In order to determine the full cost of the investment, in order to determine its profitability, it was necessary to take into account the individual stages of work not directly related to the photovoltaic installation. All costs are divided into direct and indirect costs. Indirect costs are mainly those related to the construction of infrastructure responsible for receiving and transmitting energy, which includes Fic, 2023; Zimm et al., 2019; Bhuiyan et al., 2021:

- development of design documentation for the electrical industry (transformer station, individual installations),
- construction of a transformer station equipped with appropriate devices (transformers, meters, protections with supervision and remote operation),
- construction of cable lines connecting the installations with the transformer station,
- preparation of space for installation.

Direct costs are those related to the construction of a specific installation, completed at the inverter stage, and they include:

- purchase of installation components (photovoltaic modules, inverters, roof mounting system),
- delivery and assembly,
- other connection elements (solar cable, wiring, assembly elements).

Indirect costs resulting from the division described above amounted to PLN 150,000. Direct costs are presented broken down into individual types of installations. For the first installation with a capacity of 49.82 kWp, the costs incurred for the purchase of installation components, delivery and assembly amounted to PLN 165,900. For the second installation with an installed capacity of 309.32 kWp, the costs amounted to PLN 624,200. They were related to

the purchase of photovoltaic modules, inverters, roof mounting system as well as delivery and installation. For the third installation with a capacity of 294.75 kWp, the costs incurred were PLN 596,100. After comparing indirect and direct costs and their costs Summing up, the amount of PLN 1,536,200 was obtained for the entire installation with a capacity of 653.89 kWp, together with the entire infrastructure needed for the proper functioning of the mini power plant.

From the perspective of a company with a photovoltaic installation, the method of accounting for the surplus energy that goes to the grid is important. An entrepreneur who generates electricity only from renewable energy sources to use it for his own needs becomes a prosumer and has the option of transferring the surplus of energy produced to the power grid. One of the conditions for a company to become a prosumer is that the company has an agreement covering the sale of electricity and the provision of distribution services by the distribution network operator. Regulations in this matter are provided by the Act on Renewable Energy Sources and inspections are carried out by the Energy Regulatory Office. For installations defined as small installations, i.e. with a capacity of 50 kW to 1 MW, an entry in the register of energy producers in a small installation kept by the Energy Regulatory Office is required. In the described company, the method of accounting for the energy generated by the photovoltaic installation consists in selling surplus electricity to a distributor with whom the company has a contract, at a fixed price (at the moment it is PLN 360/MW) and buying energy when it is needed, also at a fixed price (currently PLN 974/MW including shipping fee). Payments are made both ways after each billing period (both for energy sold and purchased by the company). From the company's point of view, the profitability of owning a photovoltaic installation is justified only in the case of high self-consumption or in the case of having an energy storage facility. In the analyzed company, despite the fact that the degree of self-consumption is very high, there are times when surplus energy is sold, mainly on days off, which is later settled according to legal regulations.

3. Results and discussion

The research was conducted in the period from May 2020 to July. 2022. The data collected over this period made it possible to reflect the functioning and impact of the photovoltaic installation on the consumption of electricity taken from the grid. For the installation with a capacity of 49.82 kWp, data was recorded from May 2020, for the second installation with a capacity of 309.32 kWp, data was recorded from December 2020, while the results obtained by the third installation with a capacity of 294.75 kWp were recorded from July 2020. In the final statement, all the results obtained by each installation were combined to provide an overall statement of the energy production of the entire photovoltaic system in the company. The main purpose of the study and the presented results is their economic analysis.

The presented data for individual months made it possible to check in which periods photovoltaics are the most effective and have the greatest contribution to the company's economy, and when they are less efficient. The collected data give the opportunity to present the results from the entire lifetime of the photovoltaic installation in the company and allow you to calculate the payback period of this installation. Table 1 and Figure 3 present sample data obtained from the daily production of the analyzed installations for the period: September 5-26, 2022.

Table 1.

Results of the survey from September 5 to September 26, 2022

Examination day	Reading from the energy meter		Reading from the inverter
	Energy taken from the grid (kWh)	Energy sent to the grid (kWh)	Energy produced by the installation PV (kWh)
05.09.2022	678.8	0.0	2755.8
06.09.2022	821.5	0.0	2206.7
07.09.2022	551.9	0.9	2662.4
08.09.2022	720.8	0.0	2478.2
09.09.2022	962.0	0.0	2017.6
10.09.2022	286.2	309.1	1190.5
11.09.2022	93.1	918.2	1185.8
12.09.2022	356.2	0.1	2884.3
13.09.2022	1006.6	0.0	2327.6
14.09.2022	2285.8	0.0	829.8
15.09.2022	2406.9	0.7	754.4
16.09.2022	1191.5	0.6	2043.1
17.09.2022	186.7	94.1	1544.0
18.09.2022	83.1	1377.4	1658.5
19.09.2022	1696.9	97.1	1240.1
20.09.2022	1531.2	107.9	1455.0
21.09.2022	2050.6	9.6	1064.5
22.09.2022	1097.5	223.0	1894.8
23.09.2022	1693.6	43.4	1255.9
24.09.2022	113.7	594.0	1909.1
25.09.2022	49.2	1007.4	1274.6
26.09.2022	2187.8	25.0	803.5

Source: own.

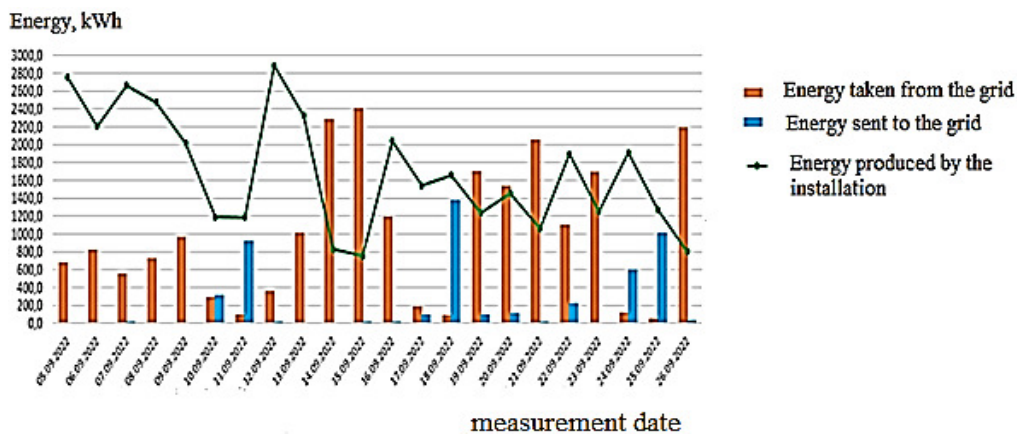


Figure 3. Distribution of energy consumption in the enterprise.

Source: own.

From the analysis of Figure 3, a downward trend in the energy produced by the PV installation should be noted. This decline is not sudden, but there are smaller and smaller peaks for individual days, there are also days when the production is significantly higher, but these are increasingly rare cases. The reason for this situation is the month in which the survey was conducted and the degree of insolation during this period. It can be observed that at the beginning of September the conditions are favorable and the results of the energy produced reach over 2500 kWh, from the further course one can read one more day when the energy produced was at the level of over 2800 kWh, while later such results are no longer repeated, and the largest production for one day oscillates around 2000 kWh and is gradually decreasing. These results are a natural consequence of the arrival of a period of lower efficiency of PV modules, caused by less insolation, greater cloud cover and shorter insolation time. Another relationship, clearly visible on the chart, is in the case of energy taken from the grid and energy produced from photovoltaics. In a situation where there is a large production of energy from photovoltaics, energy consumption from the grid is lower, which is best seen in the first and at the beginning of the second week of the study (energy production of about 2500 kWh - consumption below 1000 kWh per day). On the other hand, the opposite situation is when the production from the modules is low, then the energy consumption from the grid is high (most visible on days 14 and 15, production of about 800 kWh - consumption from the grid over 2200 kWh, and from the 19th until the end of the study, where the green line intersects the orange). These relationships result from the fact that the electricity generated from PV panels first goes to production and is consumed there, and any shortage of energy is only obtained from the grid, so when there is little production from the PV installation, most of the electricity comes from the grid, and when there is a large that's more covered by photovoltaics. There is no such dependence on non-working days, in this case Saturday and Sunday, then further data on the energy transferred to the grid appear (blue). On Saturdays, production is limited, so you can see a small consumption of energy from the grid and a noticeable transfer of energy to the grid (produced energy is consumed first and the surplus is sent to the grid). On days such as Sunday, the company does not work, most of the energy produced is sent to the grid, and a small part is used for maintaining devices, lighting and other (in the graph, the blue bars approach the green line). It is also important to explain the situation shown in the graph, when on working days it happens that energy is sent to the grid and the consumption from the grid is higher than the production from photovoltaics. This situation occurs when the production of energy by the PV modules exceeds the current demand or when there is no consumption by the company, e.g. employees have a break and the machines are turned off. Including when the PV installation does not have an energy storage, it goes to the grid. Figure 4 also shows the company's total energy consumption on a given day.

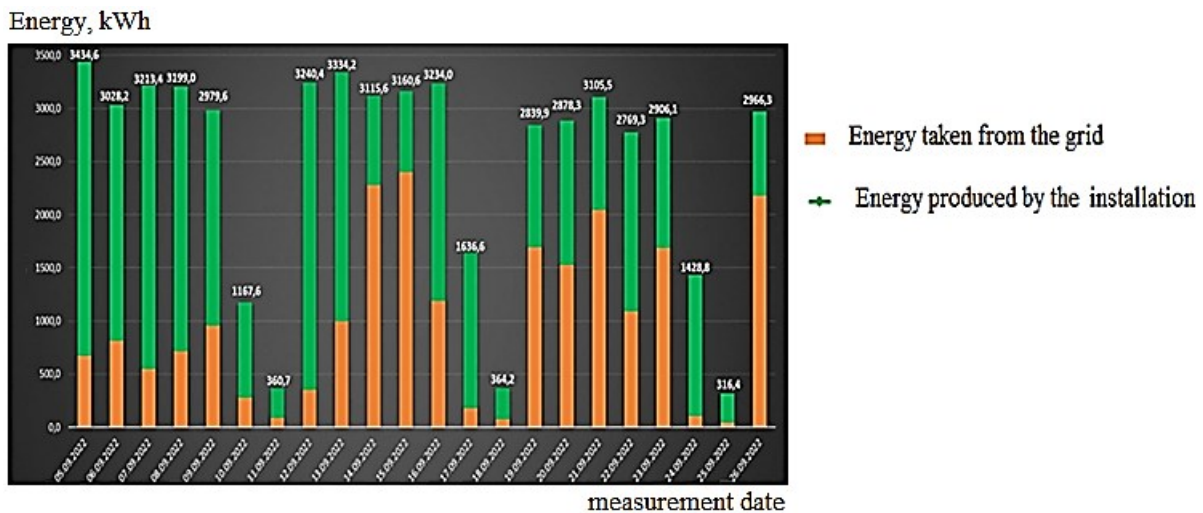


Figure 4. Annual daily energy consumption in the enterprise.

Source: own.

Figure 4 presents data that show the total energy consumption of the company on the analyzed day. They represent the cumulative value of the energy taken from the grid and the energy generated by the photovoltaic installation, reduced by the energy returned to the grid. In addition, it can be read that the daily energy consumption on working days oscillates around 3 MW. As noted, due to the decrease in production from photovoltaics caused by the season, in the first week most of the energy consumed in the company is covered by photovoltaics, in the second there are days with a mixed division, while in the rest the energy taken from the grid prevails. The exceptions are days with limited production or non-working days, when almost all the energy is covered by the photovoltaic installation and the share of energy consumed from the grid is marginal.

The analysis of the results obtained by individual installations made it possible to read in which months the modules produce the most energy, and when the production is low. In addition, the amount of energy generated by the installation, broken down by month and year, as well as the total production, since the beginning of operation, was recorded. The results for the first installed installation with a capacity of 49.82 kWp in 2020-2022 are shown in Figure 5.

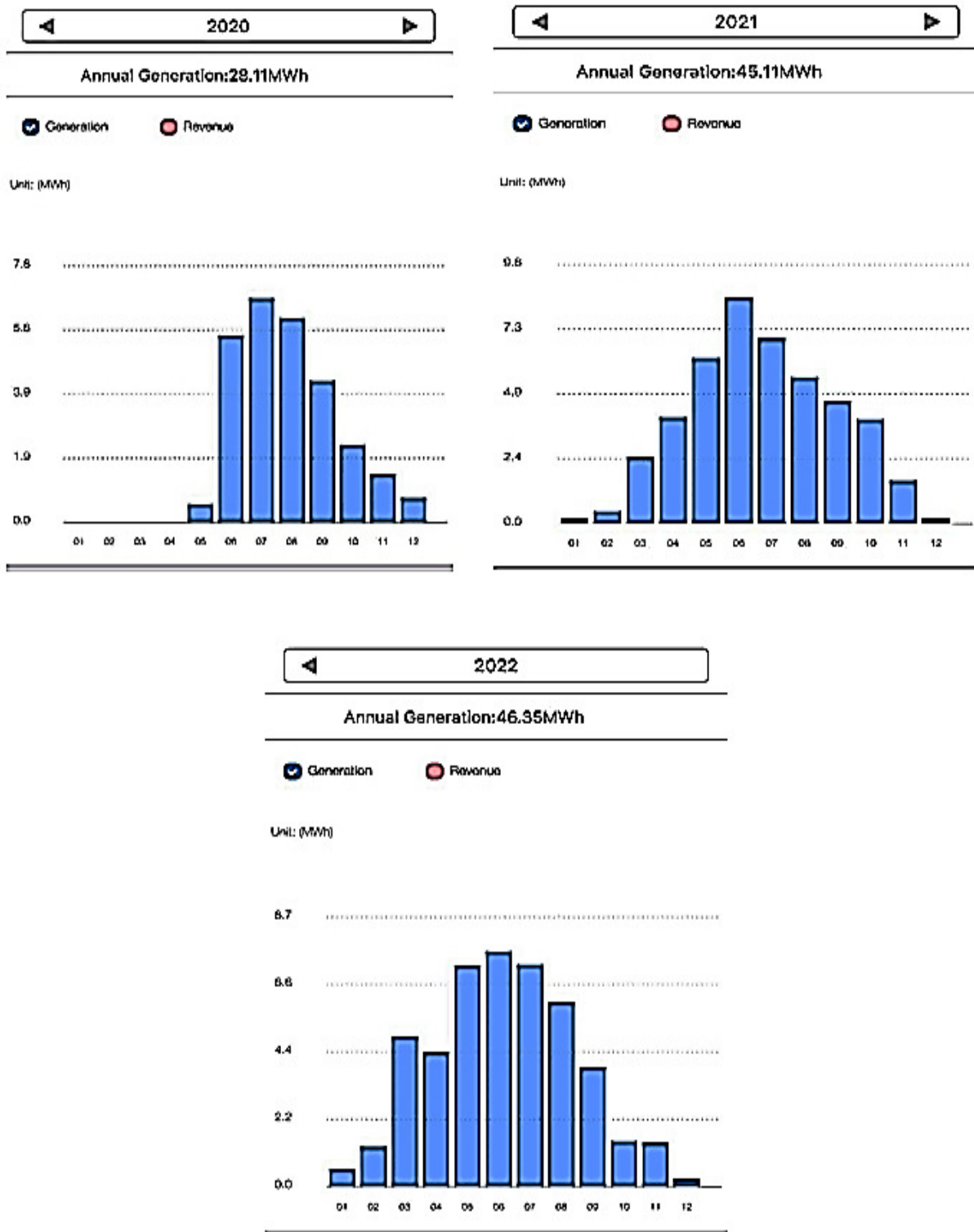


Figure 5. Energy generated by the first installation in 2020-2022.

Source: own.

The analysis of Figure 5 shows that the best efficiency of the installation is for the months of May, June, July and August, while the least effective installation is in January, February and December. The total result of the installation since the beginning of operation is shown in Figure 6.

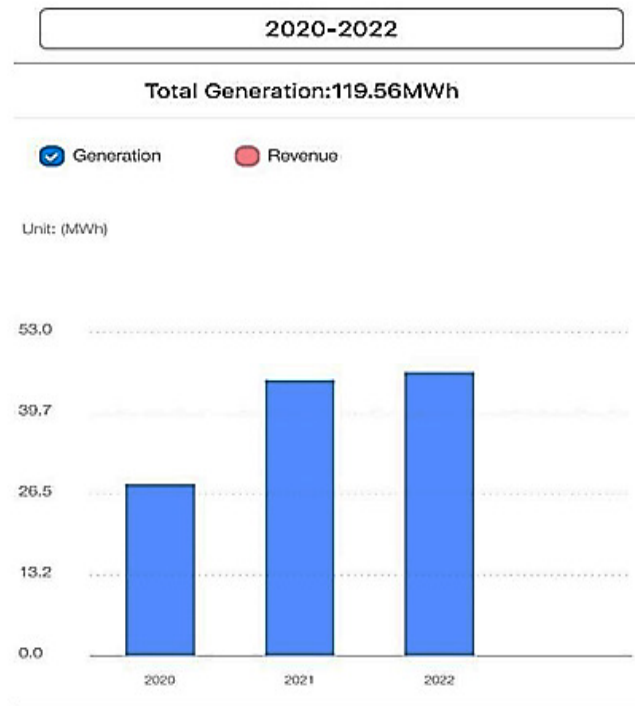


Figure 6. Energy generated over the entire lifetime of the first installation in 2020-2022.

Source: own.

The total production, as of May 2020 for the installation with a capacity of 49.82 kWp, is 119.56 MWh. The total production within one year oscillates around 46 MWh.

Figure 7 shows the results of the energy produced for the second installation, with a capacity of 309.32 kWp, operating since December 2020.

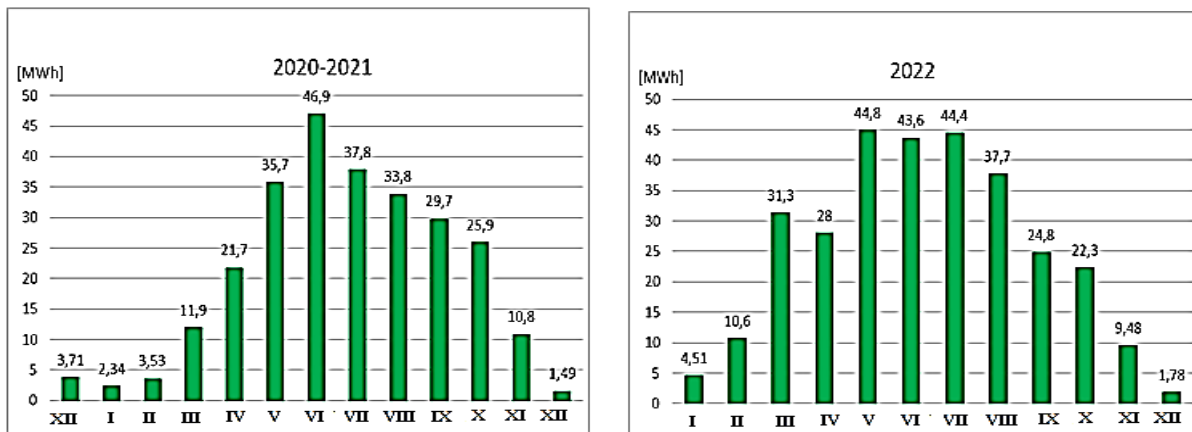


Figure 7. Energy generated over the entire period of operation by the second installation in 2020-2022 with a capacity of 309.32 kWp.

Source: own.

Figure 8 shows a significant difference in total energy production between 2020 and 2022, which is over 40 MWh. In turn, Figure 9 shows the monthly difference in the analyzed production, and Figure 10 shows the total production.

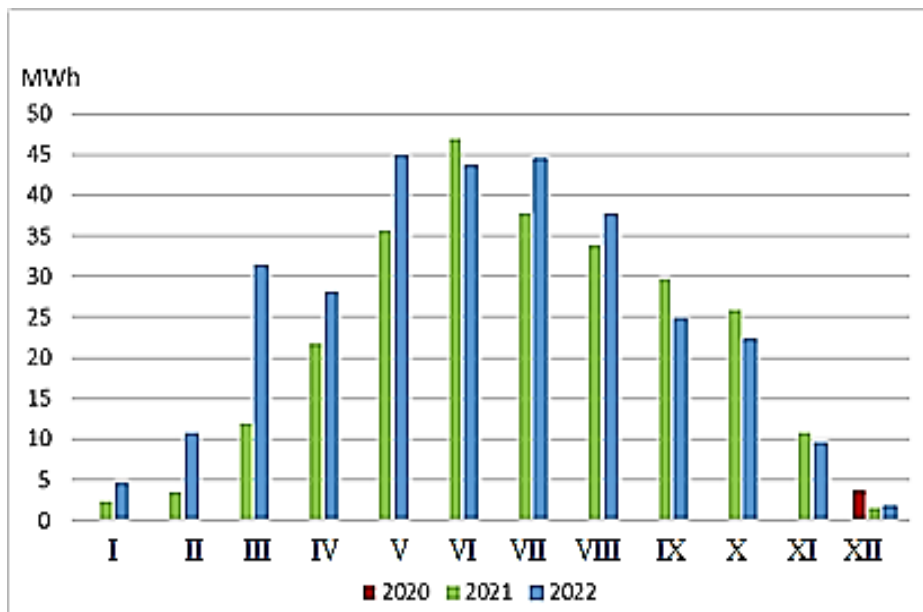


Figure 8. Comparison of production in 2020-2022 for PV installations 309.32 kWp.

Source: own.

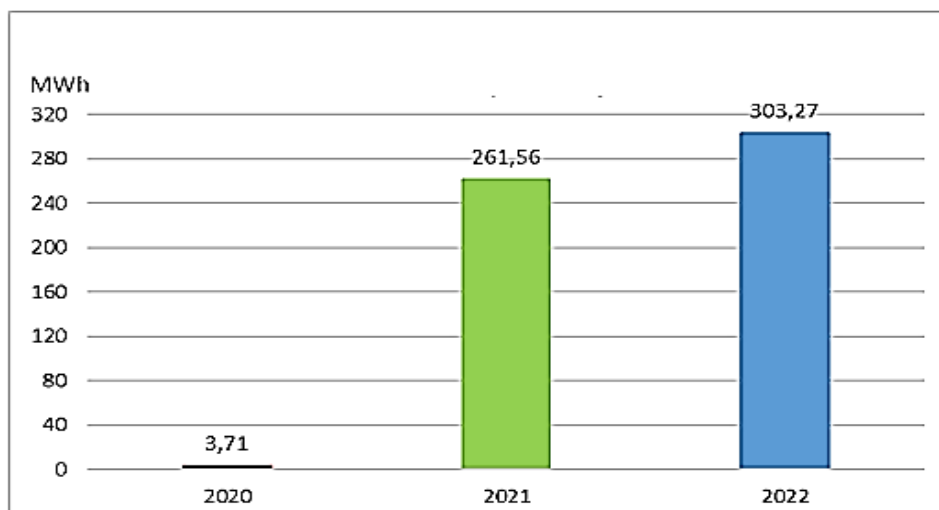


Figure 9. Total production for a PV installation of 309.32 kWp.

Source: own.

The installation with a capacity of 309.32 kWp produced 568,540 kWh of energy over the entire period of operation Figure 9. Considering the years 2021 and 2022, where the production was for all months, a large discrepancy in production can be noticed.

The last of the installed photovoltaic installations, with a capacity of 294.75 kWp, has been operating at the company since July 2021. The production results in particular years are presented in Figure 10.

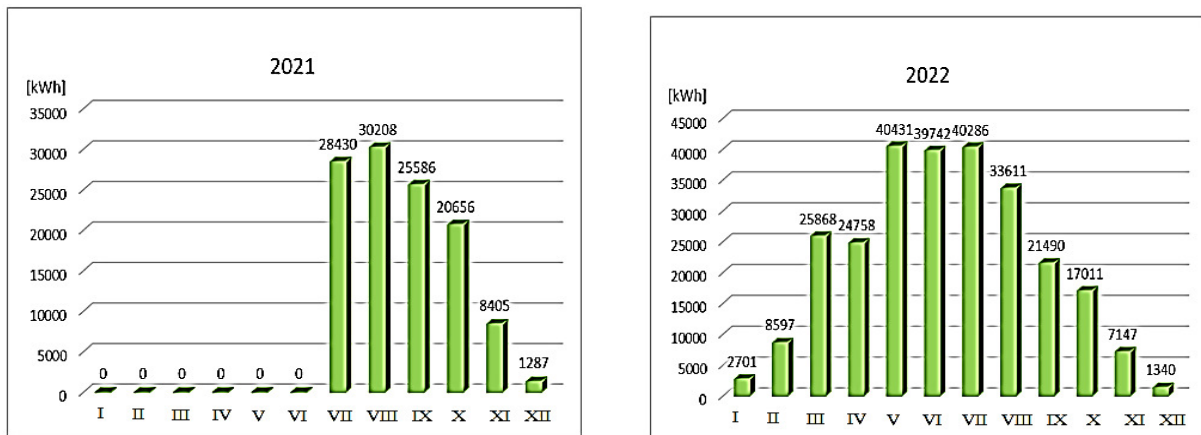


Figure 10. Energy generated over the entire period of operation by the second installation in 2020-2022 with a capacity of 294.75 kWp.

Source: own.

In turn, Figure 11 shows the monthly difference in the analyzed production, and Figure 12 shows the total production.

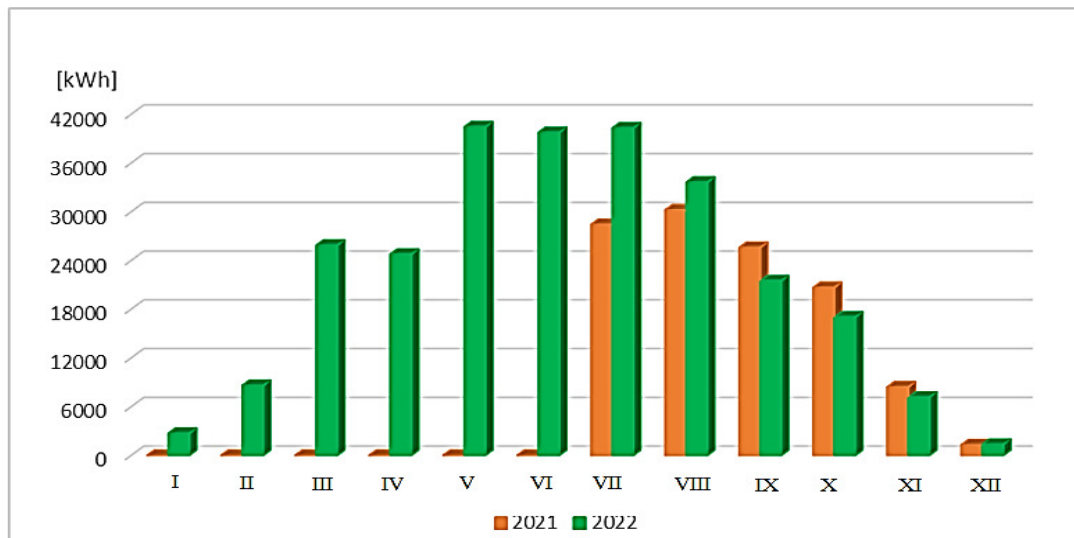


Figure 11. Comparison of production in 2020-2022 for PV installations of 294.75 kWp.

Source: own.

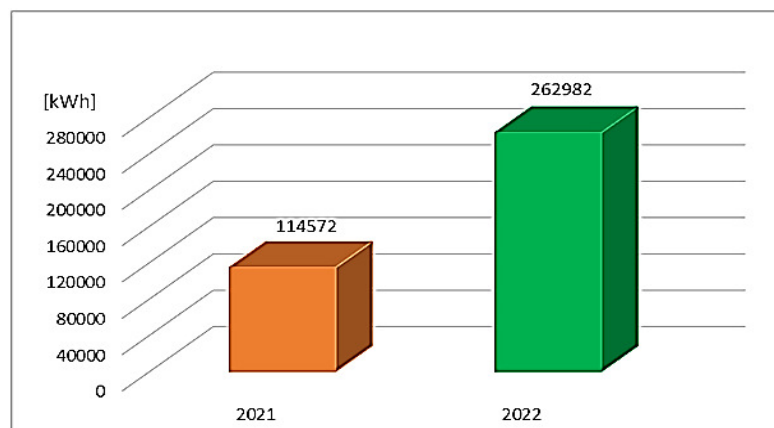


Figure 12. Total production for a 294.75 kWp PV installation.

Source: own.

The total amount of energy produced over the entire period of operation by the installation with a capacity of 294.75 kWp is 377,554 kWh. Disproportions in the results obtained, for individual months and years, in all installed installations show that the photovoltaic system is a highly unstable and difficult to forecast source of energy. Despite the very large amount of energy produced by the photovoltaic installation, it cannot become the sole power supply for the company, but it significantly reduces electricity costs. Figure 13 shows the total production of PV installations of 653.89 kWp for the analyzed period of 2020-2022.

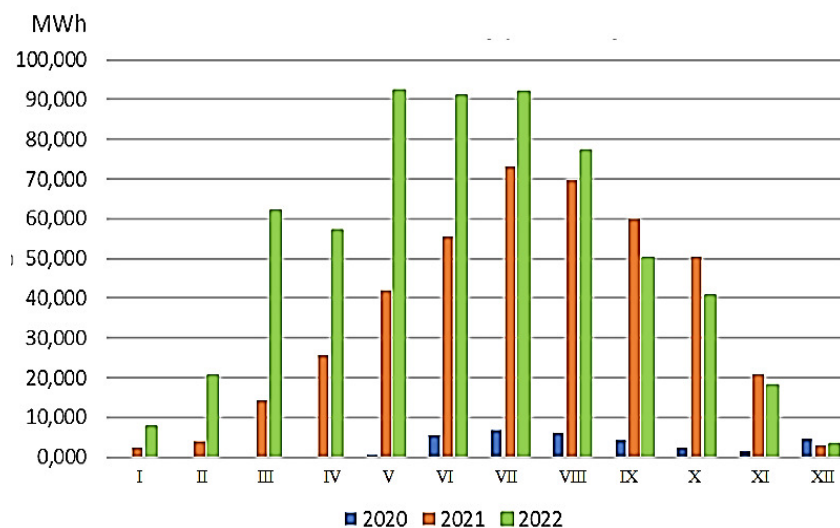


Figure 13. Comparison of total production from 2020-2022, PV installation 653.89 kWp.

Source: own.

Figure 13 shows a production comparison, showing the total energy produced by all installations. In order to read the data correctly, it should be noted that the installation with a total capacity of 653.89 kWp has been operating since July 2021. Earlier, from December 2020, two installations with a total capacity of 359.14 kWp were in operation, and data from May 2020 show the operation of one installation with a capacity of 49.82 kWp. For this reason, in 2020 the production is low, in 2021 it becomes much higher, and from July, when all installations are in operation, a large increase in energy production can be observed. We can only make a proper comparison in the period from July 2021, where we see that for July and August this year, production is lower than in this period in 2022. The only months in 2021 when the installation was more efficient than in 2022 are September, October and November. The sum of all results for individual years of operation of the entire photovoltaic system is shown in the Figure 14.

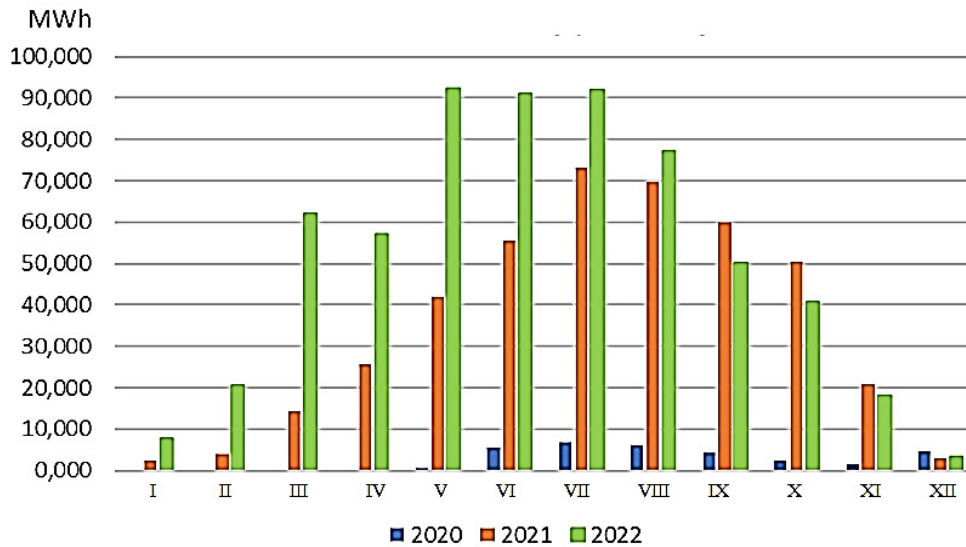


Figure 14. Total production in 2020-2022, PV installation 653.89 kWp.

Source: own.

Figure 14 shows the energy generated in a given year and the total amount of energy produced in the years 2020-2022 by the photovoltaic installation in the company. Thanks to the use of the potential for photovoltaics in the company and the construction of new installations, the capacity of the PV installations increased, which resulted in higher production every year. After summing up the results for individual years, over the entire period of operation, the photovoltaic installation with a capacity of 653.89 kWp produced 1065.624 MWh of electricity for the company, which was mostly used for the needs of the company's production. Figures 15 and 16 show the results of energy consumption from the grid and energy sent to the grid in the period from October 2021.

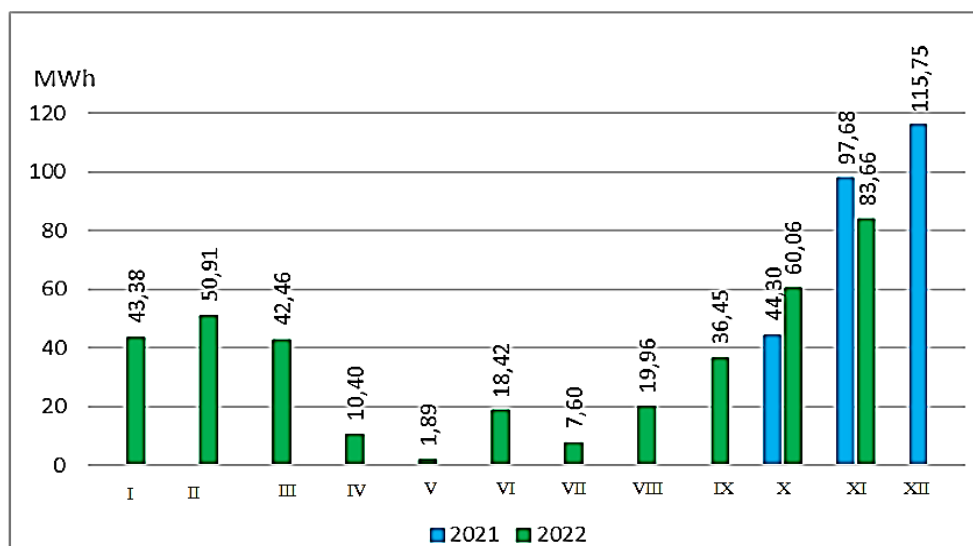


Figure 15. Energy taken from the distribution network by the company in 2021-2022, PV installation 632.91 kWp.

Source: own.

In 2022, the amount of energy taken from the grid for production purposes is over 375 MWh, which, with the production by PV installations for this year in the amount of over 612 MWh, means that the annual energy consumption in the company oscillates around 850 MWh, and the energy produced by the system photovoltaic covers more than 60% of the total consumption.

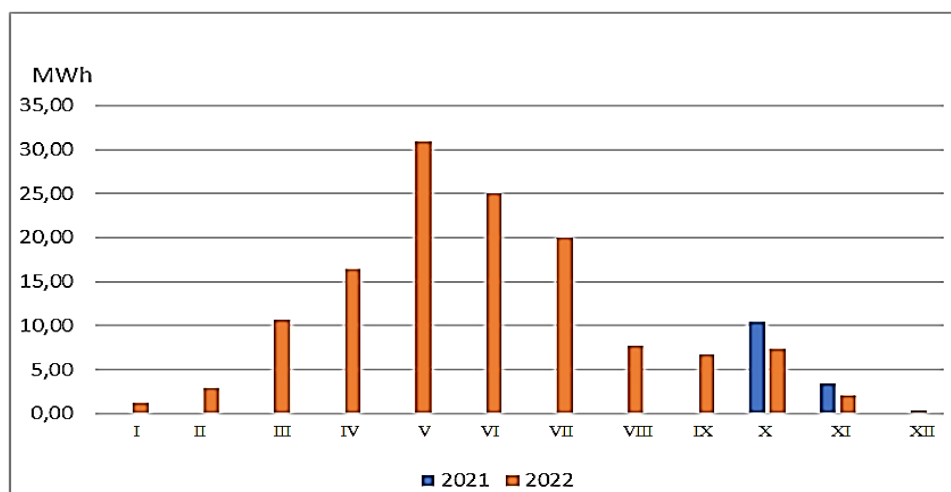


Figure 16. Energy sent to the distribution network by the company in 2021-2022, PV installation 632.91 kWp.

Source: own.

The data presented in Figure 16 shows that for the period from October 2021, the company sent over 145 MWh of energy to the distribution network. This surplus comes mainly from holidays and days when the company's production is lower.

The presented results provided comprehensive data on the functioning of the photovoltaic installation in the analyzed company and allowed to determine the proportions in which energy is consumed in the company, divided into energy from photovoltaics (over 60%) or from the distribution network (over 30%). Using the data from the entire study, as well as from the previous chapter, it is possible to calculate the payback period of the installation and the savings for the company in respect of the energy generated by individual installations of different capacity, over the entire period of operation. Presenting the savings obtained from each installation separately is important because each is different and works for a different period, therefore, first individual profits for each installation are presented, and then the payback period of the entire PV installation according to the formula, counting from 2022 and based on data from this year.

Savings generated by the 49.82 kWp PV installation:

- period of operation from May 2020 to the end of 2022,
- energy produced during operation: 119.56 MWh,
- rate for energy from the network: PLN 974/MWh, company savings due to energy produced in this period: PLN 116,451.

Savings generated by a 309.32 kWp PV installation:

- period of operation from December 2020 to the end of 2022,
- energy produced during operation: 568.54 MWh,
- rate for energy from the network: PLN 974/MWh,
- company savings thanks to the energy produced in this period: PLN 553,757.

Savings generated by a 294.75 kWp PV installation:

- operation period from July 2021 to the end of 2022,
- energy produced during operation: 377.55 MWh,
- rate for energy from the network: PLN 974/MWh,
- company savings thanks to the energy produced in this period: PLN 367,737.

Savings generated by the entire 653.89 kWp PV installation:

- period of operation from 2020 to 2022,
- energy produced during operation: 1065.624 MWh,
- rate for energy from the network: PLN 974/MWh,
- company savings thanks to the energy produced in this period: PLN 1,037,917.

The payback period of the entire installation was calculated for a PV installation with a capacity of 653.89 kWh. The base year for calculating the payback period of the installation is 2022, because this is the first full period in which all installations work together and are treated as one PV installation, all necessary data is also presented for this year to calculate the payback investment.

Cost of the photovoltaic installation: PLN 1,536,200:

- energy produced by PV installations in 2022: 612.583 MWh,
- energy produced, sent to the grid: 131.155 MWh,
- energy produced and consumed directly by the company: 481.423 MWh,
- total energy consumption in 2022: 856.603 MWh,

(energy taken from the grid + production from the PV installation - energy sent to the grid),
 $375.182\text{h} + 612.583\text{ MWh} - 131.155\text{ MWh} = 856.603\text{ MWh}$

- rate for energy taken from the grid: PLN 974/MWh,
- rate for energy sent to the grid: PLN 360/MWh,
- profit from energy used directly by the company: PLN 468,906,
- profit from energy sent to the grid: PLN 47,217,
- annual energy costs if there was no photovoltaic installation: PLN 834,331,
- annual energy costs with a PV installation: PLN 365,425,
- annual energy costs with a PV installation less the profit from energy sent to the grid: PLN 318,208.

Installation payback period:

$$\frac{\text{photovoltaic installation costs}}{\text{annual costs without a photovoltaic installation} - \text{annual costs with a photovoltaic installation}} = \frac{1536200}{834331 - 318208} = 2,98 \approx 3 \text{ years} \quad (1)$$

The payback period of the installation, assuming results and data for 2022, is 3 years. Thanks to these calculations, only a simplified calculation is presented, which does not take into account possible financing costs, operating costs, or financial ratios such as inflation or change in the value of money over time. The calculations do not take into account the operation time of individual installations, but the starting point is the first full period of operation of the entire installation. This does not change the fact that in the case of high self-consumption, which is in the described company, these results give an optimistic view of the company's photovoltaics, even if the calculated payback period, as a result of the above dependencies, was extended by up to half.

4. Summary and Conclusions

The conducted research concerned the use of a photovoltaic installation in the company and the impact of the results obtained by photovoltaics on the company's electricity consumption costs. From the point of view of a company focused on production, where energy consumption is high, this is an important issue, because the use of photovoltaics allows you to reduce electricity costs and become more competitive, which is not easy nowadays. The aim of the work was to examine the efficiency of the photovoltaic installation in the company and to check the economic aspect of such a solution. With an extensive database and results related to the described installation at our disposal, the research carried out on their basis allowed us to achieve the goal of the work (Hayibo et al., 2021) and (Chakraborty et al., 2019). Based on the conducted research and analysis of daily results, it can be concluded that the use of a photovoltaic installation in the company is justified in practice and allows you to reduce energy costs electricity costs borne by the company, in this case by about 60%. The analysis of daily results allowed to illustrate the characteristics of the installation's operation in synergy with the production carried out by the company. The presented data reflect the actual share of energy produced by the photovoltaic installation in the total energy consumption of the company on a given day. Thanks to the recorded results, it is possible to analyze the distribution of energy, divided into energy consumed and sent to the grid, as well as taking into account the amount of energy produced by the photovoltaic system, depending on the conditions (Niekurzak, Kubińska-Jabcoń, 2021; Kochanek, 2019; Niekurzak, Mikulik, 2021). The analysis of the results obtained by individual photovoltaic installations and the year-on-year comparison

of the results made it possible to conclude that the photovoltaic system is a highly unstable and difficult to forecast source of energy (Rouzbahani et al., 2021). Despite the disproportion in the results obtained in all installations, for individual months and years, the photovoltaic installation still has a measurable impact on reducing costs electricity incurred by the company. The overall results related to electricity in the company show that the annual energy consumption oscillates around 850 MWh, and the photovoltaics installed in the company can cover over 60% of the entire demand. These data give a positive assessment of the use of photovoltaics for the purposes of the company. With the help of the presented graphs and results, savings for the company were calculated for the energy produced by photovoltaics (Burgio et al., 2020; Niekurzak, 2022; Shahzad et al., 2021). The savings generated in a relatively short period of time prove that a photovoltaic installation can significantly reduce electricity costs. Taking into account the result for the calculated payback period of the installation, which is 3 years, it shows that such an investment is very profitable for the company, which is also confirmed by the authors in their works (Dogan et al., 2020; Alvarado, et al., 2021; Isik et al., 2021; Ahmad et al., 2021; Kraan et al., 2021; Zimm et al., 2019). To assess the profitability of investments, it is recommended to conduct a discounted analysis and use dynamic indicators, i.e. taking into account the time factor. In the case of unusual nature of cash flows, it is recommended to use the ratios in a modified version, i.e. taking into account a separate income reinvestment rate. When comparing various investment projects, one should be consistent in the selection of individual financial and technical parameters and compare investments with the same implementation periods. Using renewable energy sources is certainly profitable, but you have to take into account a fairly large one-time expense when purchasing and installing equipment. Such an investment usually pays off after min. several years - depending on the solution we decide on (Wróblewski, Niekurzak, 2022).

Summing up, the conclusions resulting from all the studies allow us to conclude that the use of a photovoltaic installation in an enterprise has its practical justification. Taking into account both the work efficiency and the economic background, high energy yields can be noticed, and as a consequence, a significant reduction in the costs incurred by the company for electricity consumption.

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THE IDEA OF HUMAN RIGHTS ACCORDING TO LESZEK KOLAKOWSKI. PROLEGOMENA

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Purpose: The subject of the publication is a philosophical reflection on the idea that organizes the space of human and citizen life, of which we are contemporary beneficiaries. This idea today inspires the search for the subjective status of man, shapes the axiological system of societies, defines the duties of the human person, sets legal standards.

Methodology: The publication is theoretical in nature. The analysis of the literature on the subject constituted the method of working on the publication. This method made it possible to learn about the current state of knowledge in the subject under discussion, indicated the scope of consideration of the problem, and also determined the perspective of further issues and questions that require answers.

Findings: The publication discusses the values on which the idea of human rights is based, the assumption being that a person who transcends the characteristics of the zoological species participates in the moral and rational sphere, the sphere of unconditional moral imperatives that cannot be empirically determined.

Social consequences: The perspective adopted in the publication discussing the idea of human rights is, first of all, important criteria and categories for the construction of the normative order, it projects the formation of social ties and the evolution of values that consolidate society. The idea of human rights in this sense is a regulator of collective life that creates social order.

Originality: The publication asks what are the sources of the idea of human rights, whether the rooting of man in intellectual loyalty to reason is a sufficient motive to safeguard against the desire to invalidate them, whether man as a moral being is immune to the action of the instincts of his own nature.

Keywords: human rights, human being, freedom, humanity, subjectivity, dignity.

Category of the paper: conceptual paper, viewpoint.

Introduction

All people are born free and equal in terms of their dignity and their rights. They are endowed with reason and conscience and should act towards others in a spirit of brotherhood. This is the first article of the Universal Declaration of Human Rights. The content of this article reveals the meaning and character of European culture, which has always been searching for its identity in the unending desire to recognize the principles of human functioning in the world as a self-targeted value, so as to transcend with the shape of its existence the limits of transcendence, and therefore beyond the limits of empirical reality: "there is nothing of which empirical reality is an image: it is itself and has no latent meaning" (Kolakowski, 2000, p. 193). The cultural code of the European area is unconditional moral imperatives and a system of abstract values conditioning, as a consequence, its potential and creativity realized, among other things, in systemic or institutional solutions. Precisely the essence of human rights is supported by this cultural code and can be understood as an ongoing discovery of the moral status of human beings: in what "way" a person becomes a human being. Awareness of one's own separateness, transcending the reified nature marks the path of man's search and realization, for it represents a move beyond physical adaptation to the conditions of the environment and submission to its conditions, towards self-improvement, causation, the achievement of freedom and subjectivity. The two most important dimensions for finding the essence of the problem are reason and transcendence. Oscillating between the categories reveals not only the path to morality as a formal set of norms and laws, but also the path to the humanity of the human being as an abstract value. Europe from this perspective has always been a path rather than a solution, an idea rather than a system of practical solutions, an idea because its strength is and has been the unflagging vitality of the temptation to discover the unconditionally obliging conditions of being that is human.

Sources of the idea of human rights

A life free from violence is a human right argues Amnesty International, formulating one of the basic needs to which every human being is entitled, and situating this need in terms of a code of moral values, a code that is recognized and universally respected, which we are accustomed to think of as its content is inalienable and inevitable and almost guaranteed, and in the popular consciousness functions as the idea of human rights. What, then, is the idea of human rights, can this idea have a universal dimension, are there collective human rights, what are the causes of violations of human rights, what is their genesis, why do certain rights have the status of human rights. These are questions to which answers are still being sought,

to the greater extent that the scale of violence, cruelty and oppression and injustice continues to become a tragic experience for millions of people worldwide. Human rights violations are a fact, statistics expose the scale of the phenomenon, concrete people become victims of violence every day, and especially then this abstract idea, the idea of human rights takes on a very practical meaning. At the very least, this idea is not needed, after all, to be aware of the numerous violations committed in this matter, it is not needed as a source of knowledge, even if only statistically, about the numbers of victims of violence, or it is not necessary simply to know that bad and undignified things are happening. However, it is absolutely necessary as a motive for enabling and conditioning an understanding of who man is as an individual/human being and man as a member of a complex social configuration, it is certainly useful as a justification for taking effective action to prevent violence, and as a blueprint for establishing standards for such action. The sum of these factors adds up to a mechanism that has been built into the structure of the reality of the Western world for several decades, and feeds the tendency to universalize these structures beyond its geographical and mental boundaries. For human rights and their "self-evident" nature are local in scope, confined to the Western world, observance of them in this part of the world is standard, a universal norm, the existence of which remains almost imperceptible and almost natural, in contrast to vast areas of the world where the level of security of rights and fundamental freedoms is not only programmatically violated, not only systemically negated and invalidated, but more than that, it simply does not exist in human, social and state consciousness, that is, it does not exist in the organizational or linguistic climate of these communities. Thus, the concept or notion of human rights is a way of thinking about human subjectivity that honors such a vision of entitlements that justifies both taking actions and creating procedures that will limit obvious violations of human rights, as well as solidifying the belief that human rights should be implemented in a world of cultural diversity thus securing a code of moral rules that do not coincide with utilitarian criteria. Thus defined, the issue of the essence of human rights makes it possible to understand that, at least in a limited cultural space, there are such cultural assumptions whose value horizon exceeds the utilitarian character and goes beyond the structures of tribal organization of social life reduced to codification based on the argument of force in resolving disputes. This value-oriented horizon creates an existentially safer moral world, because it disseminates a system of rudimentary categories necessary and conditioning for the functioning of our civilization, thus creates not only its security framework, but also determines and organizes all its essential senses, which can constitute its potential, that is, its strength and vitality, and thus secures its integrity, and therefore its permanence and persistence. Human rights, therefore, we can see as a tool for thinking about reality, for expressing our thoughts about it, especially in the context of normativizing the idea of having rights for all people, regardless of the culture in which they live and function (Freeman, 2007). The idea of human rights is a general concept, and the concept of human rights is abstract, (Hoffe., 1992). So is the concept of humanity, which in a cultural sense is not an empirical description, which also cannot be derived from

anthropological observation alone. The abstract nature of human rights, as well as the concept of humanity itself, find moral grounding. For there is no such phenomenon as human rights in nature, nor is there such a phenomenon as humanity, nor has anyone seen a human being, (Zamelski, 2011). For all these distinguished concepts find empowerment and grounding as moral values and can only be considered in terms of moral laws, these are the determinants of our way of thinking and are largely a consequence of transcending ethnocentric closure, for: "European cultural sameness reasserts itself in the refusal to accept any completed identification" (Kolakowski, 1984, p. 15). Defined in this way, the issue of the idea of human rights places in the broad spectrum of considerations not only a conceptual or institutional dimension, but precisely a moral one, and it is in this dimension that the search for an answer to the decisive question for the future of man about the necessary conditions for the survival of this being that is man and this reality that is culture is located. In essence, the question arises whether the project of human rights has not found an area of unconditionally obliging precepts, independent, among other things, of current experience, which can provide a sufficient and necessary source of certainty as far as possible from the utilitarian conjuncture narrowing to what is beneficial or not, useful or not. For the human being, understood transcendentally and not anthropologically, cannot be identified with the properties of human psychology, cannot be marked by accidental zoological characteristics of the species, but by the necessary conditions of possible experience, and these boundary conditions are specified in the form of free will and reason (Kolakowski, 1984). This gives rise to consequences, for this experience applies only to all rational beings, defined by reason, not species. Referring to Kant, Kolakowski notes that: "moral principles, despite the fact that, when formulated in unconditional form, they specify only the necessary formal conditions of any norm, are valid for any being acting freely, equipped with free will" (Kolakowski, 1984, p. 132). Moral security and morality as such can thus be realized in the assumption that humanity is not a natural object, a natural singularity or ephemeris, and that the humanity associated with it transcends the zoological object and situates itself in moral-only terms, beyond the reach of natural reflexes or primordial adaptive instincts: "humanity is not defined by the peculiar determinants that distinguish it from other species, but by its participation in the realm of rational necessities, epistemologically expressed as a set of synthetic a priori judgments, as well as in the realm of unconditionally compelling moral imperatives that are empirically impossible to determine" (Kolakowski, 1984, p. 132). The idea of human rights seems to be, in part, an exemplification of the Kantian realm of moral values and norms, which must not be deduced from descriptive judgments, the legitimacy of which would be based on and subordinated to each individual's decisions or current interests. This is the priority question for the legitimization of the idea of human rights, i.e. how to justify or discover rules and values that are absolutely obligatory, affirming human subjectivity, i.e. about which there will be universal agreement or at least understanding and consensus in the face of a concept that today seems either moralistic or legalistic, (Possenti, 2000). The universalization of the idea of human rights proposes equal rights and freedoms for every human being, thereby

incorporating the basic assumption of Locke's (Locke, 1992) natural right to liberty, among other things, which all human beings are entitled to by virtue of their very nature alone, which is still not a proposition or an absolute rule, especially since: "all value systems, as long as they are internally consistent can always defend themselves against logical and empirical criticism. For it is impossible to prove that religious tolerance is better than a regime, that equality before the law is superior to legislation that grants privileges to certain castes" (Kolakowski, 1984, p. 17). This question is important both for the legitimacy, implementation and universal recognition of the idea of human rights, and, in a way, is essential for the future of man as a moral being: "can our civilization in general survive without believing that the distinction between good and evil, the distinction between what is morally commanded and forbidden, does not depend on our each time decisions, that therefore it does not coincide with the distinction between what is beneficial and harmful" (Kolakowski, 1984, p. 132). So to recognize that moral rules coincide with utilitarian criteria is as much as to recognize that there are no moral rules, thereby accepting before our own nature that natural instincts are the criteria for human actions and behavior, the effects of which we can still observe in dehumanizing acts of human stupidity and thoughtlessness. It is unlikely to be enough, or neutralized, by the optimism of Enlightenment utilitarians naively believing in man's natural inclinations to perform acts in a spirit of solidarity and friendship, acts made real by illusory wishful thinking about a harmonious and conflict-free social order. The concepts of unconditionally obliging precepts and rules of duty were constructed in his philosophy of morality by Kant, who: "attempted to show that reason can justify a set of ethical and political rules on the basis of an obligation to respect the dignity of others, understood as moral, autonomous and rational individuals" (Freeman, 2007, p. 34). Thus, this criterion of justification and legitimacy of moral rules, on which the idea of universal human rights can be supported, is reason, hence the duties of and to the human being, are determined by participation in the realm of rational necessity, in the realm of moral imperatives, which cannot be empirically proven: "the question is not at all whether this or that actually happens, but what, happens according to the imperatives which reason by itself and independently of all phenomena issues" (Kant, 1953, p. 31). From an empirical point of view, the question of the legitimacy of judgments and the criteria of good and evil is not sensible, but for the consequences it is very often dangerous, because from the perspective of experience it is difficult to see something like good and evil: "Ethics in general can only exist insofar as it maintains a clear distinction between natural drives and duties, between what we do and what we should do, between the most common actual motivations of our actions and legitimate norms" (Kolakowski, 1984, p. 133). This distinction was a fundamental issue for Kant and was a fundamental attempt to establish the origin of good and evil as a matter of reason, not revelation, fundamental because the awareness of this distinction was, for the Königsberg philosopher, decisive for the moral future of man and the life of civilization. This distinction is also a fundamental issue today, for it constitutes the distinguishing feature of European culture, which remains the affirmation of the human person

and his privileged status as a morally acting subject. The Kantian legacy enlightened the minds of then and now with the category of the abstract human being, that is, one who is equal in his dignity to everyone else: "Kant believed in the indelible equality of human beings in their dignity as rational and freely acting subjects. (...) He also believed that all norms, insofar as they have a moral content, apply to every individual without exception, and that there are also claims that every individual without exception can make, for each should be treated by others as an end in itself and not as a means" (Kolakowski, 1984, p. 135). Kant's theory of natural law has constitutive consequences for both cultural assumptions and the resulting legal solutions: "each man separately, on the basis of general human nature, is entitled to certain fundamental rights; the Kantian postulate according to which we are to treat man, each individual, always as an end in himself, means that no man can be the property of others, that slavery therefore opposes the very notion of humanity" (Kolakowski, 1984, p. 136). This perspective makes it possible to discover and understand what is essential for the recognition of ethical standards, including what is a priority for the protection of, among other things, human dignity, that the negation or rejection of what is all-human makes it impossible to accept the sole basis of the principle of human rights: "for this principle can be legitimate only on the assumption that there are entitlements that everyone, as a human being simply, can revindicate, that is, on the assumption of everyone's equal participation in human nature, in other words, only on the basis of the theory of "abstract man" (Kolakowski, 1984, p. 136). Therefore, if we reject this notion, if this conceptual abstract is negated then it is difficult to have other solutions in this matter of human and social relations than ideological, and if this aspect of ideology dominates the space of entitlements and rights, then there will be no rights, and the human person's entitlement to dignity and freedom will become a rhetorical figure, a vague record hollowed out of its content, and then nothing will prevent the legitimization of slavery and genocide: "it is difficult to define what human dignity is, it is not an empirical finding, but without it we are in trouble when we try to answer the simple question: why is slavery wrong? For all its vagueness, the concept of human dignity is good enough to deal with such a question" (Kolakowski, 1999, p. 215).

Philosophical aspects of human rights

The human rights enshrined in the 1948 Declaration have a universal and common character, for they apply without exception to all people, living in any society and regardless of their situation and social position, they have a fundamental character, they constitute a privileged category that does not require any justification by other rights, and this means, that every human being has the right to assert his or her claims by invoking his or her humanity, they also have an inalienable character, for a person cannot cede these rights to other persons and no one has the power to deprive him or her of these rights, in addition, they are also inherent,

belonging to a person by virtue of birth, every person is born endowed with them. Human rights should therefore be classified in the category of moral rights, the validity of which remains unquestionable today, and the awareness of their existence seems unquestionable, although still too often only in the declarative sphere (Osiatynski, 1998). The founding premise of this corpus of fundamental and inherent rights is the adoption and affirmation of the concept of the person as an unquantifiable value recognized in its inalienable and inviolable rights. Enlightenment humanism has infused successive generations with such a vision of man, the abstract nature of which realizes and guarantees his status of being a subject, and from there it is close to humanity as a universal category, with which moral progress, understood also as the protection of the individual from violation of his autonomy, is likely to be realized. The vision of the Enlightenment that man is rooted in himself makes man aware of taking responsibility for his own choices, a moral attitude towards the world and precisely towards the reality of the other. What conditions this attitude of affirmation of humanity grows out of the assumptions of the Enlightenment heritage that "humanism is defined by the idea of man's incompleteness, his state of inevitable hesitation, his uncertainty resulting from freedom of decision" (Kolakowski, 1984, p. 22). This conviction sets in motion a state of perpetual way, but not of reaching the goal, a way of searching for solutions that create our presence in the world as moral subjects, and that manifests itself in the belief that no human being has the right to exercise power over another human being, power that is unintelligent, adopted under duress, unjustified and unlawful (Tischner, 1999). It seems that Europe's strength is realized in a shaky equilibrium, in the belief that there are no final solutions, and this self-knowledge is a kind of immunity mechanism built into the structure of European culture. To the destructive force of a homogeneous, because tribal, social structure, Europe opposes the ability to self-question, the ability to get rid of self-confidence and contentment, and this is what constitutes the spiritual strength of the project that is Europe. The idea of human rights is essentially, from a philosophical perspective, but also from a social perspective, to ask the question about the condition of human nature, about the constitutive conditions for the continuation of human beings in the transcendent dimension, about the essence of tensions and conflicts that can threaten human survival, and finally about whether there are landmarks and points of support that constitute the necessary conditions for its continued existence and development. This area of issues centrally places man as a causal, action-taking being, endowed with freedom of will, which freedom implies the ability to do good and evil: "whenever I call for freedom, I betray the secret of humanity, for I reveal that freedom is due to man" (Kolakowski, 1994, p. 38). Man understood in this dimension, transcending the characteristics of the zoological species participates in the moral and rational sphere, the sphere of unconditional moral imperatives that cannot be empirically determined. Humanity transcends the properties of nature, it is not defined by the peculiar determinants that distinguish it from other species. Humanity, therefore, is a moral concept, an attempt to make an endless intellectual effort that marginalizes inherent instincts in favor of the belief that man is a moral entity, being an end in itself, not a means.

Consideration and response to this question determines the status of man as a supra-biological being, and consequently may determine the fate of man and the future of civilization. To go beyond the tribal structure into which natural instincts push us is to constantly transcend utilitarian criteria, to build awareness that this purely abstract finding of human rights protects our mind and conscience from the temptation to treat others as tools. Consequently, we prove with the idea of human rights that humanity is not a zoological find, humanity is not a natural object, and morality is not reduced to the ad hoc, capricious decisions of each individual, for subjectivity is a construct of our free will, the realization of man's rational nature, dignity *ex definitione* is the proclamation of limits in the disposition of human freedom and decision-making, and freedom is a function of our intellectual potency beyond the horizon of narrow, utopian assumptions and dogmas leading to the cusp of absurdity. Human rights prove that we have mastered our weaknesses and the torments of our animal nature, that we have risen above our limitations and beyond the rationale of being reduced to a physical, corporeal existence. We also prove with them that the law cannot be worse than a misdemeanor or a crime, and that punishment is not revenge expressed in impulsively acting drives, as Aristotle points out when he writes about the force of an argument contrasting it with the argument of force. Generations have grown up with the belief that the majesty of law authenticates the entire apparatus of the tyrant's oppression directed against the individual, by the force of an abstract idea we have broken out of this order of tribal morality and today it is the source of universally binding law, and its protection is the duty of every political community. This idea today organizes our lives, and we are all its beneficiaries, for it expresses respect for the subjectivity of the individual, recognition of his individual expression, willingness to submit to the dictates of moral authority, and is the hope of building a coherent moral constitution. This perspective makes it possible to see that human rights are non-human in the genre sense, they do not refer to man as a representative of the natural world, but to man as a rational being, endowed with free will, desiring constant self-creation, exceeding the framework of his individual, measurable and predictable existence (Kolakowski, 2000). Being in such a dimension opens the space of consciousness beyond the individual, ethical values are actualized, in the field of vision of which another human being appears, who becomes a reference for the observance of norms and rules, and intellectual loyalty to reason appoints the causal instance, which is free will marking life henceforth with a conflict of opposing values remaining in constant tension. In essence, this conflict shapes man's humanistic subjectivity and determines the conditions of his survival as a creator and participant in social life. In the natural world, on the other hand, man is a completely reified figure, limited by his structure of existence and remaining, as it were, outside himself, a figure reduced to the function of an accidental, labile existence, in which the experience of meaning other than instincts and passions does not exist, or is radically reduced to mere material content and is based on the inherent inclinations belonging to natural objects (Kolakowski, 2002). The object of human rights is the assumption of man's emancipation from the natural world, the rejection of the "material" and the attempt to achieve an authentic way of

existence. Human rights realize, in a philosophical perspective, that man establishes his presence in the world by becoming, by taking responsibility for life, by affirming life, which ceases to be the place of his exile and alienation. It is hard to resist the impression that it is in concepts that the deeper meaning of human existence and human subjectivity is encoded, and through concepts we recognize fundamental assumptions about the moral destiny of a rational human being. Finally, it seems that the idea of human rights represents the kind of optimum that man, under the conditions of his biological condition, could achieve and still can achieve, for this idea shows the direction of the development of the individual and the collective in which he can participate, the taming of innate instincts and the establishment of a legal instance and subjective barrier against the restraint of this subjectivity by the institutions of the state.

Conclusion

The essence of the idea of human rights is the recognition of the inherent and inalienable rights that the human person acquires at birth and that are due to him by virtue of being human. This is and has been a historically revolutionary assumption, as it points to the autonomy of the individual, ascribes absolute value to him as a moral subject, grants him personal rights and the right to participate in authority, and safeguards against the intrusion of that authority into spheres henceforth considered personal and private. This is not a revolutionary assumption from a transcendental perspective, and is based on duty criteria, absolute principles and norms having justification in the highest authority, which is reason. Thus, human rights are a morally constituted reality, the source justifying and proving the existence of these rights can only be an appeal to transcendence, not to anthropology. This conviction autonomizes the human individual in his rights concretizing in the adoption of the universal consciousness that a human being can not only be free, but that no human being can belong to another human being becoming his property, hence the adoption of this perspective can effectively oppose the evils of slavery or its version of social-Darwinism. A consequence of the moral theory about rational and freely acting moral subjects is the basic assumption on which the idea of human rights is based, concerning the inherent and inalienable dignity of man as a source for his freedom. This is a fundamental issue for legal and constitutional solutions in a modern democratic state, since, in addition to the positive law established by the institutions of the state, it is the dignity of the individual as an expression of natural law that must be taken into account and honored by positive law that matters (Banaszak, 2004). The right to dignity as inherent to the individual is independent of the established positive law and is a reference for the system of values that positive law tries to promote and realize: "the recognition of inherent dignity as the source of all rights indicates their a kind of secondary nature to the person, their subordination to his good. The *raison d'être* of their existence and such and not other content is man, they do not

have an independent existence. The relation to the well-being of man as a whole is an integral element of any law and cannot be disregarded in determining the content of the formulated demands. Consequently, the ultimate reference point of a legislated legal order protecting or respecting human rights is not these rights, but the human person" (Piechowiak, 1999, p. 78).

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SMART CITY TRENDS AND INNOVATIONS SHAPING THE FUTURE OF CITIES

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Purpose: To highlight the current smart city trends and innovations that will shape the future of modern cities.

Design/methodology/approach: This article review is based on a theoretical literature review on the idea of smart city trends and innovations globally. The theoretical approach was based on published journals, government sources, and other sources.

Findings: Human needs as well as the development of electronic-based projects for urban areas have evolved over the years. Environmental pollution has caused a drastic change in climate, urbanization happening rapidly, and more pandemics are expected in the future. But with modern technology advancements, it's important for public institutions and private entities to collaborate to make cities more sustainable. Smart energy solutions, urban planning, and smart health communities are important to smart city trends that can help to significantly transform urban centers.

Originality/value: the presented review paper provides a current realistic overview of the innovations and trends implemented for smart city projects. They are implemented in some of the major cities of the world and their influence is important in shaping the lives of urban residents and the future of cities.

Keywords: smart city, urban, sustainability, trends.

Category of the paper: Literature Review.

1. Introduction

The goal of smart cities is to promote sustainability economic growth, improve the quality of people's lives, (Visvizi, Lytras, Damiani, & Mathkour, 2018) and optimize the city's infrastructures using data analyses and smart technologies. The world's population has massively increased, especially in urban areas. Rapid urbanization has caused significant stress

in the existing infrastructure and led to environmental pollution. As cities move towards digitization and focusing on sustainability, it's important to build efficient and eco-friendly solutions. The Covid-19 pandemic has also led to a shift in the way medical services are delivered- instead of them being confined in institutions, there is a need for the community to play a role in wellness.

Globally, more than 50% of the world population currently lives in urban areas. By 2045, this population will increase 1.5 times and reach 6 billion. By 2050, the urban population is expected to double its current size (Urban Development, 2022) which means that almost 7 in 10 people in the world will be living in cities. On the other hand, climate change is already causing havoc worldwide as both humans and wildlife face new survival challenges. The future of pandemics seems inevitable but it's possible to reduce the risk by implementing smart sustainable solutions. Smart city technologies are in rapid use with more countries implementing smart services for city inhabitants.

2. Literature Review

Smart cities are cities that use various types of electronic techniques and sensors to collect data and provide services that solve the cities' problems. Data in smart cities is captured by the Internet of Things (IoT) devices (Liu, Heller, & Nielsen, 2017) and then processed by artificial intelligence (AI). While the idea of smart cities goes back to 1974, it rapidly kicked in after the 9/11 tragedy. After the 9/11 attacks, New York and other major cities in the world decided to implement AI systems and 24/7 surveillance cameras to protect public spaces.

With the increased likelihood of attacks in urban areas, climate change, infectious diseases, and digitization, the development of smart cities is now more than a need. Efficiency, situation predictability, safety, improved quality of life, and sustainability have forced governments and private entities to develop more innovative solutions.

The period between 2000 and 2005 is considered as the 'IT stage only' and saw the start of the development of ubiquitous cities (U-cities) to solve urban problems but research and implementation at this stage was limited. The infrastructure development of turning U-cities to smart cities kicked in between 2006 and 2010. This was designed to solve citizen's problems based on urban problems. 2011-2015 was a critical stage for the development of smart cities with IT solutions being used to solve specific urban area problems. From 2016 up to now, extensive IT solutions have been implemented to solve entire urban area problems. Thus, smart city trends have evolved over the years, changing from just using 24/7 surveillance cameras to IoT, data analytics, and AI.

3. Smart City Trends and Innovations Shaping the Future Cities

The journey to develop smart cities has evolved from the 1970s when Los Angeles created the 'Cluster Analysis of Los Angeles' report, the first urban big-data project to 1994's 'De Digital Stad' by Amsterdam to promote the use of the internet. The evolution has been successful due to the contributions of companies such as Cisco which put up \$25m in 2005 for five-year research into smart cities (GlobalData Thematic Research, 2020). In 2011, the city of Barcelona organized the first Smart City Expo World Congress and in 2013, China announced its first batch of pilot smart cities, consisting of 90 cities, towns, and districts. Vietnam is currently working on a \$4.2 billion smart city near Hanoi and its expected completion is 2028 (Cheema, 2019). With more cities and countries focusing to redefine and readapt their urban ecosystems, here are current smart city trends and innovations expected to shape the future of cities.

3.1. Smart Energy

Smart energy features intelligent optimization of energy efficiency and energy costs based on innovative technology that's implemented to operate sustainable energy management systems. In 2018, the global energy demands grew by around 2.9 per cent (Global Energy Consumption Only Going Up, n.d.) and this consumption is expected to increase by almost 30% by 2040. Energy costs have skyrocketed worldwide due to rising cost of fossil fuels and soaring costs of imports. As cities move towards digitization, there is a need to design systems that promote sustainability and efficiency.

The implementation of smart energy systems is necessary for facilitating the development of sustainable energy systems. This way, the world can achieve its greenhouse gas emissions and reduce the impact of climate change. Smart grids are important in enhancing real-time energy tracking while virtual power plants can be powerful tools in facilitating efficient energy distribution.

Agder Energi Nett has created smart energy systems using machine learning, IoT, and data analytics (Creating Smart Energy Systems with Data Analytics, IoT and ML, 2020) in a bid to transform their grids. With the use of smart meters, Agder Energi Nett customers can access their energy consumption hourly, leading to smart energy management. Besides that, this system ensures that the company can quickly discover and resolve power grid faults. With most cities in Europe moving towards digitization, the smart meter market is expected to grow at 8.5 per cent CAGR between 2022 and 2027 (Europe Smart Meter Market - Growth, Trends, Covid-19 Impact, and Forecasts (2023-2028), n.d.).

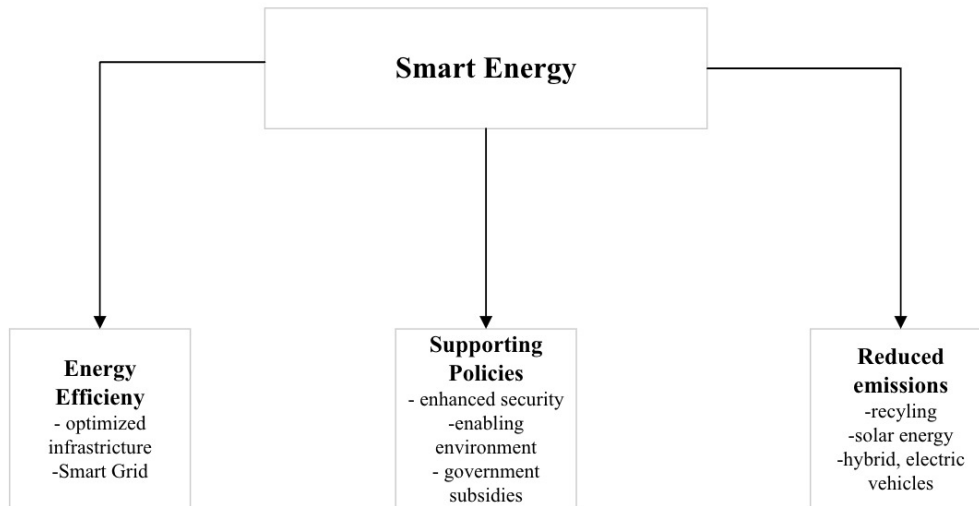


Figure 1. Smart Energy System.

Source: own image.

3.2. Smart Mobility

This is an intelligent mobility and transport network, involving various components of mobility and technology. Smart mobility is a crucial aspect of smart cities, bringing in immeasurable efficiency. In the United States, congestion in urban areas has been cited to cost \$66.1 billion annually (McCarthy, 2020)

Smart mobility umbrella features optimized public transport networks, ride-hailing, carsharing, and intelligent transport systems for logistics. In 2022, the top mobility trends included autonomous driving, smart infrastructure, mobility-as-a-service, and electrification. Advances in these areas are geared towards promoting zero-emission transportation by making urban mobility more eco-friendly and intelligent traffic management. Smart mobility's objective is to reduce noise pollution, and traffic congestion, reduce transfer costs, improve transfer speed, and increase safety.

For over a decade, European cities have been at the forefront of developing smart cities. The common aim is to increase the competitiveness of cities in this region, improve the quality of life of its citizens and help it achieve its European climate and energy targets (Smart Cities, n.d.).

3.3. E-governance

Electronic governance (e-governance) involves the use of information technology in delivering government services (Heeks, 2020). A smart city requires the dissemination of efficient and comprehensive public/government services, thus it's the foundation of a smart city. This trend is supposed to make public services and decisions more transparent, collaborative, and sustainable. This can be achieved using IoT and blockchain solutions while involving stakeholders in the decision-making process.

E-governance includes digital services such as digital passports, online voting, filing tax returns, applying for licenses, etc. The European Union has taken concrete actions in developing digital cross-border public services to help governments, businesses, and citizens.

The efficiency of e-governance involves rethinking how organizations operate, how public services are delivered, and the changing behavior of those services to citizens. The cost savings benefits of e-governance are massive and the EU's cross-border digital public services are designed to allow the free movement of people within the union. For instance, Denmark's electronic invoicing saves businesses almost 50 million euros and taxpayers 150 million euros annually. Italy's e-procurement systems have saved the country almost 3 billion euros. If such a system is introduced across various cities in the EU, then the union's annual savings can exceed 50 billion euros (eGovernment and Digital Public Services, 2022).

3.4. Green Urban Planning

In a bid to cut emissions and waste and build eco-friendly cities, green urbanism is a smart city trend that promotes sustainable urban design. Green Urban Planning is based on three main interactive pillars: materials and energy; urban planning and transportation; water and biodiversity. Sustainable cities have electrified mobility systems, energy-efficient buildings, and eco-friendly city designs. All these should be based on the principles of circular economy which is driven by design i.e., to eliminate pollution and waste, circulate materials and waste, and regenerate nature (Circular Economy Introduction, n.d.)

Copenhagen is one of the top green cities in the world that's popular with green travelers. Almost 47% of its inhabitants use bicycles every day in addition to having one of the highest numbers of electric vehicles per capita globally (What is Green Urbanism and Why is it Important?, 2021).

3.5. Smart health communities

The Covid-19 pandemic has shown us that the community is critical in creating better health environments. To make healthcare more intelligent and efficient, smart health consists of hospitals, regional, and families. They depend on communication and information digital-based environments to enhance existing healthcare procedures and introduce new intelligent features.

Smart healthcare communities introduce a new multi-level change (Tian, et al., 2019) including informatization construction changes, disease-centered to patient-centered medical model, personalized medical management, and focus on preventive healthcare.

This trend will allow smart cities to develop medical ecosystems that support intervention and prevention, away from the traditional model of diagnosing and treating medical issues. Once social or communal determinants are effectively determined, it will be easier for both the private sector and governments to efficiently collaborate and address healthcare issues.

It's important for cities to create healthy living communities and a smart health system facilitates the engagement between patients, public entities, and companies in delivering high-quality digital health services, improving the quality of life, and supporting economic growth due to better public productivity.

A smart health community ensures that healthcare moves outside medical institution by creating new, disruptive community players in the city's ecosystem. Consequentially, this facilitates more scientific advances in the medical field and guarantees affordability in personalized healthcare services. A citizen's wellness will be based on data analytics and processes interoperability, leading to positive decision making (Smart Health Communities, n.d.).

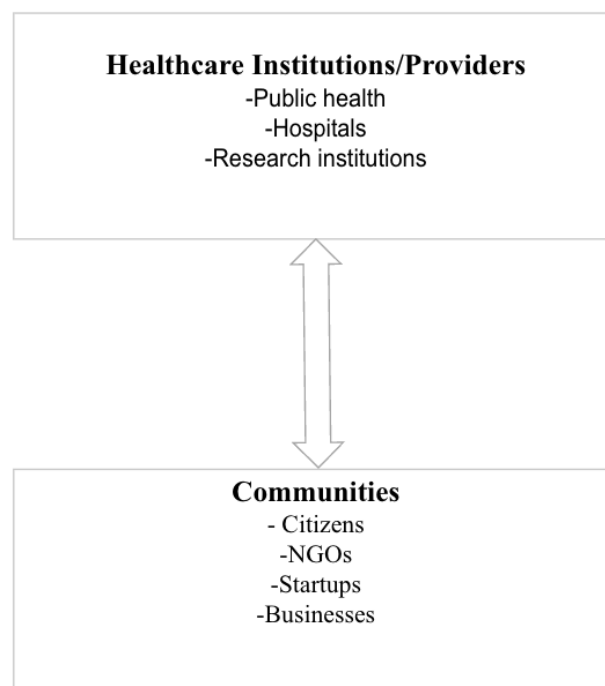


Figure 2. A Smart Health System.

Source: own image.

4. Limitations

Implementation of smart city projects faces poor coordination between private and public sectors (Smart City Planning Must Work for Both Private Business and Public Citizens, 2022). It's very difficult for government agencies and private organizations to share sensitive data. It's also difficult for them to standardize common infrastructure, networks, and tools, limiting the effectiveness of cross-collaboration (Kim, 2022). The life cycle of politics is dynamic and one of the biggest challenges in the development of smart city initiatives. Thus, political capital can easily expire before the completion of a project, leaving the incoming administration in

jeopardy. This often leads to increased complexities and delays. Smart city projects are generally implemented on a large scale and therefore not easy to fund since they need buy-ins from several stakeholders, based on a public-private funding system that naturally blends with local, state, and national interests. These projects need administrations with long-term commitments. Smart cities guarantee people efficiency, convenience, and healthy environments. However, nobody wants to be constantly monitored. While sensors and cameras being installed everywhere may help deter crime, for law-abiding citizens, this may only make them paranoid (Klimovsky, Pinteric, & Saparniene, 2016). However, such can be avoided if citizens are educated about these projects. Developing transparency and community minds might help improve the level of trust for people whose these solutions are designed for.

5. Conclusion

This article's goal was to highlight some of the current smart city trends that will shape the future. Energy prices have skyrocketed globally and as countries and urban centers seek to implement mechanisms that can help cut down energy costs, smart energy solutions can come in handy in limiting energy waster and enhancing promote the utilization of smart energy systems. An intelligent transport system can help reduce traffic congestion, air pollution, and promote mobility efficiency. Green urban planning is critical since climate change is real and cities must find a way of making their spaces safe, eliminate waste, circulate materials and waste, and regenerate nature. After the covid-19 pandemic, the future of other pandemics is inevitable hence cities must create systems that minimize overreliance solely on medical institutions and move healthcare systems to communities. This integration will ensure citizen's wellness will be based on data analytics and processes interoperability, leading to positive decision making. However, the implementation of smart cities comes with challenges such as privacy concerns from city inhabitants, political commitment, and lack of cooperation between public institutions and private entities. There is a need for the masses to be educated on the benefits of smart city projects, especially with regards to data transparency. Administrations should also make long-term commitment to smart city projects since the completion of most of these projects take time and require long-term financial investments.

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DEVELOPMENT OF THE PUBLIC INFRASTRUCTURE OF EV CHARGING STATIONS IN POLAND

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Purpose: The purpose of this article is to evaluate the development of the public EV charging station infrastructure in Poland, at the same time attempting to identify any dysfunctional areas of the process.

Design/methodology/approach: A critical analysis of the domestic and foreign research outputs regarding the importance and development of public charging station infrastructures. An analysis of secondary data derived from statistics reports which show the level of development of the public charging station infrastructure in Poland in the 2019-2022 period.

Findings: Based on the completed research it was found that the development of the public charging station infrastructure in Poland was quite dynamic. Nevertheless, an in-depth analysis of this direction of development makes it possible to identify potential problems and imperfections of that process. The most significant and accentuated problems include: (1) the disproportionately lower growth rate of the number of public charging stations in relation to the vehicle fleet electrification rate; (2) the dominating share of AC charging stations in the public charging station infrastructure, which offer a lower power level translating into longer vehicle charging times; (3) the uneven spatial distribution of the public charging station infrastructure.

Practical implications: Being aware of the direction of development of the public charging station infrastructure is extremely important when it comes to formulating and implementing subsequent investment projects and business models on the market.

Originality/value: Public charging station infrastructures – due to the relatively short history of operation – constitute a relatively new object of studies in economic sciences.

Keywords: electromobility, electric vehicles (EV), EV charging stations, zero-emission transport, sustainability.

Category of the paper: Research paper.

1. Introduction

Alternative fuels infrastructure development in road transport is an area of interest shared by a wide range of socio-economic life participants – EU institutions, national regulatory bodies, self-governments, and also individual users. The significance of the issue derives from one of the most important technological transformations of the 21st century – the gradual dethronement of the IC engine as the main drive of the broadly defined mobility (Jesień, Kurtyka, 2016). The global trend of substituting (mainly in the road transport) internal combustion drives with alternative fuels ensues from the sustainability concept which is based on a concern for the natural environment and for the excessive exploitation of energy carriers in the global economy (Ślusarczyk, 2020).

Undoubtedly, the economy sector that is the most dependent on fossil fuels is transport. From the beginning of this decade, the energy consumption in the transport sector has been increasing by 2% per year, and more than 90% of the energy comes from oil resources (Figure 1).

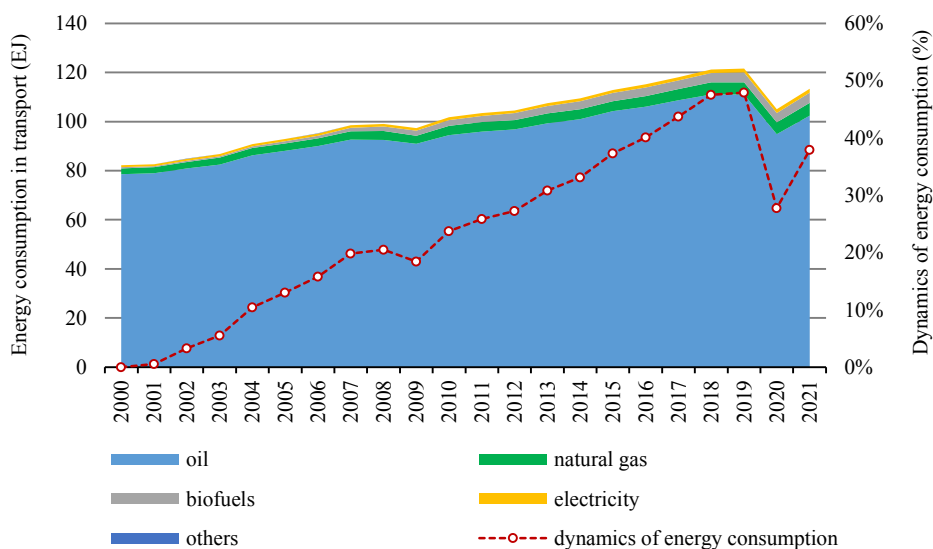


Figure 1. Energy consumption in transport by fuel (based on exajoule – EJ; the left axis) and the dynamics of energy consumption (year to base year – 2000; the right axis).

Source: own study based on: <https://www.iea.org/>.

As a result of the dependency on oil-derived fuels, in 2021 the transport sector was responsible for 37% of the global CO₂ emissions. At the same time, over the past two decades, the level of pollution produced by the transport sector increased by 33% (in relation to 2000), and the mode of transport responsible for the greatest part of the emissions is the road transport (Figure 2).

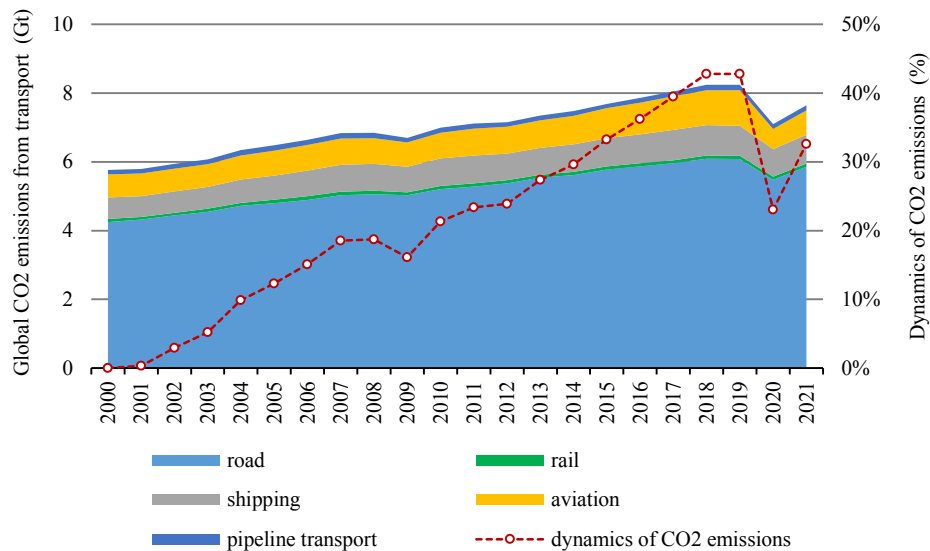


Figure 2. Global CO₂ emissions from transport by transport mode (in Gt) (the left axis) and the dynamics of CO₂ emissions (year to base year – 2000) (the right axis).

Source: own study based on: <https://www.iea.org/>.

In the context of these findings, transformation of the current economic models towards sustainability and low-carbon economy oriented systems is not merely a need, but an imperative and challenge for the contemporary world. The transport decarbonisation policy in the EU countries has its sources in numerous legal acts – these take the form of community-level regulations as well as internal legislation of the EU member states – and one of its pillars is transport electrification, more broadly referred to as electromobility (Chinoracky et al., 2022). It is electromobility that is considered to be the tool to mitigate the negative impact of road transport on the air-pollution levels.

The purpose of this article is to evaluate the development of the public EV charging station infrastructure in Poland, at the same time attempting to identify any dysfunctional areas of the process.

2. Socio-economic importance of the public EV charging station infrastructure

Electromobility is a concept that is intrinsically connected with any deliberations on the future of sustainable and low-emission transport. Being a relatively new and still developing term, electromobility has not yet been unambiguously defined. Still, it may be assumed that the electromobility concept covers individual and collective transport performed by means of road vehicles with electric drives, powered with electric energy stored in a battery (Mataczyński, 2018). The analysed concept should also include a public charging station infrastructure as its immanent element, because it provides a potential user of a BEV (battery electric vehicle) or

a PHEV (plug-in hybrid electric vehicle) with an unlimited (equal) access to a charging point, i.e. a device that enables charging a single vehicle (Ustawa, 2018).

Both issues mentioned above – electrically powered vehicles and a public charging station infrastructure – should be treated integrally as complementary elements that together form a definition of electromobility. What is more, both issues are interdependent in the context of electromobility development perspectives and road transport electrification. This is due to the fact that the research studies completed so far have demonstrated that lack of access to a charging station infrastructure constitutes a key barrier to a wider use of electrically driven vehicles (Alp et al., 2022; Berkeley et al., 2018; Sierzchula et al., 2014). In view of the limited travel range of electrically driven vehicles, an insufficiently developed (in terms of quantity and spatial distribution) public charging station infrastructure further reduces the flexibility and comfort of using such a means of transport. In comparison to vehicles with the traditional IC drive, BEVs are characterised by a shorter travel range on one charge, and the battery charging time is definitely longer than the refuelling time. These circumstances curb the functionality of electric vehicles and constitute a considerable hindrance in consumers' purchase decisions on the BEV market (Franke et al., 2012; Hoen, Koetse, 2014). Therefore, it is a legitimate claim that a well-developed public charging station infrastructure – both in terms of their quantity and their appropriate geographical distribution – will significantly mitigate the said hindrances (Schulz, Rode, 2022) and contribute to balancing the shares of the means of transport that are substitutive to one another (fossil-fuelled vs. electrically driven vehicles).

Another issue connected with the charging station infrastructure is the battery charging time, which depends on the kind of current that supplies the station and the charging technology. In practice, two EV charging models are the most commonly found¹. The first of them is based on alternating current with the output power of up to 43 kW². This kind of charging is offered by AC (alternating current) charging stations, and the characteristic feature of this model is the indirect way of charging the vehicle battery – the alternating current from the station goes to the vehicle's rectifier which transforms the alternating current to direct current that subsequently charges the vehicle's battery. The second solution is charging an electric vehicle with direct current with the output power of up to 350 kW (Schulz, Rode, 2022). This kind of charging is offered by DC (direct current) charging stations characterised by direct charging of the battery – straight from the charging station to the vehicle's battery.

The above indicated differences in EV charging models have a significant impact on the time necessary for battery charging (Table 1). The quick charge (DC) stations offer the possibility of charging a vehicle several times faster than the AC stations. Thus, the quick charge (DC) formula reduces the concerns related to the available travel range and enables

¹ In this study, the issue of plug standards and kinds of charging sockets for BEVs has been disregarded.

² In Poland, the maximum single-phase AC charging power is 7.36 kW, whereas in the case of 3-phase AC the max. charging power amounts to 22.08 kW (UDT, 2022).

relatively seamless driving for BEV users. Thus, being able to use DC charging stations translates into the possibility of driving long distances in electric vehicles, with short downtimes for battery charging (Lin et al., 2022).

Table 1.

Average time of EV battery charging depending on the kind of charging station – AC vs. DC

Charger type and speed	Power rating	Approximate time to charge*
AC – single-phase (slow)	3–7 kW	7–16 hours
AC – three-phase (normal)	11–22 kW	2–4 hours
DC (fast)	50–100 kW	30–40 minutes
DC (ultra-fast)	> 100 kW	< 20 minutes

*Also depends on the battery capacity and other variables.

Source: ECA, 2021.

It is also worth noting that along with the development of EV drive technologies – demonstrated i.a. by increased capacities of installed batteries – AC charging stations will be less and less useful in meeting BEV users' needs. A higher battery capacity means a longer charging time – undoubtedly, users will want to have fully charged batteries so as to be able to utilise the full functionality of the vehicle such as its travel range. Consequently, it may be supposed that the expected direction of future development of public charging station infrastructures will be based on direct current (DC) charging.

3. The public EV charging station infrastructure in Poland

The development of electromobility and the gradual electrification of the road transport constitute global phenomena. In 2021 the sales of electrically driven vehicles doubled in relation to the previous year and amounted to 6.6 million vehicles. Nearly 10% of the global car sales in 2021 were electrically driven vehicles, and this segment increased four times in relation to 2019. As a result of the above, at the end of 2021 there were 16.5 million electric vehicles on the roads all over the world, which was three times more than in 2018 (IEA, 2022).

The growing interest in electrically driven vehicles is also seen in Poland (Figure 3). As at the end of 3Q2022 there were 57,256 electrically driven vehicles registered in Poland, out of which 54,795 were cars. Over the adopted period of study, the average quarterly growth rate of the number of electric vehicles fluctuated around 20%, as a result of which at the end of 3Q2022 the number of electrically driven vehicles was ten times higher compared to the beginning of 2019 and 73% higher than in the analogous period of 2021. Taking into account the hitherto growth trend in the analysed market, it is estimated that by the end of 2025 the total number of registered EVs will exceed 300,000 (PSPA, 2021).

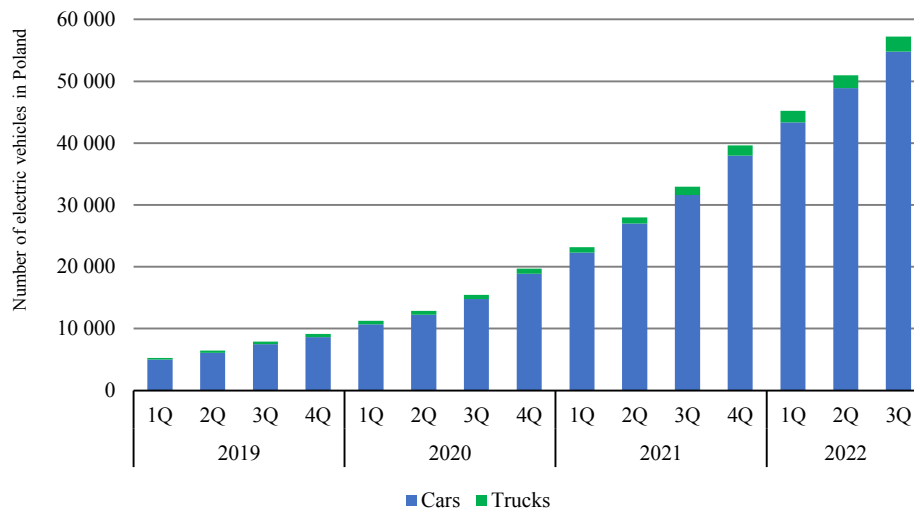


Figure 3. The number of electric vehicles (cars and trucks) in Poland in the 1Q2019-3Q2022 period (as at the end of the period).

Source: own study based on: <https://www.pzpm.org.pl/>.

Parallel to the EV market, the public charging station infrastructure has been developing in Poland (Figure 4). As at the end of 3Q2022, in Poland there were 2,460 public EV charging stations, offering the total of 4,736 EV charging points. Over the studied period, the average quarterly growth rate in the number of public EV charging stations amounted to around 10% (from quarter to quarter), and the dominating type of station was the alternating current (AC) charging station with a power capacity of max. 22 kW. Direct current (DC) charging stations accounted for only 28% of the total number of public EV charging stations functioning as at the end of 3Q2022.

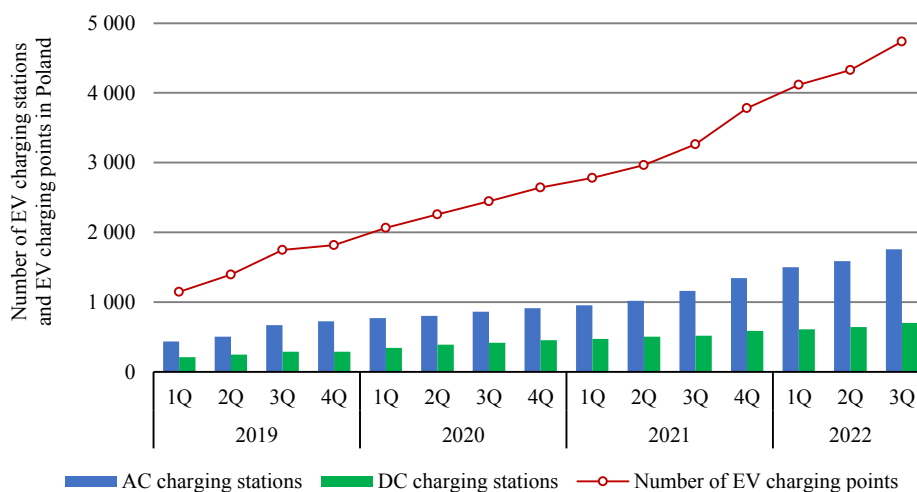


Figure 4. Number of EV charging stations and EV charging points in Poland in the 1Q2019–3Q2022 period (as at the end of the period).

Source: own study based on: <https://www.pzpm.org.pl/>.

One of the measures to assess the market saturation of the public charging station infrastructure is the ratio of the number of EVs to one charging point or station. The ratios estimated for the years 2019-2022 have shown a growing trend – from quarter to quarter the number of EVs per one charging station or charging point has been increasing (Figure 5). This phenomenon ensues from the disproportionate growth rates of the electric vehicle market and of the public charging station infrastructure development. As a result, at the end of 3Q2022 there were 13 electric vehicles per charging point in Poland, whereas in many countries of the European Union (i.a. Austria, Belgium, Spain, Holland, Finland, France, Sweden) the ratio was below 5.

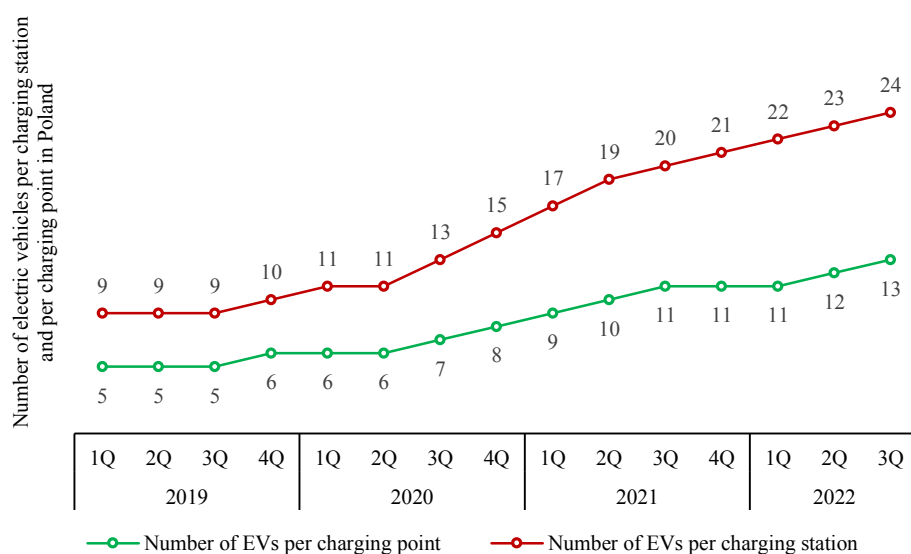


Figure 5. Number of electric vehicles per charging station and per charging point in Poland in the 1Q2019-3Q2022 period.

Source: own study based on: <https://www.pzpm.org.pl/>.

Another measure used in international rankings of public charging station infrastructure development is also the number of EV charging stations per 100 km of road. According to estimates, six EU countries do not have even one charging station per 100 km of road, whereas 17 countries have fewer than 5 charging points per 100 km, and only five countries have more than 10 chargers per 100 km of streets (www.acea.auto, 2022).

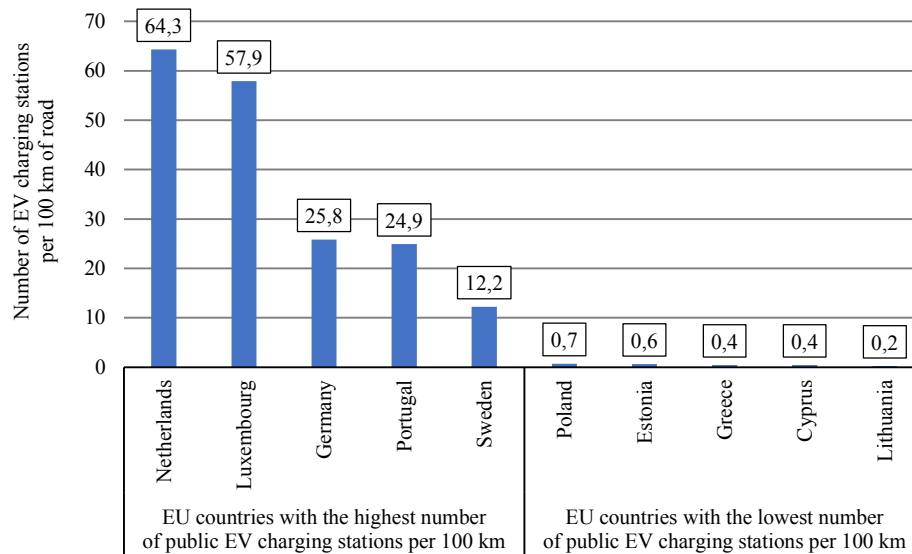


Figure 6. Number of EV charging stations per 100 km of road.

Source: <https://www.acea.auto/>.

What is more, it is possible to observe a considerable gap between the countries where there are the most chargers per 100 km and those where the number is the lowest. For example, in Holland there is one charger per each 1.5 km of road, whereas in Poland there is only one charger per 150 km. Consequently, in Holland over a stretch of 100 km on average there are 64 EV charging points, whereas in Poland – 0.7. Thus, the distribution of EV charging points in Poland is considered to be one of the worst in the European Union (Figure 6).

4. Conclusions

There is no doubt that electromobility redefines the contemporary transport model and sets the course for its future development. The gradual electrification of road transport has a significant impact on the level of air pollution³, contributing to improved air quality and better living conditions as well as to protecting the health of local communities, especially those living in urban agglomerations. Nevertheless, full implementation of the electromobility concept requires ensuring appropriate conditions for correct and effective substitution of the IC engine with the electric one – ensuring a well-developed infrastructure of public charging stations, in terms of both their quantity and spatial distribution.

³ It should be explicitly emphasised that in order to ensure zero-emission road transport (or just a reduction in the carbon footprint) it is necessary to provide electric power that is derived from sources other than fossil fuels (e.g. renewable sources of energy or nuclear power).

In the conditions of the Polish economy – despite its relatively short history of operation, the public charging station infrastructure has been developing quite dynamically. Nevertheless, an in-depth analysis of this direction of development makes it possible to identify potential problems and imperfections of that process.

First of all, it is possible to notice that the growth rate of the number of charging points has not been keeping up with the vehicle fleet electrification process that is definitively faster. Over the studied period, the number of electric vehicles per charging point almost tripled (from 5 to 13). If this trend continues – particularly in view of the planned prohibition on sales of fossil-fuelled vehicles – this may mean an insufficient number of charging stations to meet the needs of their users.

Another significant issue is the prevailing type of public charging station in terms of the kind of offered power. In Poland there is a tendency to install AC charging stations which consistently account for 70% of the total public charging station infrastructure. The prevailing share of slow charging stations combined with the above mentioned potential market shortage of EV charging stations can only exacerbate the problem of EV charging points availability in the future. In addition to that, continuing the infrastructure development while preserving the dominating share of AC charging stations may be deemed contrary to the direction of the technological progress. After all, the offer of electric vehicles on the market has been developing successively, and the main point of interest for the market participants is the ever increasing travel range of EVs. This is possible in principle only via increasing the battery capacity, which entails longer charging times.

Another problematic issue is the spatial distribution of the public charging stations in Poland. In international rankings, Poland is classified as a country with one of the least developed public charging station infrastructures in terms of spatial distribution. This not only hinders the fluidity of EV operation in everyday traffic, but also impedes travelling on longer distances, which makes Poland less attractive for tourists using EVs.

In conclusion, it must be emphasised that the problems addressed here certainly are not exhaustive. This article constitutes merely an attempt to diagnose the current state of the public charging station infrastructure development in Poland and points to hitherto most vital dysfunctional areas that entail potential barriers to further development. Changes in the transport sector take place at such a fast rate that the need for eliminating the said problems should be treated in terms of “a high necessity” rather than “a possibility”.

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MANAGEMENT SYSTEM STRUCTURE VS. BEHAVIOR – A SUPPLY CHAIN SIMULATION ANALYSIS

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Purpose: The purpose of this article is to present a research report on a system dynamics simulation modeling and experimenting of bullwhip effect (BWE) to examine effectiveness of some selected inventory control policies with down- and upstream information flow in a *Beer Distribution Game* (BDG) of a supply chain structure.

Design/methodology/approach: The impact of systems' structures and decision making policies in supply chains or logistics systems are measured and analyzed by an application of systems thinking paradigms and approaches. Particularly, the continuous simulation modeling approach with systems thinking *Iceberg model* metaphor, allowing to focus on strategic aspects of management with some recommendation to design better structures and decision making policies are taken. For the bullwhip effect analysis of a supply chain example (based on BDG model), a *System Dynamics* (SD) continuous simulation modeling method with some proposals in order to analyze feedback loop dominance are undertaken to explain supply chain behaviors and to make some sensitivity analysis for decision making (inventory control) policies.

Findings: The research findings outline the impact of cause – effect relations, feedback loops polarities, and decision making policies to particular behaviors of the BDG supply chain.

Research limitations/implications: Because of complexity of heuristic methods for feedback loop dominance analysis only simple approach was applied (LPD), and some selected scenario for simulation experiments were undertaken resulting in limited conclusions.

Practical implications: The conclusions of the research draw some practical recommendations for a design of information sharing system and an effectiveness of some inventory control policies to be applied in supply chains.

Social implications: One of the systems thinking elements in practical management is an influence to mental models of managers and decision makers. Managers in supply chain systems particularly need some recommendations to avoid bullwhip effect negative impacts. Additionally, managers and also scholars still call for more research to investigate the design and decision making in supply chains, therefore systems thinking simulation research can bridge the gap between traditional operations research and management with other approaches to provide insight into supply-chain dynamics and deliver impactful suggestions to managers.

Originality/value: The paper gives a concept of supply chain dynamic analysis by an application of *Iceberg model* systems thinking metaphor, feedback loop dominance analysis, and a measurement of some selected inventory control policies effectiveness.

Keywords: supply chain, bullwhip effect, inventory control, simulation modeling.

Category of the paper: research paper and a methodological review.

1. Introduction

The emergence of the simulation modeling (SM), as an important field of management systems modeling support, creates a new need and interest for management research community in the ways in which the SM method or technique can assist the process of modeling and analyzing macro-scope management systems, processes, functions and structures. However, despite the existing successful application examples, SM in dynamic management systems modeling has not to date received the methodological support to establish it as a separate research area in management theories' building. Also a micro-scope method of modeling, usually as stochastic discrete modeling, is another form of simulation to be applied rather at an operational level of management.

One of the major research problems in dynamic systems' SM is the identification of relationships between the structure of a dynamic system and the behavior it generates. It is obvious, that cause and effect relations, feedbacks, delays and amplifications, as basic structural features of systems and applied (implemented) decision making policies and rules in system's management or control on dynamic properties of systems, have a significant impact on the system. Complex systems (e.g. economic and management systems), behave in a way that is hard to identify and determine unambiguously (a paradigm of anti-intuitive and counter-intuitive behavior). The main reason for this is the coexistence of many nonlinear structures and higher order feedbacks. There are also '*shadow/phantom*' structures, resulting in the same types of behavior, difficult to identify in terms of feedback dominance. And although in such systems many so called '*system's effects*' are also created (synergy effects), understanding the nature of a single feedback and decision (control) making policies implemented within, is highly critical to a design process of appropriate structures and decision-making policies.

There is a substantial and still growing bibliography on the one of the most fundamental phenomena in supply chain management – a 'bullwhip effect' (BWE), and its impact on supply chain performance (Akkermans et al., 2005; Croson et al., 2005; Liang et al., 2006; Jakšič et al., 2008; Ouyang et al., 2010; Duc et al., 2010; Bhattacharya et al., 2011; Dass et al., 2011; Ding et al., 2011; Dobos, 2011; Sodhi et al., 2011; Zhang et al., 2011; Kristianto et al., 2012; Mesjasz, 2012; Serman et al., 2015; Gonçalves et al., 2021). This effect is an amplification of order oscillations (fluctuations) and time phases lags moving up the supply chain (in an upstream direction) – away from the supply chain final point – a final customer. Given the impact of BWE on supply chains, scholars have called for more research to investigate the behavior of actors within a supply chain (Bolton, Katok, 2008; Narayanan, Moritz, 2015). Behavioral operations research (OR) and SM can bridge the gap between traditional management heuristics and other behavioral sciences such as psychology, neuroscience, and organizational science to provide insight into supply-chain dynamics and deliver impactful suggestions to managers.

The principles, structure and mechanics of BDG¹ game are well documented. Its successful history began with J.W. Forrester first business oriented research, being used basically as a supply chain model experimental setting and treatments in a board or computer controllable forms, however there is still a need to provide more profound research regarding its information system design, and inventory control policies impacts to supply chain performance. The game consists of four actors as players (4-echelon structure) and one actor as an external source of demand (customer or arbiter). Players take the role of inventory managers at one of these four echelons within an integrated supply chain: retailer, wholesaler, distributor, and manufacturer. Within each role, manager as a decision maker is responsible for placing orders to direct upstream supplier and filling orders placed by direct downstream customers. The decisions must be made repeatedly over series of periods, and within each period events occur in the following sequence: a) shipments arrive from direct upstream supplier, b) new orders arrive from direct downstream customer, c) new orders are filled and shipped from inventory, however when order quantity than available inventory (inventory on hand), unfilled order is placed in backlog and filled once the inventory becomes available in a future (in next periods), and d) each supply chain actor places an order to a direct upstream supplier.

The purpose of this paper is to present a research report on a system dynamics simulation modeling and experimenting of bullwhip effect (BWE) to examine effectiveness of some selected inventory control policies with down- and upstream information flow in a *Beer Distribution Game* (BDG) – a model to represent a 4-echelon supply chain structure. The paper addresses also to a methodological gap by investigating the suitability of macro SM in the context of management-oriented organizational analysis and design, and also tries to answer the question how management dynamics of systems are dependent on systems' structures. In fact, the management quality improvement is primarily a design problem and encourage a use of SM models with team/group communications to identify design/redesign requirements.

¹ A business game called BDG (*Beer Distribution Game*) was developed at the Sloan School of Management, Massachusetts Institute of Technology (MIT) in the 1960s as a version of the earlier (1958) *Refrigerator Game*. Demonstrated during the *System Dynamics Conference* (SDC) in Chestnut Hill - Boston by John D. Sterman (Sterman, 1989), it gained worldwide recognition and popularity among management theoreticians and practitioners. It has also an interactive Internet version (Machuca et al., 1997). In Poland, it was presented for the first time during a session of the *Economic Systems Simulation School* in Węgierska Górká in 1990 by Bogusław Wąsik (AE Kraków) and described in (Wąsik, 1992).

2. Research method

2.1. Systems thinking paradigm and SD modeling method

For the ambitious research, a challenge of dynamic system structure influence to system behavior analysis is considered particularly with an application of System Dynamics (SD) method. This method, originated by J.W. Forrester (Forrester, 1961; Forrester, 1972), belongs to systems thinking and macroscopic continuous simulation modeling methodologies. The SD method relies extensively on system's structure (particularly feedback loops and delays) in order to analyze and explain how system structure drives behavior and leads to particular patterns of behavior. Even some formal methods are being developed for an analysis of "structure-behavior" relations (e.g. loop polarity dominance, behavioral analysis for loop dominance, pathway participation metrics, graph theory measurements), still practical analysis by simulation modeling and one- and multi-factor experimenting have largely been restricted to laboratory simple examples as guides to intuition. In social complex systems' SD modeling and analysis practice, large-scale models with many loops are still analyzed in a largely informal way, using trial-and-error simulation. Although this is not a weakness, any formal tool that might help identify important structures in the model as they affect a particular mode of behavior could be of enormous utility, particularly in large models trying to map complexity relations in social systems. According to control system theory, behavior of a system must be considered in a complex – as *input/system/output* framework. System dynamics particularly is analyzed in the context of input and system structure influences on system responses, as outputs. The most important dynamic system properties to be analyzed in feedback control systems are: stability, robustness, time and frequency response, and equilibrium state (Kampmann et al., 2008). System dynamics stability issues are an important part of feedback control system theory and practice.

Systems approach is a creative and epistemological approach, which focuses on systems and structure relations. In that sense it corresponds closely with structuralism - a philosophical school dealing with basic assumptions on ways of perceiving the world by the cognitive subject. The most important assumption is relativism, reducing cognitive forms of seeing entities (objects, subjects, elements) only to relations between entities (cognition in the structural context). It also corresponds to nativism which assumes genetic and biological skills of people to make some order and collect experiences in structural forms. The history of system sciences is an evolution of three branches: systems philosophy, systems theory and systems methodology. The systems philosophy, neglecting reductionism, determinism and linearity of cause-effect descriptions - tends towards interactive holistic thinking with perceiving final goals of systems. The systems theory describes systems of various domains in universal categorization - it implies some ambitious efforts to find *general theory of systems*. The systems methodology, with some philosophical and theoretical elements, is a theory of

systems science developing system concepts, strategies to investigate, analyze and design systems. The systems approach in research implies accepting basic principles of "systems thinking". That is why both terms are also treated as synonyms. The dynamic simulation modeling in economic and social sciences is more difficult than in physical sciences (Kampmann et al., 2014). Cognitive subject and observer is also a part of a system - an active element of research object - and it is not a problem of an observer relativism and his/her measurement instruments. In one of the modern philosophy concepts - hermeneutics - experience and ways of world descriptions in models are proposed in no-foundation and no-atomic introspective analysis. It means that the "atomization" is treated as an epistemological deformation.

The macro-scope SD modeling method in social system is adopting also a systems thinking concept and approach. A model that is helpful for understanding "global" (holistic and systemic) issues in system SD modeling, is the *Iceberg Model* (Figure 1), often used in systems thinking and problem resolving or solving.

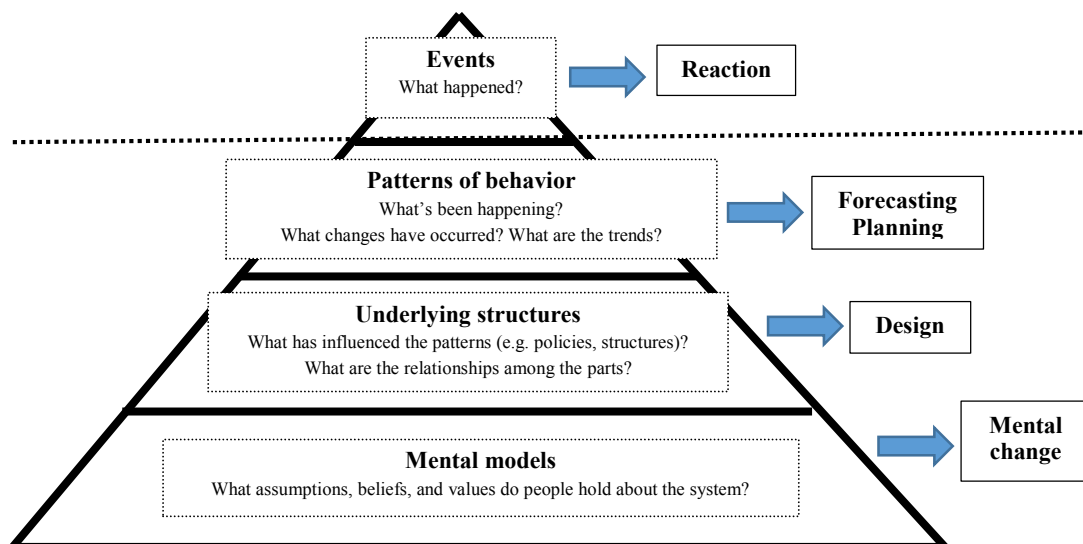


Figure 1. The systems thinking with *Iceberg Model* and SD modeling paradigms in system's analysis, forecasting, planning and design.

Source: own work based on <http://www.systemsthinking.com>.

In SD modeling life-cycle stages, global issues can be looked at in some research and analytical layers, allowing successful system and process restructures and improvements. The *Iceberg Model* is the systems thinking tool designed to help an individual or group discover the patterns of behavior, supporting structures, and mental models that underlie a particular system event. If we apply this model to SD modeling procedure, we could say by an iceberg metaphor, that at the tip above the water, are *events*, or thing that we see or hear about happening in the whole system. If we look just below the water line, we often start to see *patterns*, or the recurrence of events. Finally, at the very base of the iceberg are the assumptions and worldviews that have created or sustained the structures that are in place. The important thing to understand is that in problems' solving, the greatest leverage is in changing the structure.

Like the different levels of an iceberg, deep beneath the patterns are the *underlying structures* or root causes that create or drive those patterns. SD method in system modeling allows to analyze a managed system so as to: model the ways in which its information, action and consequences components interact to generate dynamic behavior; diagnose the causes of faulty behavior; tune its feedback loops to get better behavior.

The first stage in SD application to system modeling is to recognize the problem and to find out which people care about it, and why. Secondly, and the first stage in SD as such, comes the description of the system by means of an influence diagram, sometimes referred to as a “causal loop diagram” (CLD) or “cause-effect diagram”. This is a diagram of the forces at work in the system, which appear to be connected to the phenomena underlying people's concerns about it. Influence diagrams are constructed following well-established techniques – basically “least-extension” technique. Having developed an initial diagram, attention moves to the third stage - 'qualitative analysis' - looking closely at the influence diagram in the hope of understanding the problem better. This is, in practical SD, a most important stage, which often leads to significant results (sometimes it is the end of modeling project). If qualitative analysis does not produce enough insight to solve the problem, work proceeds to fourth stage, the construction of a simulation model with operationalizing “stock and flow diagram” (SFD). The next stage (the fifth one) is where results based on quantitative analysis start to emerge. Initially, use is made of the bright ideas insights and pet theories from qualitative analysis. This stage represents exploratory modeling of the system's characteristic patterns of behavior by experimenting with the aim of enhancing understanding and designing new policies and rules for system.

SD method is originally based on feedback control theory which includes both hard (quantitative) and soft (qualitative) approaches in analyzing dynamic behaviors of the development and changes of a system. SD approach assists to improve decision making process and policy formation through its characteristics of incorporating all relevant cause-effect relationships as well as feedback loops in dynamic behavior modes of systems. By developing a mathematical model as a set of differential equations solved by numerical integration (e.g. by Euler method) and in a computer simulation environment, SD is capable to resolve any dynamic, inter-dependent, counter-intuitive and complex problem, such as problem of investigating the impact of social (management and economic) factors on system outcomes.

2.2. Methods of analytical and simulation based loop dominance analysis

The dominant feedback loop in a multi-feedback system determines the behavior of the system. The concept of dominance is a temporal one, depending on the operating conditions of the system - different feedback loops can be activated and deactivated, causing a change in the feedback loop dominance (Richardson, 1995; Kampmann et al., 2006; Kampmann et al., 2006; Güneralp, 2006; Rahmandad et al., 2009; Kampmann, 2012; Abdelbari et al., 2017; Naumov et al., 2018).

The concept of feedback loop polarity, particularly important in a mathematical method of feedback loop polarity dominance (LPD), is a concept that allows to read loop dominance in a certain way. The feedback in the system contains (should contain) at least one state variable as an integration variable (SD method stock $x(t)$ at time t). Let us consider feedback loop with a stock (resource) x and the flow variable described by the differential equation:

$$\dot{x} = dx/dt, \quad (1)$$

The polarity of the feedback loop containing the resource variable x and its derivate (dx/dt), representing a dynamic of the resource, is calculated as:

$$\text{sign}(\dot{x}/dx) = \text{sign}((dx/dt)/dx). \quad (2)$$

Determination of any feedback loop polarity and dominant feedback loop polarity in more complex systems (with number of feedback loops $n > 2$), as well as polarity turning points becomes analytically more difficult. In practice of any system's SD method modeling there is also a need to introduce many types of variables, as levels (stocks), rates (flows) and auxiliaries (converters), which in turn depend on the other system's variables belonging to particular feedback loops. For the case, where in a given feedback loop there are: state variable x , its rate $\dot{x} = dx/dt$ variable, and auxiliary a_1, a_2, \dots, a_n variables, the sequence of cause – effect relations is $x \rightarrow a_1 \rightarrow a_2 \rightarrow \dots \rightarrow a_n \rightarrow \dot{x} \rightarrow x$. Polarity in such a feedback loop is therefore referred to as a complex function:

$$\text{sign}(\partial \dot{x} / \partial x) = \text{sign}((\partial a_1 / \partial x) \cdot (\partial a_2 / \partial a_1) \cdot (\partial a_3 / \partial a_2) \cdot \dots \cdot (\partial a_n / \partial a_{n-1}) \cdot (\partial \dot{x} / \partial a_n)). \quad (3)$$

The LPD method is a part of a set of eigenvalue elasticity analysis (EEA) methods to analyze and evaluate the effect of structure on behavior in dynamic systems' models.

The other proposal as a method for the identification and behavioral analysis of feedback loop dominance (BAFLD) consists of an iterative 8-step heuristic procedure (Ford, 1999):

1. Identification and selection of a model variable of interest to the analyst from the point of view of feedback loop dominance, for which a preliminary simulation is performed and a trajectory of time behavior is determined.
2. Identification of time periods in which the selected model variable behaves in an elementary way. Reference patterns of behavior are linear, exponential and logarithmic. The conditions for obtaining elementary standards are determined by the system structure and model parameters.
3. Identification of the model feedback loops affecting the tested model variable and selection of one feedback loop as the dominant loop to be found, starting from the feedback loop containing the tested variable inside.
4. Identification or creation of a control variable in the tested feedback loop, which is not a variable belonging to other model feedback loops at the same time. This variable should influence the polarity of the test feedback loop and is used to activate or deactivate the test feedback loop.

5. Simulation of behavior of the tested variable in time intervals with the tested feedback loop in the deactivation state and identification of an elementary pattern(s) of behavior of the tested variable in time intervals.
6. Identification of time periods in which the observed variable behaves in an elementary pattern. If the elementary behavior in the time interval determined in the previous step is different from the behavior initially determined (in step 2), the feedback loop under test is dominant for the behavior of the model variable under test under system conditions. If the behavior is the same, two situations are possible: a) the tested feedback loop is not a dominant loop, b) the tested feedback loop is a dominant loop, but it also has a "parallel" feedback loop, a "shadow" type loop. In order to identify the shadow loop, repeat steps 4-6 with the tested feedback loop deactivated, which will allow to unambiguously identify the parallel loops. After the identification of a shadow loop, it should be deactivated and then the dominance tests for the tested loop should be repeated. If there is no change in the model variable being tested, it is to conclude that there is no dominance of the feedback loop for the model variable being tested.
7. Repeat steps 3-6 with the active test feedback loop to identify possible multiple dominant feedback loops in the test intervals.
8. Repeat steps 1-7 for different time periods to identify changes in feedback loop dominance and loop dominance for other model variables.

Unfortunately, in the BAFLD heuristic approach there is an emerging computational and experimental challenge to test all the possible structure paths and to identify possible "parallel" (shadow) feedback loops and to identify time intervals for patterns of behavior comparisons.

The next heuristic method as a feedback loop pathway participation metrics analysis (PPMA) is based on the use of feedback loop participation metrics in the overall behavior of the dynamic system (Mojtahedzadeh et al., 2004). Since the influences of different feedback loops may be crossing in the model variable under test, the analysis of the model is based on the identification of the most significant feedback loops by evaluating the effects of single paths. The basic intuitive assumption of the PPMA method is also based (similarly to the BAFLD method) on the identification of elementary patterns of behavior. The analysis is based on the following 7 elementary patterns of behavior: linear growth, linear decline, reinforcing growth, reinforcing decline, balancing growth, balancing decline, equilibrium. The results of the SD model simulation for selected model variables are analyzed in relation to the model variables and the simulation time intervals. The mathematical algorithm (Mojtahedzadeh et al., 2004; Mojtahedzadeh, 2011) identifies variables with the same polarity by calculating the first and second derivative on time. The non-linear dynamic system under consideration has a form:

$$\dot{\mathbf{x}} = \mathbf{f}(\mathbf{x}, \mathbf{p}), \quad (4)$$

where:

\mathbf{x} is a vector of n state variables,

$\dot{\mathbf{x}}$ is a derivative of the \mathbf{x} vector in time,

\mathbf{p} is a vector of model parameters.

For the k -th state variable, the model equation has a form:

$$\dot{x}_k = f(x_1, x_2, \dots, x_n, \mathbf{p}). \quad (5)$$

Differentiating the changes occurring in the feedback loop for the tested k -th state variable for $x_k \neq 0$ from the same variable we get:

$$\frac{d\dot{x}_k}{dx_k} = \sum_{i=1}^n \frac{\partial f_k}{\partial x_i} \cdot \frac{x_i}{x_k}. \quad (6)$$

In the equation above, feedback loops and their possible paths, beginning on i -th state variable and ending on k -th state variable being a subject of analysis, are represented. The decomposition of each feedback loop and its paths with x_k state variable influences is done by a calculation:

$$\frac{d\dot{x}_k}{dx_k} = \sum_{i=1}^n \sum_{j=1}^{m(i)} \frac{\partial f_k^j}{\partial x_i} \cdot \frac{x_i}{x_k}. \quad (7)$$

where $m(i)$ is the number of loops and paths that start with the i -th state variable and end with k -th state variable, $\partial f_k^j / \partial x_i$ is a polarity of a path or feedback loop. The x_i/x_k expresses the relative changes of i -th state variable and the relative changes of the k -th state variable. The influence of each feedback path can be normalized in such a way, that it can be expressed between -1 and 1. Therefore, for each path leading to a state variable under study, a metrics can be used to measure the influence of that path (or irrelevant feedback loops) on the behavior of the variable under study. The Path Participation Metrics (PPM) is defined as:

$$PPM(i, j) = \frac{\frac{\partial f_k^j}{\partial x_i} \cdot \frac{x_i}{x_k}}{\sum_{i=1}^n \sum_{j=1}^{m(i)} \left| \frac{\partial f_k^j}{\partial x_i} \cdot \frac{x_i}{x_k} \right|}. \quad (8)$$

For the dominant path or feedback loop, the participation metrics (PPM) is the largest one and it has the same sign (polarity) as the expression 7. If the model variable being tested is not a state variable, the relative changes for the selected variable should be determined, and the same procedure should be followed. Let us consider a dynamic system model in which \mathbf{a} is a vector of model variables that are not state variables and are associated with state variables by g function, while \mathbf{p} is a vector of parameters:

$$\mathbf{a} = \mathbf{g}(\mathbf{x}, \mathbf{p}), \quad (9)$$

If the variable under consideration is a_k , the relative changes of this variable in time dt (numerical integration step) are expressed as:

$$\dot{a}_k = \sum_{i=1}^n \frac{\partial g_k}{\partial x_i} \cdot x_i. \quad (10)$$

When calculating a derivative of the change, we get it as:

$$\frac{d\dot{a}_k}{da_k} = \sum_{i=1}^n \left(\frac{\partial^2 g_k}{\partial x_i \cdot \partial a_k} \cdot x_i + \frac{\partial g_k}{\partial x_i} \cdot \frac{dx_i}{da_k} \right), \quad (11)$$

and after transformation it means:

$$\frac{d\dot{a}_k}{da_k} = \sum_{i=1}^n \left(\sum_{j=1}^n \left(\frac{\partial^2 g_k}{\partial x_i \cdot \partial a_k} \cdot \frac{x_i}{a_k} \right) \cdot x_i + \frac{\partial g_k}{\partial x_i} \cdot \frac{dx_j}{dx_i} \cdot \frac{x_i}{a_k} \right). \quad (12)$$

The procedure of the PPMA method consists of the following stages:

1. Identification and selection of a model variable of interest to the analyst from the point of view of feedback loop dominance, for which a preliminary simulation is performed and a trajectory of time behavior is determined.
2. Division (decomposition) of the trajectory of the tested model variable into phases corresponding to one of the 7 elementary patterns of system behavior (identification of elementary phases).
3. Looking for fragments of structures responsible for elementary patterns of system behavior identified at the step of decomposition in appropriate feedback loops, i.e. being a significant reason for the observed behavior of a variable. In the appropriate mathematical procedure for a given model variable (x) the influence of the change of this variable (dx/dt) on the calculated variable $\dot{dx}/dx = (dx/dt)/dx$, which is a measure of a given path participation in the Total Pathway Participation Metrics, is determined. This metrics shall contain information about the derivatives (1st and 2nd) for the model variable being tested.
4. Identification of the feedback loop path that has a significant influence on the behavior using the calculated participation metrics. The dominant feedback loop path is identified as the one for which the calculated metrics is the largest and has the same polarity as the total changes.

An automated calibration (AC) approach - to systems dynamics modeling, a new interesting concept for classical 'structure – behavior' problem solving with an application of graph theory and its tools was also created (Oliva, 2004). This approach aims at formalizing the heuristics for model partitions and a sequencing strategy for the calibration/testing process in modeling. Even it tends only towards incremental improvements of a SD model confidence (validity) in the model design process, it can be helpful to identify and assess particular system structure elements in the context of their influence to overall system behavior. Given an available set of data (model variables and input parameters for which historical data are available), it is possible

to iteratively identify the set of equations (for variables and parameters) that are directly involved in the outcome variable calculations. Therefore, it is possible to identify the minimum equation set that can be used for estimations. The minimum equation set will guarantee that all parameters used in the estimation are involved in the generation of the selected model outcomes and, hence, that the best use of the input data is made. Confidence in a dynamic system hypothesis is usually built by step-by-step procedure to integrate more complex and strongly connected system's components into simple and observable parts of structure.

The dynamic system independent loop set (ILS) consists of feedback loops with at least one edge not included in the previous accepted loops. Then, after an application of graph theory optimization it is possible to find the shortest independent loop set (SILS) and because of reflexive property of reachability matrix (non-zero values of elements on main diagonal), it is possible to find distance matrix, that shows in each cell the length of the shortest path (a sequence of non-repeating connected vertices and edges) between two vertices, as a walk, a sequence of connected vertices and edges, with non-repeating vertices (Huang et al., 2012).

The GTA method (Oliva, 2004) for the identification and behavioral analysis of feedback loop dominance, and model parameters calibration consists of an iterative 5 step heuristic procedure with some graph theory optimizations:

1. Identification of dynamic system model relations between quantities (variables and parameters) and setting relational matrixes – adjacency matrix (AM) and reachability matrix (RM) in graph theory formalisms to visualize and analyze model structure.
2. Identification of data-availability partitions according to empirical set of data.
3. Structural partitions for SD model levels. Identification of level partitions in AM by blocking (i.e. block consists of only one model level) – the algorithm generates an array with the list of vertices that correspond to each level in each cell. If the adjacency matrix (AM) is reordered according to level structure, the resulting matrix is a lower block triangular with each block representing a level.
4. Structural partitions for SD model feedback loop cycles. Identification of cycle partition as a set of strongly connected elements that contain *all* the feedback complexity of a dynamic system model structure. By an application of RM, it is possible then to calculate the distance matrix (DM) that shows in each cell the length of the shortest path (a sequence of non-repeating connected vertices and edges) between two vertices. A path is a walk, a sequence of connected vertices and edges, with non-repeating vertices.
5. Identification of minimal structures by calculation of geodetic cycle lists and model graph parameters.

Unfortunately, the GTA method algorithm only identifies “geodetic circuits” and does not detect all the feedback loops in the cycle partition. Moreover, simple logical tests can ensure that only cycles, circuits with non-repeating nodes are included in the list. The geodetic cycle list generated by this algorithm is *unique* if the cycle partition has no shortest paths of equal

length between any two vertices in the cycle set. While the algorithm has no explicit way of selecting among alternative shortest paths of equal length (if they exist), it does guarantee that, if it exists, a shortest cycle linking every vertex-pair is included in the list. While the number of geodetic cycles is still large, the algorithm is more efficient than an exhaustive loop search. And also by adopting the GTA representation of a SD model, we can focus on structural complexity feedback loops components rather than the dynamic complexity that arises from linear or nonlinear relations with delays and amplifications.

The algorithmic detection of archetypal structures (ADAS) method (Yucel et al., 2011; Shoenenberger et al., 2015) is an approach to test dynamic hypotheses about archetypal structures belonging to the four generic system's archetypes (i.e.: the underachievement, relative achievement, relative control, and out-of-control) as a result of intended and unintended consequences of system's feedback loops. This approach is based on classical (analytical) feedback loops and cycles' partitions, and it takes also graph theory analysis (GTA) method as an assumption. However, for the detection of generic structure archetypes, it requires not only vertices and edges but also other dynamic parameters as input data – polarities, magnitudes and delays. A qualitative, algorithmic procedure of ADAS method consists of the following stages:

1. Identification of archetype reference behavior of a variable of interest.
2. Formulation of a hypothesis (SFD model) to explain particular system's behavior.
3. Conversion of SFD model into directed graph in adjacency matrices (AM) for polarities and delays.
4. Setting the variable of interest (from stage 1) as the outcome (observable) variable in the algorithm.
5. Algorithmic checking for the variable of interest the other archetype structures with a presence of this variable.
6. Identification of plausible archetypal structures that cause the problematic behavior of the variable of interest, and then reinterpreting the archetypes in stage 5 in the context of SFD model in stage 2.
7. Introducing policies as classical SD solutions.
8. Simulation of the model and reviewing the behaviors for the variable of interest.

The ADAS approach (as a practical application of GTA) to feedback loop analysis, is based on an assumption that the dynamic system structure represented in a model can be relevant to and accurately described as a directed graph. It implies that model variables and relations must be translated into vertices and edges, respectively, and to analyze complex and large scale dynamic systems with complex feedback loops to return to many types of archetypal structures. This problem can be effectively solved by reduction of structure partitions with feedback loops (e.g. by SILS algorithm or by identification of minimal feedback loop structures).

2.3. Comparison of analytical and heuristic methods of loop dominance analysis

To compare structure and behavior analysis methods we must have some assumptions regarding relevant classification criteria and measuring metrics to be identified. Particularly, feedback loop impact as the most important structure issue is taken first into consideration. However, the presented above an arbitrary selection of feedback loop dominance analysis methods, which are presented in most of research applications and published SD journals and reports, form different level of maturity. Some approaches are rather only theoretical concepts without serious practical implementations, some other approaches are practical algorithms to solve particular research problem (e.g. calibration of model parameters). The methods and algorithms for feedback loop dominance identification and analysis, as described above, have many common features. However, there are also some fundamental differences in the proposed approaches (Table 1).

Table 1.

A comparison of feedback loop dominance analysis methods

Criterion	Method				
	LPDA	BAFLD	PPMA	GTA	ADAS
Method type	Mathematics	Heuristics	Mathematics/ heuristics	Heuristics	Heuristics
Method aim	Identification of dominant feedback loop polarity	Identification of dominant feedback loop polarity	Identification of dominant feedback loop polarity	Calibration of the model parameters	Identification of intended and unintended archetypes
Problem solving	Differential calculus	Iterative	Iterative	Graph optimization	Iterative
Behavioral patterns	No	Linear, exponential, logarithmic	Linear growth, linear decline, reinforcing growth, reinforcing decline, balancing growth, balancing decline, equilibrium	No	Underachievement, relative achievement, relative control, out-of-control
Metrics	Relative change	No	Path participation	Distance	Edge weights
Model variable	All types	All types	All types	Levels	All types
Shadow feedback identification	No	Yes (no dominance analysis)	No	No	No
Model simplification	No	Yes (versions)	No	Yes (minimization)	Yes (minimization)
Software	No	No	Yes (<i>Digest</i> prototype)	Yes (<i>SILS</i> algorithm)	No

The 5 methods being analyzed (LPDA, BAFLD, PPMA, GTA, ADAS) are a result of an attempt to implement a sound postulate expressed by many systems' analysts (particularly simulation-oriented modelers of SD community) – to develop tools for feedback loop analysis with the use of formal dynamic system representation.

According to the above overview of some loop polarity detection methods, there are some prospects to have in a near future some effective software tools to support an analytical process of management systems' behavior identification. However, we also cannot give any hope for a *unified theory of systems analysis*, that is able to automatically provide modelers with any guideline to identify directly *dominant structures*. But this is also not to say that formal (or even heuristic) methods should not be developed. In practice, by the implementation of many SD modeling simulation projects and customer-oriented modeling techniques (customer knowledge and experience, needs and expectations), the issue of dominant feedback loop identification and analysis can be solved/resolved by an intuitive, heuristic, and subjective experimental procedure. Properly designed simulation experiment allows to recognize those parts of the model (paths and feedback loops, delays) which determine model behavior.

3. Supply chain dynamics – BDG analysis

3.1. Generic supply chain models – basic analysis

For example, in a dynamic generic supply chain system structure (Figure 2) with two feedback loops of the 1st order and dynamic equation given as:

$$\dot{x} = a \cdot x - b \cdot x = (a - b) \cdot x, \quad (13)$$

where x is an inventory level, a and b are constant parameters describing dynamic rates for supply inflow (a) and supply outflow (b). According to this definition, polarity of the system with the two feedback loops is equal to $\text{sign}(a-b)$. It means, that when $a > 0$ and $b > 0$, the polarity as $\text{sign}(a - b) > 0$ if $a > b$, and polarity as $\text{sign}(a - b) < 0$ if $a < b$ (Table 2).

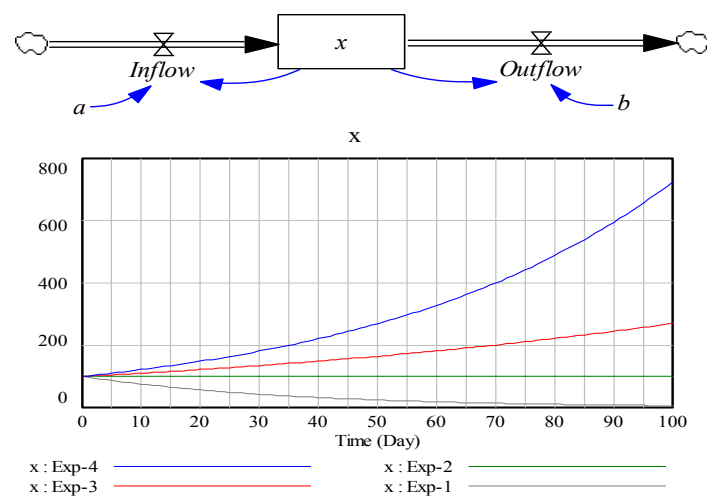


Figure 2. Dynamics of 1-echelon generic supply chain system example with 2 feedback loops and some canonical (exponential increase/decrease) behaviors by the change of a parameter $\{a=0.002, 0.03, 0.04, 0.05\}$, and $x(0)=100, b=0.03$.

Table 2.
Polarity in a system with 2 feedback loops of the 1st order

	Polarity					
	+	-	-	+	-	+
Conditions	$a > 0$ $b > 0$ $a > b$	$a > 0$ $b > 0$ $a < b$	$a < 0$ $b > 0$	$a > 0$ $b < 0$	$a < 0$ $b < 0$ $ a > b $	$a < 0$ $b < 0$ $ a < b $

For example of more complex, 2-echelon inventory supply chain example (Figure 3) with four feedback loops of the 1st and 2nd orders, dynamic equations are given as:

$$\dot{x} = a \cdot (n - y) + c \cdot y - b \cdot x, \tag{14}$$

$$\dot{y} = b \cdot x - c \cdot y, \tag{15}$$

where x and y are inventory levels, a, b, c, n , are constant parameters describing dynamics rates for supply inflows (a and b) and supply outflows (b and c), and n as a constant parameter describing desired (normative) level of y inventory (Figure 4). The four feedback loops (Figure 3) are as follows: (1) $x \rightarrow \text{Outflow-}x \rightarrow y \rightarrow \text{Outflow} \rightarrow \text{Inflow} \rightarrow x$, (2) $x \rightarrow \text{Outflow-}x \rightarrow y \rightarrow \text{Inflow} \rightarrow x$, (3) $x \rightarrow \text{Outflow-}x \rightarrow x$, (4) $y \rightarrow \text{Outflow} \rightarrow y$.

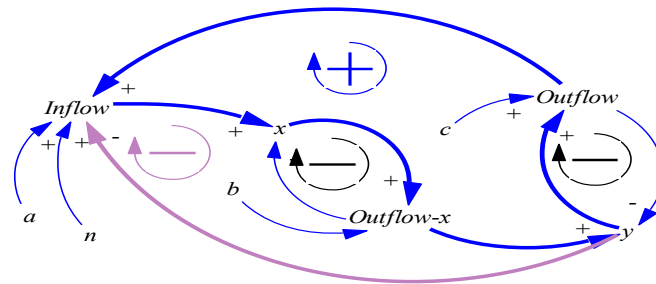


Figure 3. Influence diagram of the 2-echelon inventory supply chain model with 4 feedback loops.

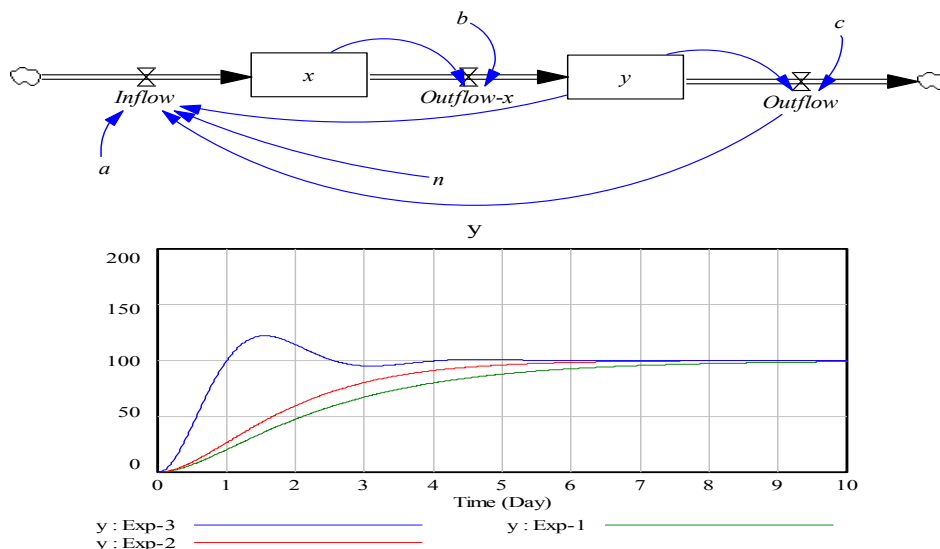


Figure 4. Dynamics of 2-echelon generic supply chain system example with 4 feedback loops and some canonical (goal seeking, S-shape, oscillation) behaviors by the change of a parameter $\{a=0.75, 1.00, 5.00\}$, and $x(0)=0, y(0)=0, b=1, c=1, n=100$.

According to the polarity definition, dominant polarity of the system with the four feedback loops possible to identify in this supply system above is more complex and must be determined by equation (3). In fact, due to a , b , c , and n parameters positive or negative values, we can expect rather combinations of elementary polarities. For positive values, we can identify a dominant negative polarity in order to get steady state behavior – very fundamental one in any inventory control system with temporal exponential growth, S-shaped, and oscillation patterns of dynamics behavior (Table 3).

Table 3.

Polarity in a system with 4 feedback loops of the 1st order

Conditions	Polarity
	+/-
Critically overdamped inventory control – Exp-1	$(b + c)^2 > 4 \cdot a \cdot b$
Critically damped inventory control – Exp-2	$(b + c)^2 = 4 \cdot a \cdot b$
Critically underdamped inventory control – Exp-3	$(b + c)^2 < 4 \cdot a \cdot b$

3.2. BDG supply chain – upstream vs. downstream information impact

Now let us consider a more complex 4-echelon supply chain model, possible to identify in a very famous supply chain business BDG game. This game is a commonly recognized game, as a most important tool to educate and train logistics managers, particularly to illustrate dynamics aspects of decision making in logistics management, and also a very negative impact of BWE phenomenon to supply chain performance. There are many analytical (e.g. operations research) and simulation oriented studies regarding decision making ordering principles and possible co-operations of game actors in order to increase effectiveness, efficiency, and also adaptability (e.g. resilience) of supply chain management. The model described below is a representation of BDG game in forms of *cause-effect* relationships (Figure 5) and *Vensim* simulator, developed with SD continuous simulation modeling approach (Figure 6).

The model consists of four independent organizations (4-echelon structure), as supply chain cooperating actors: retailer (*RetInv*), wholesaler (*WhoInv*), distributor (*DisInv*), manufacturer (*ManInv*) and one actor as a source of demand (*CustDem*). Within each organization, manager as a decision maker, is responsible for placing orders to direct upstream supplier and for filling orders placed by direct downstream customers (Figure 5). The decisions must be made repeatedly over periods, and within each period events occur in the following sequence: a) shipments arrive from direct upstream supplier, b) new orders arrive from direct downstream customer, c) new orders are filled and shipped from inventory (e.g. *RetOut*), however when order quantity than available inventory (inventory on hand), unfilled order is placed in backlog (e.g. *BLRetOrd*) and filled once the inventory becomes available in a future, and d) each supply chain actor places an order to a direct upstream supplier. In the SD model presented below, also some economic aspects of overall supply chain performance are included (*Total cost*).

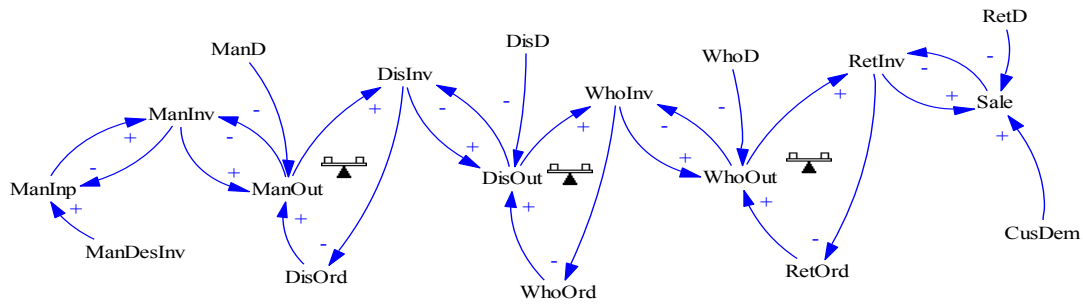


Figure 5. Influence diagram of the basic (no information sharing) BDG 4-echelon supply chain model.

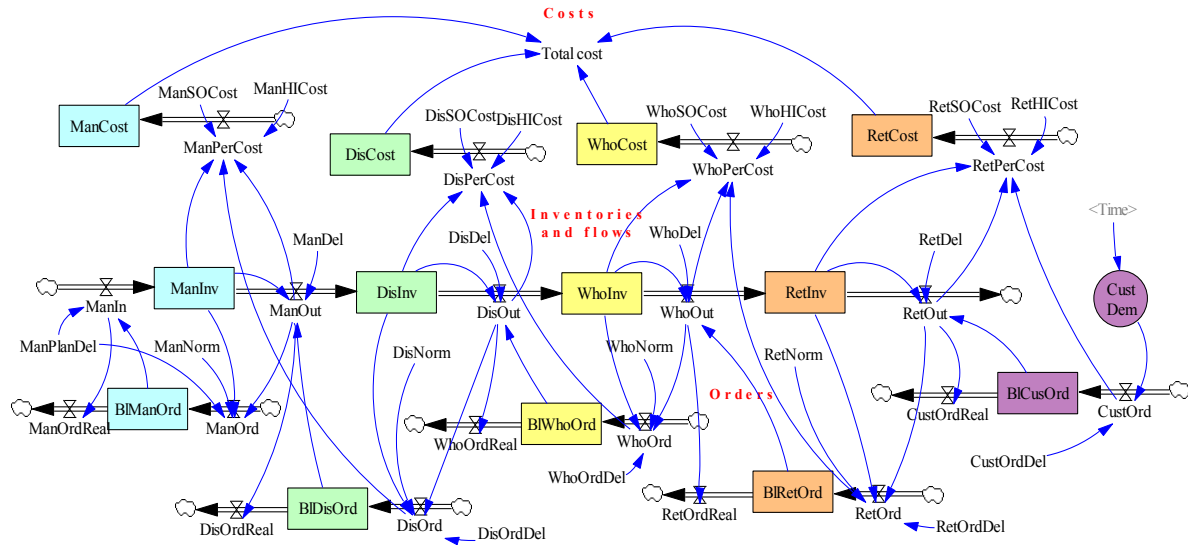


Figure 6. Stock and flow diagram (SFD) of the basic BDG 4-echelon supply chain model with inventory control by norms, and no information sharing.

In simulation experiments made on the model above, an impact of 3 customer demand functions to overall supply chain performance was tested: a sinusoidal function (Figure 7) $CustDem=4+4 \cdot \sin((2 \cdot \pi / 26) \cdot Time)$, a step function (Figure 8) $CustDem=4+STEP(4, 26)$, and random uniformly distributed function (Figure 9) $CustDem=RANDOM(0, 8, 1)$.

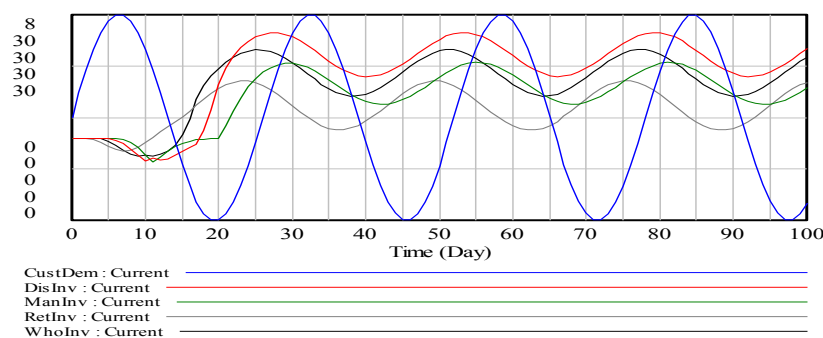


Figure 7. Dynamics of 4-echelon generic BDG supply chain system example with 4 feedback loops, with goal seeking behaviors, inventory control by norms, and no information sharing, as a response to customer demand sinusoidal function.

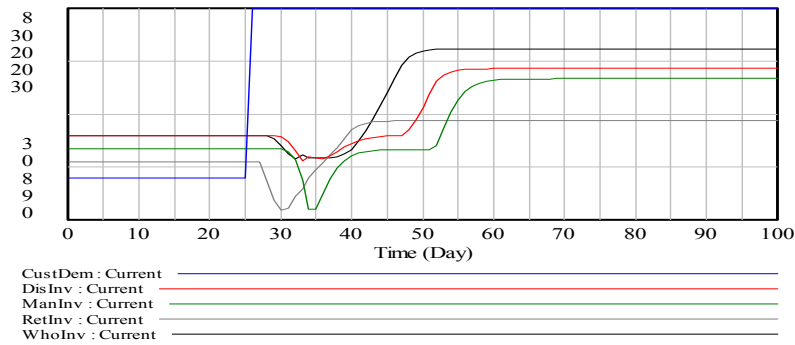


Figure 8. Dynamics of 4-echelon generic BDG supply chain system example with 4 feedback loops, goal seeking behaviors, inventory control by norms, and no information sharing, as a response to customer demand STEP function.

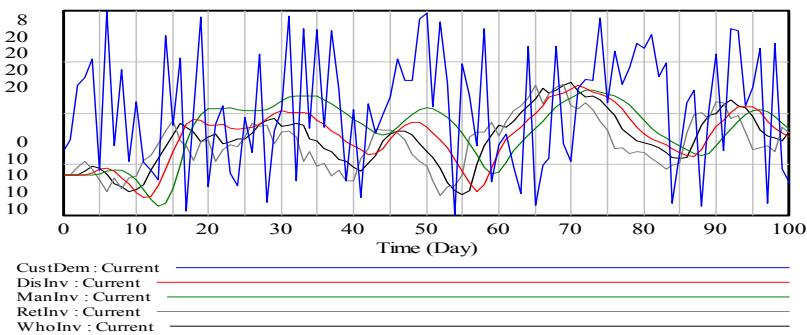


Figure 9. Dynamics of 4-echelon generic BDG supply chain system example with 4 feedback loops, goal seeking behaviors, inventory control by norms, and no information sharing, as a response to customer demand RANDOM function.

To compare no information sharing supply chain performance with information sharing supply chain performance, 2 versions of the model above were developed: a downstream information sharing model, where ordering decisions are made by exponential smoothing averages of direct downstream orders (Figure 10), and an upstream information sharing model, where ordering decisions are made by backlogs and an information on current inventory levels of direct upstream actors (Figure 11).

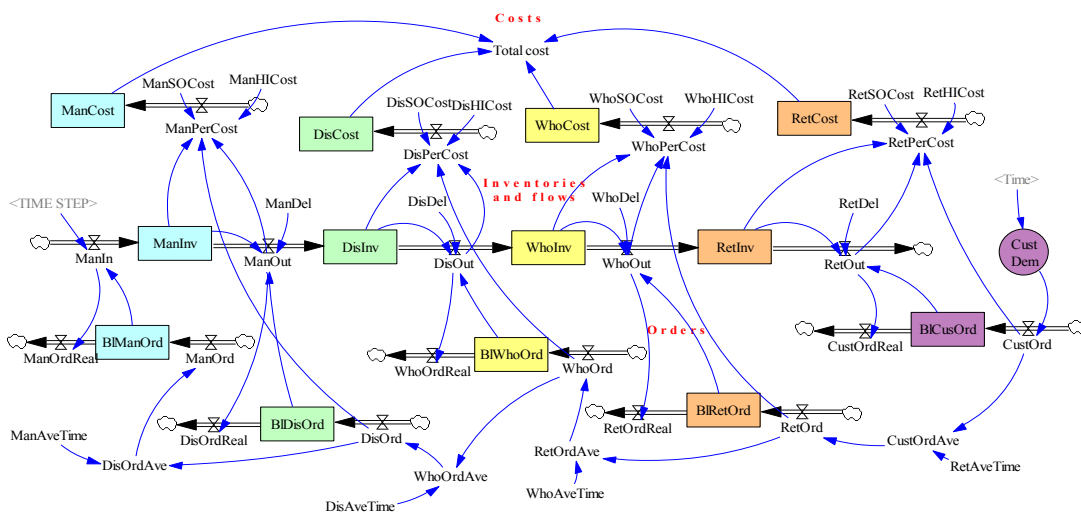


Figure 10. Stock and flow diagram (SFD) of the basic BDG 4-echelon supply chain model with inventory control by average demand with direct downstream information sharing.

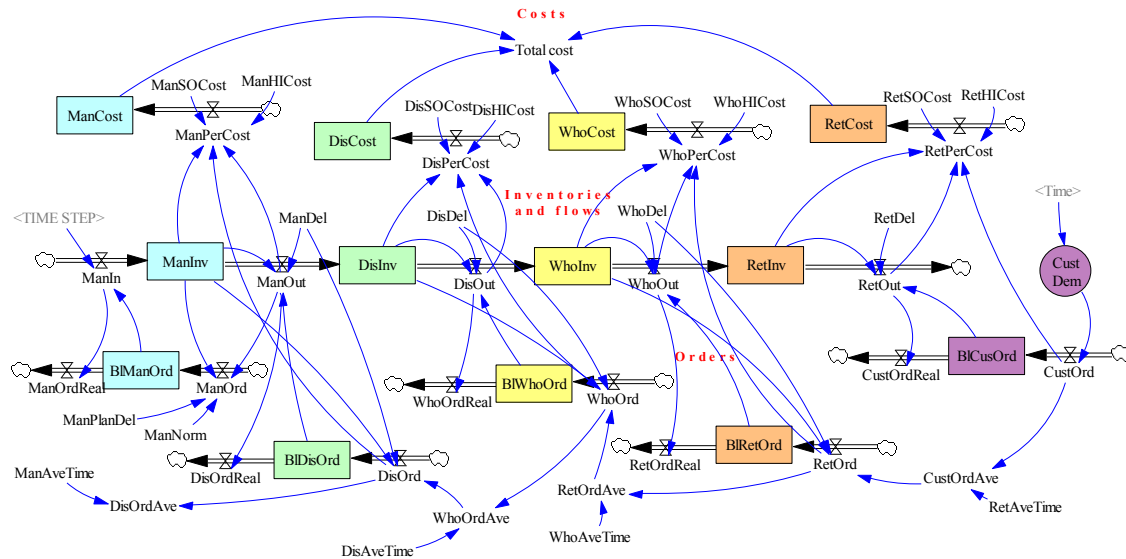


Figure 11. Stock and flow diagram (SFD) of the basic BDG 4-echelon supply chain model with inventory control by average demand by direct upstream inventory information sharing.

The simulation results of all these BDG model versions in the case of 3-type exogenous *CustDem* input functions (sinusoidal, step, and random) have proved better performance of upstream and downstream information sharing ordering policies in the supply chain (Table 3).

Table 3.

Total cost of supply chain in BDG model with 3 options to share information

Demand pattern	Information sharing		
	no information	direct downstream	direct upstream
Sinusoidal	3139.43	3173.24	2476.43
Step	3897.79	3073.89	2608.58
Random	2891.73	2413.65	2218.93

4. Summary and final remarks

The methodology of dynamic system analysis and understanding, e.g. the issue of supply chain system’s structure influence to system’s behavior, is still an important research challenge for theory and practice of systems science, systems’ modeling and management. As presented above in a loop polarity detection methods comparison, we cannot give any hope for a *unified theory of systems analysis*, that is able to automatically provide modelers with any guideline to identify directly *dominant structures*. But this is also not to say that formal (or even heuristic) methods should not be worked out. Relatively well developed mathematical methods and techniques concern gradient systems as well as some classes of non-linear systems. In practice, in the implementation of many simulation projects with an application of SD modeling method and customer-oriented modeling techniques (customer knowledge and experience, needs and expectations), the issue of dominant feedback loop identification and analysis is solved

(resolved) rather by an intuitive, heuristic, and subjective experimental procedure. The lack of an effective mathematical (or heuristic) methods to select structurally responsible systems' paths and feedback loops for systems' behavior is a limit to disseminate SD approach in systems' modeling. Existing solutions in the form of software tracking tools for feedback loops in SD models in some software packages (*Vensim*, *IThink*, *Stella*, *PowerSim*) are far to provide satisfactory results (Heyward et al, 2014).

Important challenges for the future SD modeling of social and economic systems aiming at dynamic systems' analysis, diagnosis, and design (redesign) for management purposes (e.g. in supply chains) still remain. It contains development of theory foundations, technological and model implementation environments, and education with training resources. In the theory context, the most important challenges are nonlinearity and complexity of dynamic systems, social and economic evolution processes, influence of mental models (e.g. individual models, group models, team models) on systems' comprehension and decision making policies design, identification of potential behavior of a dynamic system just from the structure, and some typical theory of modeling issues, i.e. aggregation (e.g. metamodeling) and disaggregation (e.g. agent-based modeling), relevance of models (e.g. validity, verification, certification). In the technological and implementation context, the future challenges are improvements in available modeling technologies and software tools, i.e. effective and efficient algorithms, functions and methodological integration, standardization, parameters' calibration, automated and interactive modeling stages with help and assistance, visualization of model runs, input and output data analysis, consensus development in soft systems (e.g. group model building approaches, communication in modeling). In the context of knowledge propagation (education and training), the future research issues are systems thinking and dynamic systems modeling knowledge-based systems' design (e.g. best modeling practice and guidance library collection), new (better) curricula and pedagogy for schools (primary, secondary, high), and universities.

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Footnotes

A business game called BDG (*Beer Distribution Game*) was developed at the Sloan School of Management, Massachusetts Institute of Technology (MIT) in the 1960s as a version of the earlier (1958) *Refrigerator Game*. Demonstrated during the *System Dynamics Conference* (SDC) in Chestnut Hill - Boston by John D. Sterman (Sterman, 1989), it gained worldwide recognition and popularity among management theoreticians and practitioners. It has also an interactive Internet version (Machuca et al., 1997). In Poland, it was presented for the first time during a session of the *Economic Systems Simulation School* in Węgierska Górka in 1990 by Bogusław Wąsik (AE Kraków) and described in (Wąsik, 1992).

TALENT MANAGEMENT PRACTICES – EMPIRICAL EVIDENCE FROM POLISH HEALTHCARE ENTITIES

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Background: In the Polish healthcare system, there is a high demand for highly qualified medical staff who can be considered talents. Therefore, the use of appropriate talent management practices by managers of healthcare entities is becoming increasingly important.

Purpose: This study examines the respondents' perception of the current use of selected talent management practices in healthcare entities in Poland. It was also important to investigate the relationship between talent management practices and employee retention and check whether the assessments of individual talent management practices differ depending on the type of healthcare entity and the education of managers. Because the spectrum of talent management processes is wide, in this article, we pay attention to talent acquisition and identification, competence development and employee appraisal.

Design/methodology/approach: A questionnaire for managers of Polish healthcare entities was used to collect the data. 120 respondents took part in the research. A five-point Likert scale was adopted to assess individual talent management practices. In order to examine the properties of the measurement scale and the items that make it up, a reliability analysis was performed. Data were then analyzed using descriptive statistics, Spearman's rho correlation analysis, Kruskal-Wallis, and Mann-Whitney U tests.

Findings: The study showed that the talent management level in Poland's public healthcare entities is not sufficiently advanced. The study's results also revealed the positive impact of talent management practices on employee retention. The analysis shows that the type of medical entity differentiates the level of development of employees' professional competencies and evaluation. No differences in talent management level were observed depending on the managers' education.

Originality/value: In practice, this study highlights problematic areas of talent management practices in healthcare entities. The study contributes to the new knowledge on the perception of managers of healthcare entities regarding the use of talent management practices in the Polish health sector.

Keywords: talent management, healthcare entities, talent acquisition and identification, employee appraisal, development of professional competencies.

Category of the paper: Research paper.

1. Introduction

The healthcare system in Poland and the world is currently facing many challenges, such as low availability of medical personnel and intense cross-country migration of highly qualified health professionals (Shaffer et al., 2016). According to recent studies, labour shortages in the healthcare sector are likely to exceed soon 15 million workers (Liu et al., 2017).

The above problems reinforce the need to adopt strategies regarding talent management practices in healthcare providers. The literature emphasizes that implementing such practices can improve employee retention and organizational efficiency, reduce medical costs and reduce patient health risks (King, 2015; Trebble et al., 2014; Williamson, 2011).

Talent management (TM) is defined in the literature as the process of attracting, selecting, developing and retaining working people with enhanced abilities, skills and knowledge (Budhwar, Mellahi, 2007; Wood, 2008). These activities should concentrate on the best employees in the most strategic roles (roles necessary to achieve the organisation's strategic priorities) (Vaiman et al., 2012). In contrast, talent management in healthcare has been defined as "attracting and integrating highly skilled workers and developing and retaining existing workers (Powell et al., 2013). Talent management aims to help engage and retain the company's most important asset, human capital.

Talent management consists of a series of separate but interrelated practices tailored to achieve a range of organizational or individual goals. They refer to attracting, recruiting, developing, evaluating and retaining those individuals whose professional or operational expertise contributes to positive outcomes for patients or society and creates value for stakeholders (Sopiah et al., 2020; Turner, 2018b).

The literature in healthcare management emphasizes that the most important practices in the field of talent management include attracting and integrating highly qualified employees and developing and rewarding the best-appraised healthcare workers (Turner, 2018b). This study focuses on three core talent management practices: Acquisition and Identification, developing and appraising talents.

Talent acquisition and identification practices concern recruitment activities relating to acquiring talent from the external labour market and identifying the internal talent pool. The literature emphasizes (Bibi, 2019b) that there are many ways to attract talented people, but one of the key aspects is recruitment and selection. It is considered an important task for an organization to recruit a talent pool and select a potential person from that pool who will ultimately contribute to the organization's success (Rabbi et al., 2015). Attracting talent through recruitment is an essential phase in talent management to determine which employees can serve the organization effectively. It may involve, for example, recruiting specialists such as radiologists based on a set of talent competencies, including commitment, skills and expertise (Nojdedeh, 2015). Recruitment is the process of discovering talented personnel for current or expected vacancies, while selection is selecting the right person for a given position (Oaya et al., 2017). Identifying talents regards determining what kind of people with what competencies - abilities, knowledge, skills and experience are considered organizational talents in a specific organizational context (Taha et al., 2015). Talent identification practices should be targeted both at detecting talent "already manifest in a given organizational environment" and at those employees who have the potential to excel in various future roles (activities) (Nijs et al., 2014).

Talent development includes activities that help the best employees acquire valuable information, skills and talents that support the success and development of the organization (Garavan et al., 2021). This practice also includes activities supporting the professional advancement of talents, i.e., strengthening, training, mentoring and coaching of high-potential medical employees. The literature emphasizes that the development of medical talents is the basic measure of talent management (Aljunaibi, 2014). The introduction of a talent management system in a healthcare entity requires the launch of additional processes to improve qualifications, which strengthens the staff and raises the level of competence, as well as the prestige of the medical unit (Blair, 2008). Developing a talented employee has become the basis for the organization's success. Therefore, this TM practice is essential for employees to upskill the needs of an ever-changing environment (Rabbi et al., 2015).

Talent appraisal is a process of evaluating people in an organization to identify high-potential employees. The organization should have a fair and acceptable appraisal system so that employees can evaluate their work regularly, which can motivate employees to put in the effort and behave appropriately in the workplace. This can create a pleasant working atmosphere in which employees are encouraged to achieve the organisation's goals (Ismail et al., 2021). The result of this assessment helps in succession planning (Dzimbiri, Molefakgotla, 2021). The essential element of the appraisal system is rewarding, which is about recognizing high-performing staff, and effectively rewarding them is critical to retaining them (Naim, Lenka, 2017). Evaluation of employees is an inseparable element of the organisation's personnel policy, including the medical unit. Regular assessments allow for verifying the accuracy of the personnel selection mechanisms used, as well as the effectiveness of the

implemented training programs. Evaluation of work results gives employees feedback on their work and behaviour, thanks to which they can, for example, take corrective actions or plan professional development. Such an assessment allows for the rational use of human capital potential and contributes to the better functioning of the organization as a whole (Bibi, 2019a; Kautsch, 2015).

In many organizations, assessments are made during recruitment to determine whether an employee is competent for the job and after the employee is hired and dismissed. A positive evaluation of an employee may be the basis for granting him a higher salary, bonus, award or promotion. A negative assessment may contribute to his dismissal. The organization must define the goals, conditions and criteria of evaluation in a clear, understandable and legible way so that employees accept them. Those carrying out the assessment require training in the selection and use of assessment techniques, the ability to draw conclusions and use the evaluation results. The effectiveness and efficiency of the system require a strong commitment from management and the support of employee representatives (Kautsch, 2015). The most important thing is to provide feedback based on correct employee attitudes skillfully.

Human capital is the most important resource in the workplace, and it isn't easy to replace it. In the event of medical staff shortages, retaining medical staff is particularly important in talent management. Retention is defined as the extent to which an employer can retain employees in the organization. It can be expressed as a percentage of employees with a certain length of service as a percentage of the total number of employees (Turner, 2018a). In the healthcare sector, turnover is a significant issue that can threaten patient safety, increase healthcare costs and affect staff morale (West, Dawson, 2012). Organizations are now prioritizing talent retention strategies to avoid the costs associated with employee turnover. Some commonly used retention strategies include performance-based pay, bonuses, incentives, training and development activities (Whysall et al., 2019).

Employee retention is important in all healthcare professions. Research to date has shown that retaining experienced nurses would help mitigate the scarcity, facilitate knowledge transfer and provide high-quality patient care (Lartey et al., 2014), while not retaining nurses could have a detrimental impact on medical services (O'Brien, Ackroyd, 2012). Successful retention was also seen as a way to address the shortage of rehabilitation specialists, which was considered a global problem and address the unequal distribution of physicians between rural and urban areas (Pagaiya et al., 2015). Retention is especially challenging in large metropolitan areas, where competition for talented healthcare professionals can be fierce, and in rural and sparsely populated areas, where it is a persistent problem (Carson et al., 2015).

In countries such as Poland, the retention of healthcare workers should be the primary objective of talent management due to the massive outflow of qualified people. Research has shown many reasons for leaving, including failure to recognize and capitalize on an employee's passion; inability to challenge the intellect; not developing skills and not giving the employee a voice (Turner, Kalman, 2014). Therefore, the question arises whether, through appropriate talent management, it is possible to influence employee retention and whether there is a relationship between individual talent management practices and retention.

For these reasons, this study examines the perception of selected talent management practices by the management of healthcare entities and investigates the relationship between talent management practices and employee retention. We wanted to analyze the processes and procedures of talent management in organizations operating in the Polish healthcare environment, focusing on the dimensions of talent acquisition and identification, talent development and talent appraisal. This study also provides an understanding of the role of the type of healthcare entity and the education of managers in the assessments of individual talent management practices. Understanding talent management practices as factors influencing employee retention can contribute to improving the quality of work of medical staff in Polish healthcare entities.

Research to date has shown that the use of talent management practices has been perceived differently across countries, with most research on talent management conducted in Western organizational contexts (Crowley-Henry et al., 2019; Schreuder, Noorman, 2019; Sinclair-Maragh et al., 2017). Therefore, it is necessary to assess the current use of talent management practices in the context of Poland, especially by managers in the healthcare sector. So far, such studies have been conducted mainly among medical personnel.

The rest of the article is organized as follows: In addition to this introduction, the next section will discuss the research method and the study results. A discussion of the research results will follow this. The article ends with conclusions and recommendations for further research.

2. Methods

A questionnaire for managers of Polish healthcare entities was used to collect the data. 120 respondents took part in the research. The study used a questionnaire containing 13 items to assess the perception of managers of healthcare entities on three talent management practices. These items were grouped into the following three dimensions: talent acquisition and identification (4 items), talent development (4 items), and talent appraisal (5 items). Each answer was rated on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The survey was conducted in 2021. Participation in the study was voluntary, and confidentiality

and anonymity were ensured. The collected data were analysed with the SPSS 17 software. In order to examine the properties of the measurement scale and the items that make it up, a reliability analysis was performed. Data were then analyzed using descriptive statistics, Spearman's rho correlation analysis, Kruskal-Wallis, and Mann-Whitney U tests. In all tests, p-values less than 0.05 were interpreted as statistically significant.

3. Results

3.1. Assessment of talent management practices

In order to investigate the properties of the measurement scale and the items constituting it in the survey questionnaire for managers of healthcare entities, a reliability analysis was conducted. The exact values obtained from this analysis are shown in Table 1.

Table 11.

Analysis of the reliability of the dimensions included in the survey questionnaire addressed to managers of healthcare entities

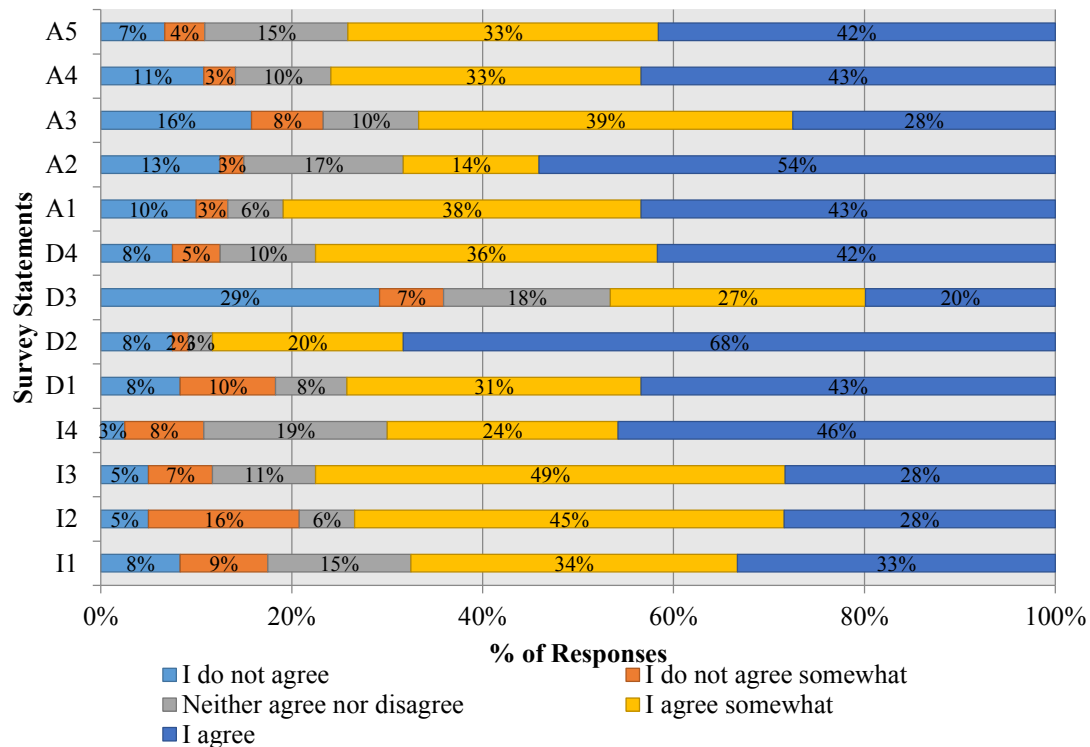
Construct	Variables		Cronbach's alpha
Talent acquisition and identification	I1	The organisation undertakes long-term human resource planning	0.76
	I2	The healthcare entity can attract and recruit the necessary staff	
	I3	The facility's reputation attracts talented medical professionals	
	I4	High-potential employees are identified in the context of our organisation's strategic priorities	
Professional competence development	D1	The healthcare entity allocates funds for staff development	0.78
	D2	Managers organise internal training	
	D3	The healthcare entity has learning and development programmes to develop talent	
	D4	The facility offers opportunities for professional advancement	
Employee appraisal	A1	The organisation has a transparent and objective way of appraising staff	0.84
	A2	Surveys to assess the performance of medical staff are conducted on a cyclical basis	
	A3	The evaluation takes place in the form of a discussion; the reasons for the employee's wrong but also good performance are addressed	
	A4	Managers provide feedback to the employee on the employee appraisal	
	A5	Employees who perform well are rewarded	

Cronbach's alpha values, more remarkable than 0.70, indicate the scale's high-reliability level. Facility managers, when assessing their commitment to identifying (I1-I4), developing (D1-D4) and appraising (A1-A5) talented employees, took extreme positions (1 ± 5). Among the healthcare entities surveyed, there were both those with no activities focused on medical talent management and those that rated their performance in this area highly (table 2 and figure 1).

Table 2.*Descriptive statistics of survey variables*

Variable	Mean	Std. Deviation	Variance	Skewness	Kurtosis
I1	3.75	1.245	1.550	-0.867	-0.215
I2	3.76	1.174	1.378	-0.879	-0.228
I3	3.89	1.052	1.106	-1.191	1.126
I4	4.03	1.104	1.218	-0.889	-0.131
D1	3.91	1.290	1.664	-1.069	-0.030
D2	4.40	1.141	1.301	-2.151	3.670
D3	3.02	1.523	2.319	-0.188	-1.452
D4	3.99	1.185	1.403	-1.279	0.866
A1	4.01	1.240	1.538	-1.414	1.054
A2	3.95	1.395	1.947	-1.098	-0.106
A3	3.55	1.383	1.913	-0.793	-0.653
A4	3.94	1.285	1.652	-1.242	0.501
A5	3.98	1.159	1.344	-1.184	0.744

Note. I - talent identification, D - development of professional competencies, A - employee appraisal.

**Figure 11.** Distribution of survey responses.

The talent acquisition and identification practice involve several methods and ways of assessing candidates' essential skills, capabilities and attributes. In order to validate this process in healthcare, managers of healthcare entities were asked to indicate how medical talent is identified in their facilities. The study found that only a proportion of the healthcare entities surveyed did long-term human resource planning (I1: $M = 3.75$; $SD = 1.245$) – 33.3% of respondents partially and 34.2% ultimately confirmed that activities had been carried out in this regard. The effectiveness of recruiting the necessary staff in all surveyed entities is rated similarly. Another finding concerned the reputation of the healthcare entity (I2: $M = 3.76$; $SD = 1.174$). The survey found that 11,7% of the managers of healthcare entities realised that

the opinions about their entities were not very favourable (I3: $M = 3.89$; $SD = 1.052$). In this dimension, all the units scored best in identifying the high-potential staff in the context of organisational priorities (I4: $M = 4.03$, $SD = 1.104$). This statement was entirely or partially agreed with by 70% of the respondents. If the values of this variable were to be assessed separately from the other variables of the surveyed dimension, the result would be optimistic and demonstrate the effectiveness in attracting talent tailored to the organisational needs of the studied units. Unfortunately, the result for the whole construct on talent identification is not satisfactory, as it reveals that healthcare entities only undertake effective recruitment activities after pressing staff shortages have emerged.

The second dimension discussed was the development of talent competencies in healthcare organisations. Managers of healthcare entities were asked to determine whether: they allocate financial resources for staff development, organise internal training, have an education and talent development programme and offer opportunities for career advancement. Based on the survey, it should be stated that obtaining professional promotion (D4) is certain in 41.7% of the surveyed facilities ($M = 3.99$; $SD = 1.185$). This statement was strongly disagreed with by 7.5% of the respondents. The most diverse responses were observed for the statement about having learning and talent development programmes (D3: $M = 3.02$; $SD = 1.523$). The creation of development paths for talent was confirmed by 46.6% of the respondents (of which 26.7% only partially).

On the other hand, 29.2% of the respondents completely disagreed with this statement. Since the activities of healthcare managers should be aimed at the continuous development of talented employees, healthcare managers were asked about the allocation of financial resources for this purpose (D1: $M = 3.91$; $SD = 1.290$). A group of 18.3% of managers stated that their facilities do not have a pool of funds that they spend exclusively on improving the competencies of medical staff or rarely fund employee development. Respondents confirmed that in-house training is organised in the healthcare facilities they manage (D2: $M = 4.40$; $SD = 1.141$). Such activity is organised in 68.3% (or rather conducted in 20%) of the surveyed entities. Healthcare entities are more willing to join talent development programmes if it does not require additional financial outlays on their part. Therefore, they most often develop the competencies of medical staff by organising internal training.

Another dimension discussed was employee appraisal in healthcare organisations. Managers of healthcare entities were asked to determine whether there was a transparent and objective way of appraising employees in their facilities (A1: $M = 4.01$; $SD = 1.185$). 43.4% of the managers strongly agreed with this statement. On the other hand, 10% of the managers strongly disagreed. The majority of managers of public facilities (54.1%) confirmed that employee appraisal in their facility is done on a cyclical basis (A2: $M = 3.95$; $SD = 1.395$). The negation of the cyclical nature of medical talent appraisal by 12.5% of the managers surveyed indicates that it is not a long-term process in these facilities. The respondents also referred to the formula for employee appraisal in their facilities (A3: $M = 3.55$; $SD = 1.383$) –

15.8% of healthcare managers said that employee appraisal in their organisations does not consist of a discussion in which the reasons for the bad and good sides of an employee's performance are addressed. Such information is not encouraging, as the evaluation of medical staff performance should take an open form and not be limited to presenting the rationale of one side. During the appraisal, the positive and negative behaviour of the medical staff should be discussed. Only 43.4% of the managers of the medical entities surveyed confirm providing feedback to the employee from the employee appraisal, while 32.5% of the managers provide partial feedback (A4: $M = 3.94$; $SD = 1.285$). The last variable of this dimension relates to the reward of high-performing staff (A5: $M = 3.98$; $SD = 1.159$). Awards are given to medical talents from 41.6% of the facilities surveyed. Based on the survey, it can be concluded that, despite relatively well-developed procedures, employee appraisal is not used to draw conclusions and take concrete actions afterwards.

As a result of analysing the individual components of talent management at the surveyed facilities, it is possible to identify the following degrees of advancement: 5 - advanced degree, 4 - intermediate degree and 3 - beginner degree.

The average figures for the different dimensions of talent management in the surveyed healthcare entities in the management group are as follows:

- $M = 3.86$ for identifying and attracting talent,
- $M = 3.83$ for developing employees' professional competencies,
- $M = 3.86$ for employee appraisal.

When interpreting the data, it is essential to note that none of the dimensions of talent management, as assessed by the managers of the healthcare entities, were even classified as intermediate.

3.2. Relationship between retention rates and the talent management practices

Managers were also asked to provide a retention rate in percentage terms, an indication of what proportion of medical staff working in January 2020 are still working in the organisation (table 3).

Table 3.

The retention rate in the surveyed healthcare entities

Retention rate	do 60%	61-80%	81-100%	Total
% of responses	8.4%	15.8%	75.8%	100.0%

It was then decided to test whether there was a relationship between retention rates and the talent management dimensions studied. Spearman's *rho* correlation analyses were used for this purpose. Table 4 shows the results of the correlation analyses.

Table 4.*Correlations between talent management practices and retention rates in the healthcare entity*

Correlations	Retention rate	
	Spearman's <i>rho</i>	Statistical significance
Talent acquisition and identification	0.25	0.006
Professional competence development	0.34	<0.001
Employee appraisal	0.26	0.005

The results of the analysis showed that retention rates are correlated with dimensions of talent management. The correlations are positive and both weak (identification and attraction of talent, employee appraisal) and moderate (development of employees' professional competencies). This means that there is a positive relationship between the level of talent management practices and the retention rates of medical staff.

3.3. Factors differentiating the talent management practices

Next, it was examined whether ratings of individual talent management practices differed according to selected characteristics of the healthcare entity and the characteristics of the managers. Initially, Kruskal-Wallis tests were performed to test whether the educational background of the person at the helm of the healthcare entity differentiated talent management practices (table 5).

Table 5.*Comparison of dimensions of talent management according to the education of the manager*

Construct	Education of the manager						<i>H</i>	<i>p</i>	η^2
	Medical (<i>n</i> = 66)		Economic, managerial (<i>n</i> = 36)		Other (<i>n</i> = 18)				
	Mean rank	<i>Me</i>	Mean rank	<i>Me</i>	Mean rank	<i>Me</i>			
Talent acquisition and identification	62.64	16.50	62.10	17.00	49.44	15.00	2.18	0.337	0.02
Professional competence development	58.60	15.50	68.83	17.00	50.81	16.00	3.70	0.157	0.03
Employee appraisal	61.49	20.00	65.78	21.50	46.31	19.00	3.91	0.141	0.03

Note. *Me* - median, *H* - Kruskal-Wallis *H* test; η^2 - eta square, a measure of the strength of the association; *p* - an estimate of the probability that the observed difference between groups is random. The result of the analysis is statistically significant if the *p-value* is less than the assumed alpha threshold, which is 0.05.

The results of this test are not statistically significant. This means that no differences were observed in the dimensions of talent management according to the educational background of the managers.

It was then examined whether talent management practices differed according to the type of healthcare entity. Again, the Kruskal-Wallis test was performed. The results of the analyses are shown in table 6.

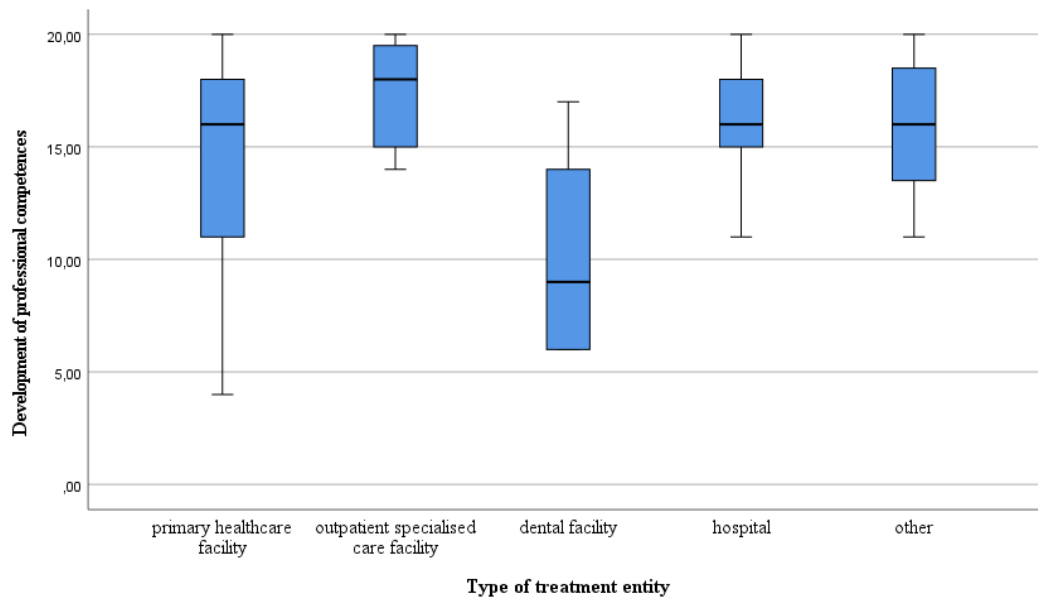
Table 6.*Differences in talent management practices by type of treatment entity*

Construct	Type of treatment entity	Mean rank	Me	H	p	η^2
Talent acquisition and identification	primary healthcare facility (<i>n</i> = 30)	61.22	17.00	7.94	0.094	0.07
	outpatient specialised care facility (<i>n</i> = 19)	75.34	18.00			
	dental facility (<i>n</i> = 6)	33.83	14.00			
	hospital (<i>n</i> = 46)	56.21	15.00			
	other (<i>n</i> = 19)	63.34	16.00			
Professional competence development	primary healthcare facility (<i>n</i> = 30)	53.98	16.00	13.29	0.010	0.11
	outpatient specialised care facility (<i>n</i> = 19)	78.74	18.00			
	dental facility (<i>n</i> = 6)	23.50	9.00			
	hospital (<i>n</i> = 46)	61.89	16.00			
	other (<i>n</i> = 19)	60.87	16.00			
Employee appraisal	primary healthcare facility (<i>n</i> = 30)	57.20	19.50	13.54	0.009	0.11
	outpatient specialised care facility (<i>n</i> = 19)	75.68	21.00			
	dental facility (<i>n</i> = 6)	22.17	12.50			
	hospital (<i>n</i> = 46)	56.98	21.00			
	other (<i>n</i> = 19)	71.16	22.00			

Note. The following were included as other types of healthcare entities: a treatment care facility, a nursing care facility, a treatment rehabilitation entity, and a hospice.

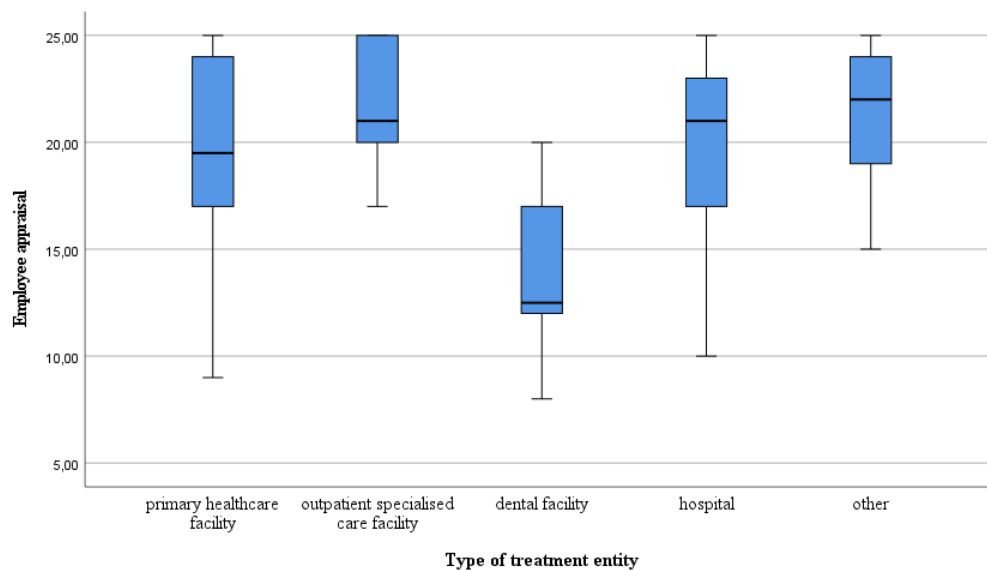
Me - median, H - Kruskal-Wallis H test; η^2 - eta square, a measure of the strength of the association; p - an estimate of the probability that the observed difference between groups is random. The result of the analysis is statistically significant if the *p-value* is less than the assumed alpha threshold, which is 0.05.

The value of η^2 (eta square) indicates the percentage of the dependent variable variation explained by the independent variable. The higher its value, the greater the variation is (more substantial effect). It is assumed that: around $\eta^2 < 0.06$, there is a weak effect; between $0.06 < \eta^2 < 0.14$, there is a moderate effect and $\eta^2 > 0.14$, there is a strong effect. The talent management practices that differ by type of healthcare entity (for which $p < 0.05$) are the development of employees' professional competencies and employee appraisal. Figures 2 and 3 illustrate the relationship between these dimensions of talent management and types of treatment entities.



Note. The following were included as other types of healthcare entities: a treatment care facility, a nursing care facility, a treatment rehabilitation entity, and a hospice.

Figure 2. Differences in terms of the development of professional competencies of talented employees according to the type of a healthcare entity.



Note. The following were included as other types of healthcare entities: a treatment care facility, a nursing care facility, a treatment rehabilitation entity, and a hospice.

Figure 3. Differences in terms of employee appraisal by type of a healthcare entity.

The analyses show that the type of healthcare entity differentiates the level of development of staff professional competencies and employee appraisal (moderate effects). In order to investigate the exact differences, post hoc tests with Bonferroni correction were performed, the results of which are presented in Table 7.

Table 7.

The significance value of pairwise comparisons with Bonferroni correction for the development of professional competencies and employee appraisal by type of a healthcare entity

Construct	Type of treatment entity	1	2	3	4
Development of professional competences	1. primary healthcare facility	-			
	2. outpatient specialised care facility	0.146	-		
	3. dental facility	0.488	0.006	-	
	4. hospital	1.000	0.741	0.106	-
	5. other	1.000	1.000	0.210	1.000
Employee appraisal	1. primary healthcare facility	-			
	2. outpatient specialised care facility	0.688	-		
	3. dental facility	0.237	0.010	-	
	4. hospital	1.000	0.477	0.206	-
	5. other	1.000	1.000	0.025	1.000

Note. The following were included as other types of healthcare entities: a treatment care facility, a nursing care facility, a treatment rehabilitation entity, and a hospice.

The talent management dimension relating to the development of employees' professional competencies was at a higher level in outpatient specialised care facilities than in dental facilities. Other comparisons are not statistically significant. In the last section, pairwise comparisons were made for employee appraisal. They show that talent management in terms of employee appraisal occurs at a higher level in outpatient specialised care facilities as well as treatment care facilities, nursing care facilities, treatment rehabilitation entities and hospices than in dental facilities. Other comparisons were found to be statistically insignificant.

4. Discussion

The study results showed that talent management practices are currently poorly assessed by managers of healthcare entities. This may be due to the fact that medical entities in Poland implement various identification and acquisition, development and appraisal strategies for talented medical employees to a small extent. The poor level of talent management practices in health care has also been identified in various third-world countries, where additional efforts have been made to identify the specific reasons for this situation. For example, the majority of medical staff in public hospitals in Malawi rated the use of talent management practices as poor due to a lack of resources to invest in developing talent management, a lack of qualified talent managers to run talent management systems, and a lack of strategic focus (Dzimhiri, Molefakgotla, 2021). The listed factors influencing the proper implementation of talent management practices coincide with other studies. A Botswana study on talent management practices revealed that poor talent management is due to a lack of qualified talent professionals (Malik et al., 2017). Another study in Kenya on talent management practices found that poor performance is due to a lack of resources necessary to invest in talent development (Wahba, 2015).

All practices studied in our research have been scored similarly. On the other hand, in other studies conducted in this area, it turned out that talent development practice is rated the best. For example, some researchers (Mahfoozi et al., 2018) have identified talent development and good relationships as crucial talent management strategies in public sector organizations. Yener, Gurbuz, and Pinar (Yener et al., 2017) also concluded that vocational training is one of the top-rated talent management practices. This practice is very well perceived when employees' individual aspirations coincide with the organisation's needs (Kadam et al., 2016). A high level of this practice was also recorded in public hospitals in Malaysia, which contributed to the success of the entire healthcare system. Talent management focuses on training through a cognitive approach that emphasizes competency-based development (Subramaniam et al., 2015). The benefits of doing so have also been identified in a study of UK NHS trusts which concluded that more emphasis should be placed on training to improve skills (Veronesi et al., 2013).

In other studies where talent acquisition and identification turned out to be the best practice, it was found that recruitment can be successful if it is based on multiple interventions. A recent Talent Identification Study in Europe looked at several recruitment campaigns, including recruiting young people into healthcare in Austria and Belgium, attracting general practitioners in 'underserved areas' and nurses in Finland and the Czech Republic (Kroezen et al., 2015). It turned out that good practice in talent search is sensitivity to the context, which largely depends on the economic or political situation. It was also important to have packages of activities in the recruitment process (not only remuneration factors but also rewards plus continuous professional development and additional benefits). Finally, the recruitment process was more likely to succeed if it had solid organisational management support.

The literature emphasizes that a high level of talent management practices is achieved when they focus on a specific group of healthcare professionals in the face of a particular phenomenon (usually a shortage of specialists), e.g. professional development of doctors in China (Yi et al., 2014), recruitment process, that combines nursing talent with organizational culture and individual values (Thompson, Ahrens, 2015).

This study's results revealed a statistically significant positive correlation between talent management practices and medical staff retention. All three dimensions of talent management had a significant relationship with retention rates. The results of this study are also consistent with other conducted studies (Brightman, 2007; Goestjahjanti et al., 2020; Iacono, 2008; Khairina et al., 2022; Noopur, Dhar, 2020; Poorhosseinzadeh, Subramaniam, 2013) which showed that talent management practices are positively related to employee retention and engagement. This may be because talent management practices focusing on talent identification, recruitment, reward, talent development, and career advancement will improve healthcare staff satisfaction and encourage them to stay in the workplace (Anlesinya et al., 2019; Helaly, El-Sayed, 2022). From the same point of view, it has been found that the ability to retain employees in an organization depends on fully developing, understanding and managing their

talents (Kravariti et al., 2021). Talent management can therefore be particularly helpful in retaining talented employees and motivating them to stay in the organization, thus reducing staff turnover (Festing, Schäfer, 2014). For example, how nurses view talent management practices in their organizations has been proven to determine their intention to stay or leave the organization (Mousa, Ayoubi, 2019).

According to some researchers, the key to retaining talent is primarily the development opportunities and career paths (Curson, Parnell, 2010; Rodwell, Ellershaw, 2016). Retention is directly related to talent management through development and career advancement because when organizations want to retain their employees, it is important to pay attention to employee learning. Allowing people to do more and learn more about what they are good at will encourage them to stay in the organization (Govaerts et al., 2011). For example, a study in Indonesia found that nurses in hospitals that focus on their future career development and opportunities rated talent management as optimizing their best skills. For this reason, nurses do not want to change jobs; they are satisfied with their current workplace and feel treated fairly, and their aspirations are listened to and considered. This has a positive impact on employee retention (Aljunaibi, 2014). Providing career and development opportunities is, therefore a key practice if talent is to be retained. Employees are more likely to stay with an organization that offers learning and development opportunities. They want to work with managers who provide excellent coaching, mentoring and guidance (Ismail et al., 2021). The scope of this practice should cover activities throughout the employee's life cycle, starting from training in the induction or onboarding phase, through coaching and mentoring at key moments, to training or development programs in the field of knowledge and skills. The argument for taking action for the development of health professionals is better knowledge and skills, which in turn leads to greater motivation and involvement of employees who have a better chance of staying in the organization (Turner, 2018a). Healthcare organizations facing talent retention challenges should strive to make their career opportunities attractive enough to convince talented professionals to stay with the organization (Harris et al., 2015).

In previous studies, employee retention was also associated with practices related to the appraisal and remuneration system. Employees are more likely to stay in the workplace when they receive constructive evaluations and additional incentives or bonuses based on them (Odubanjo, 2015). This is crucial and has a significant impact on increasing employee engagement and retention. Organizations that regularly adopt and offer a transparent performance feedback system recognize employees with some recognition and reward system that gives employees an advantage that they become attractive to employees (Pandita, Ray, 2018). Besides, employees will stay in an organization with an environment of encouragement and motivation where the reward for positive job evaluation is seen as sufficient to meet needs and aspirations (Pandita, Ray, 2018).

Besides, employees will stay in an organization with an environment of encouragement and motivation where the reward for positive job evaluation is seen as sufficient to meet needs and aspirations (Al-Emadi et al., 2015).

In the next step, it was decided to examine whether there are differences in the perception by managers of healthcare entities of the use of talent management practices based on demographic factors (education) and the type of healthcare entity. Our results did not confirm the relationship between the assessment of talent management practices and the education of managers. In turn, previous studies have shown differences in the perception of the effectiveness of talent management not only by education but also by other demographic factors, such as gender, age, marital status, position and professional experience (Barkhuizen et al., 2014; Dzimbiri, Molefakgotla, 2021; Tyskbo, 2019). In addition, it was also shown that talent management practices were more effectively applied to employees in senior positions in the organization and employees with postgraduate qualifications (Barkhuizen, 2014). In turn, our analysis has shown that the way managers of medical entities perceive the use of talent management practices varies depending on the type of organization. It confirmed the study results regarding talent management practices in the Slovak healthcare sector (Mousa, Ayoubi, 2019) that showed that the type and size of the organization influenced the use of talent management practices.

In order to retain the best of the best high-potential employees in the organization, the manager must apply talent management practices. Talent management helps the organization and its employees by enabling them to develop and move to more challenging positions while developing them through continuous learning for the benefit of the (Pandita, Bedarkar, 2015) organization (Pandita, Ray, 2018).

The study's limitation is that it focused on only one perspective (Polish healthcare entities). This issue did not consider opinions from other countries. The second limitation concerned the respondents, as the research focused only on managers of healthcare entities. This deprived the possibility of obtaining different opinions from other health professionals, such as doctors, nurses, clinicians and dentists. Further research into health professionals' perceptions of the current use of talent management practices is suggested.

Finally, we didn't consider various factors affecting TM practices. For example, other studies have shown that the decision to stay in a particular organization is influenced by many factors, including job satisfaction, external rewards, commitment to the organization, the prestige of the organization, and flexible work (Atkinson, Hall, 2011). Therefore, it is worth considering these factors in future studies.

In the future, researchers need to focus on several issues, such as examining the impact of other talent management practices on the retention of medical workers. Moreover, further research is expected to allow a comparison of the level of talent management according to other criteria, e.g. status of the medical entity.

The study had theoretical and practical contributions. To our knowledge, this is the first study that examined the level of talent management practices in Poland and their impact on employee retention in Poland. So far, this type of research has been conducted among medical workers in other countries. The study contributes to new knowledge on the perception of health care managers' practices related to talent management in the Polish health care sector and shows the relationship of these practices with employee retention. This study has huge societal implications as the results will form the basis of best practices for healthcare providers, thereby improving the well-being of patients and the general public.

5. Summary

This study aimed to examine the managers' perception of the current application of selected talent management practices in healthcare entities in Poland. This study assessed talent management practices, particularly talent acquisition and identification, talent development and talent appraisal. The study showed that talent management practices are poorly applied in healthcare entities in Poland. It has also been shown that the way managers of these entities perceive the use of talent management practices varies depending on the type of organization. Studying the impact of talent management practices on employee retention was also important. This study confirms that TM practices have a significant effect on increasing healthcare staff retention. Healthcare organizations should improve talent management strategies and practices to accommodate better change by attracting, developing, evaluating and retaining talent to meet current and future organizational demands. In today's world of hyper-change, proper talent management is a must. It is undoubtedly one of the most important elements ensuring the long-term retention of representatives in any organization. Employees are always looking for ways to be motivated, recognized and appreciated at work. They crave opportunities for personal and professional growth and constructive criticism to feel appreciated.

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THE POLICY (STRATEGY) OF FINANCING POLISH JOINT STOCK COMPANIES, IN THE CONTEXT OF THEIR INTERNATIONALIZATION

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Purpose: In the scientific literature in Poland, but also in the world, there is a lack of publications defining the relationship occurring between the internationalization of the enterprise and its financing strategy, most fully reflected in the capital structure. The point, therefore, is to examine to what extent the various stages of internationalization of the enterprise (export, establishment of subsidiaries, acquisition of enterprises in countries hosting foreign investors) affect the capital structure. It was also necessary to examine whether the sector of the business has an impact on the presence, or non-occurrence, of these relationships.

Design/methodology/approach: To investigate this, the ratios of internationalization of sales and the share of debt in total company financing were compared, and Lilliefors and Fisher-Snedecor statistical tests were applied to 28 apparel companies listed on the Warsaw Stock Exchange. At the same time, a case study of the LPP group, the largest apparel company in Poland, was developed to determine why the apparel sector was found to lack such relationships. The results of the study were compared with the results of research previously conducted at home and abroad.

Findings: It was shown that in the apparel sector, no statistically significant relationship was found between internationalization and changes in capital structure. It was found, using the example of LPP, that the foreign expansion of Polish companies in the apparel industry is increasingly associated with the use of online sales, which does not result in an increase in costs that could cause an increasing need for foreign capital. However, it also does not result in a reduction in the size of financing, as a study of Malaysian companies would suggest.

Originality/value: The lack of research in this area indicates its originality. At the same time, the already conducted and further intended research will make it possible to estimate how the demand for capital will or will not change in enterprises depending on the sector of enterprise activity. After all, studies conducted in the construction sector have shown a far-reaching dependence, which, however, is not the content of the presented study.

Keywords: Internationalization, strategy of financing, capital structure.

Category of the paper: Research paper.

1. Introduction

One important element of a company's overall strategy is its financial strategy. As part of this, the choices that companies make in financing their current and growth activities are particularly important, financing them from specific sources, creating a specific structure of financing sources, i.e. a capital structure.

Companies that have entered the path of internationalisation may modify the structure of their financing sources in the course of this process, or they may not change their capital structure. Therefore, it is worth investigating to what extent the entry into internationalisation processes has changed the financing in these companies and whether, therefore, it is possible to speak of differences in the proportion of financing between companies in this group and the group of companies that have not internationalised. This will make it possible to answer the question to what extent internationalisation processes have influenced a company's financing strategy. The research will also show to what extent the specific characteristics of the sector influence the results obtained.

2. Interpreting the relationship between internationalisation and a company's capital structure – a literature study

In the available Polish and foreign literature, there are two opposing views on the relationship between internationalisation and a company's capital structure:

- Internationalisation contributes to the reduction of foreign capital in the total financing of the company.
- Internationalisation increases the share of foreign capital in total financing.

Research by M. Albaity, A. Ho Sel Chuan of the University of Malaya indicates that the first of these possibilities is present (Albaity, Ho Sel Chuan, 2013).

The authors very rightly point to the multiplicity of factors that can contribute to changes in a company's capital structure, increasing or decreasing the share of external capital. Thus, for example, the degree of diversification of a company's activities and its size, according to some studies, influences an increased share of external capital (among other things, companies reduce the danger of bankruptcy costs by diversifying their activities).

The profitability of a company is of great importance, which should lead to a low level of debt. Profitable companies, according to this view, make less use of debt in order to apply the tax shield. The profitability of the company makes the financing of growth more from retained earnings and less by taking on debt.

The authors hypothesise that corporate growth is inversely correlated with debt, but this is mainly true for short-term debt. The higher value of a company gives it more financing options through corporate bonds or bank loans.

Studies of Malaysian companies have shown that internationalised companies have a lower proportion of debt in their financing than domestic companies. These companies are more financially stable, their business is less risky, their shares are more valued in the capital market, companies are not burdened by debt payments, and they are less likely to fail in the event of a financial crisis. In companies operating internationally, business risk is spread across as many markets as the company operates in. All this means that internationalised companies, being stronger and more developed, do not have much need to raise foreign capital and use it less than companies operating only in the domestic market of a country.

N. Daszkiewicz (Daszkiewicz, 2016) focuses on the problem of internationalisation processes in high-tech industries, and draws attention to the relationship between internationalisation and the innovativeness of a company. In this context, there is the problem of costs incurred by research and development centres located at such enterprises, whose activities are supposed to increase the innovativeness of enterprises and thus strengthen their international competitiveness. The activities of such centres can undoubtedly increase enterprises' need for foreign capital. In terms of the costs incurred, there is also a fundamental difference between equity and non-equity internationalisation. Companies that have embarked on the path of equity internationalisation (joint ventures, subsidiaries, acquisitions) have to make a stronger capital commitment than companies relying on non-capital forms (exports, licensing, contracts with sub-suppliers) (Sobiecki, Pietrewicz, 2014). The benefits associated with the use of non-capital forms of international expansion, including the reduction of operating costs, are also pointed out by R. Oczkowska (Oczkowska, 2013).

For Polish companies that have entered the process of internationalisation, it is very important to support the internationalisation process through a system of financial and non-financial incentives for investors implemented from both the central and regional level, which will fill the gap in the capital requirements of these companies (Dorożyński, 2018).

It should be noted that the financing strategy of a company and the formation of its capital structure, as a certain result of adopting a particular financing strategy, may depend on the company's phase of internationalisation, as is very rightly pointed out in some publications (Bielawska, Brojakowska-Trzęska, 2014). This mentions, moreover, several important factors that may influence this strategy:

- "psychological distance" between the home country and the country of foreign expansion - the greater the risk (political, distance, customary, etc.), the higher the risk of foreign transactions,

- stage (the way in which the internationalisation process is carried out - different intensity of the risk of international activity depending on the form of internationalisation - higher risk for born global companies compared to companies carrying out staged internationalisation,
- availability of funding sources ...,
- purpose of international activities,
- risks of international operations.... Increased risks: country political, financial, transactional - present a significant barrier to accessing foreign sources of finance, thus limiting the ability to pursue active overseas expansion objectives.

Research conducted by A. Bielawska and M. Brojakowska-Trzaska (research results in the aforementioned item), pointed to the increasing demand for equity capital under conditions of internationalisation, but also for long- and short-term foreign capital. The share of trade credit granted is also increasing. However, the most relevant question is whether there is a correlation between the phase of a company's internationalisation process and its capital structure.

Companies in the initial phase of internationalisation (exports, imports) are characterised by a rather conservative, conservative financing strategy, linked to the limited possibilities of raising foreign capital. Rapid export growth, on the other hand, would enable increased financing from profits.

In turn, companies that have opened subsidiaries or branches abroad have better access to foreign financing abroad, but also greater opportunities for their own financing from profits made by the subsidiaries. It also appears that greater sophistication in the internationalisation process may result in the possibility of alternative sources of financing.

In the light of the above considerations, it may also be of interest to investigate whether there are interrelationships between financing strategies and yet other forms of internationalisation, such as merger and acquisition processes by a company in foreign markets in host countries.

It is important to point out another aspect that sometimes escapes the attention of those who deal with this issue. This is that we may be dealing with:

- early or late entry of a company into the internationalisation process,
- sequential or parallel entry, i.e. either a gradual entry into foreign markets in a specific sequence and time sequence, or a simultaneous start-up in multiple foreign markets, which should reduce expansion costs,
- concentration on specific markets or diversification, i.e. operating in multiple markets at the same time with a view to optimising expansion directions at a later date (Limański, Drabik, 2016).

The authors note the possibility of double concentration (few market segments in few countries), or concentration may be geographic or segmental (in few market segments but in many foreign markets).

Double diversification, on the other hand, can involve taking action in multiple markets and segments.

Each of the solutions presented here will affect the corporate financing strategy adopted, the effectiveness of the commitment of financial resources, the size of the financing and the directions in which the funds raised are spent and, above all, the capital structure and therefore the financial strategy of the company.

Analysing the material presented, it can be pointed out that there is also a third possibility. Well, the process of internationalisation of a company may lead to practically no changes in the company's financing structure, or the shifts may only concern specific sources of financing within equity and debt capital. The own research carried out aims to determine which of these three possibilities takes place in the Polish companies accepted for the study.

3. Research methods and description of the research sample

The study covered companies listed on the Warsaw Stock Exchange. The clothing sector was chosen because it is the companies in this sector that are in several phases of the internationalisation process, namely:

- some companies have limited their international activities to exports,
- some companies have opened subsidiaries in host countries,
- some companies have made acquisitions of related companies operating in the host country.

At the same time, a more detailed study was carried out at LPP in order to look more closely at the internationalisation process from the point of view of changes in the company's financing strategy and the formation of the company's capital structure under conditions of internationalisation. The sector also included companies that had not entered the internationalisation process at all. In total, there are 28 listed clothing companies in the sector, including four companies not involved in the internationalisation process. Two main indicators were used to investigate the relationship between internationalisation and company financing:

- the share of foreign sales value to total sales value,
- the share of external capital in the total financing of the company.

It was hypothesised that:

H0: There is a relationship between internationalisation and a company's capital structure

Pearson analysis was used here in two groups.

In the first group, the relationship between the share of non-domestic sales in total sales and the share of debt in total financing was examined for the sector as a whole, without grouping according to demonstrated international activity, and in the second with such a division. In connection with the research conducted in the article, auxiliary hypotheses were also set.

In order to verify the auxiliary hypotheses, it was decided to use parametric statistical tests. On the other hand, the conclusions obtained from the conducted statistical tests will allow the determination of further research directions in the field of studying the relationship between the internationalisation of a company and its capital structure. Accordingly, the research hypotheses are presented below:

H1: The capital structure of a company in the first stage of internationalisation (export) and companies with no international activity have statistically significant differences.

H2: The capital structure of a company not undertaking internationalisation and a company establishing subsidiaries abroad have statistically significant differences.

H3: The capital structure of a company not undertaking international activities and a company making acquisitions in host countries have statistically significant differences.

H4: The capital structure of a company exporting its products (services) and companies generating revenue from established foreign subsidiaries have statistically significant differences.

H5: The capital structure of a company exporting its products (services) and companies earning revenues from the acquisition of local companies in the host country have statistically significant differences.

H6: The capital structure of a company generating revenue from foreign subsidiaries and companies generating revenue from the acquisition of local companies have statistically significant differences.

The possibility of using parametric statistical tests was preceded by performing Lilefors normal distribution tests for all financial indicators (share of international sales in total revenue and share of foreign liabilities in total liabilities). The normal distribution tests performed confirmed the existence of this distribution for the variables studied. Tests that showed the absence of a normal distribution were rejected, as they were most often characterised by the absence of primary data and the years analysed. Therefore, in the next stage of the study, the Fisher- Snedecor parametric statistical test was used. This was carried out for four groups within the clothing sector. The first group is made up of companies that do not have any international activity but make sales domestically. The second group are companies that, in addition to domestic sales, also export products and/or services to selected foreign markets. The third group of surveyed enterprises are companies that establish a subsidiary abroad. The last group are companies that are in their activities pursuing acquisitions in the second stage of the study for each group (the difference between the groups depended on the degree of internationalisation) statistically significant differences between the various capital structures were examined. A total of 1008 statistical tests were performed. The research sample consisted of 48 companies. Financial data for the years 2010-2021 were collected for each company. Two financial areas of the companies were taken into account in the statistical study - the share of foreign sales in total revenue (Table 1) and the capital structure of the company (Table 2). Due to the extensiveness of the data and the large number of clothing companies in the sector,

it was decided in the empirical part to present only a selected group of indicators (shares of international sales in total revenue and selected capital structures) in 2 companies from each group. On the other hand, the results of the statistical tests carried out for the research hypotheses will be presented in a collective manner as the number of tests confirming the hypotheses in the number of total tests carried out for the given group.

4. Analysis of statistical results

In order to examine the relationship discussed in the article, it was decided to select two indicators whose informative value in this respect is positively assessed in the literature. Table 1 shows the share of foreign sales of a given company in relation to total revenue.

Table 1.

Share of international sales by three groups of companies' internationalization activities

N	K	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	1	0,07	0,08	0,00	0,21	0,29	0,35	0,35	0,38	0,36	0,35	0,46	no
2	1	0,19	0,29	0,31	0,36	0,51	0,50	0,49	0,43	0,51	0,56	0,60	0,58
3	2	0,00	0,09	0,00	0,00	0,00	0,00	0,00	0,00	0,16	0,21	0,13	0,28
4	2	0,34	0,25	0,37	0,34	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5	3	0,00	0,00	0,00	0,00	0,82	0,81	0,82	0,81	0,72	0,75	0,86	no
6	3	0,00	0,00	0,32	0,42	0,31	0,70	0,66	0,77	0,35	0,35	no	no

Designations in the table: N - order number of a company in the clothing sector, K - stage of the internationalisation process.

Source: own compilation based on financial data of enterprises in the clothing sector.

The first column contains ordinal numbers, which are assigned to specific companies originating from the clothing sector. In the second column, there are labels for the different stages of the internationalisation process: exports - No. 1, revenues from open foreign subsidiaries - No. 2, acquisitions - No. 3 (two companies selected from each group). A situation in which a single activity of a company in the internationalisation process occurred was treated by the Author as accidental and irrelevant to the course of further stages of the study. Of the 28 companies analysed, four of them did not show any activity related to the internationalisation of the company during the period under study. Therefore, it is not possible to present the share of international sales in total revenue for the companies under study, but in further stages of the study in which the capital structure will be analysed according to the advancement of the stages of internationalisation, the group of these four companies will be a good point of reference for examining differences in capital structure. It is also worth noting that only four companies did not show any activity related to the internationalisation of the company during the study period - the remaining 24 companies were at different stages of the development of their international activities, depending on the degree of advancement and the activities that had been undertaken. The second group, which accounted for more than 50% of

the entire apparel sector, were companies that showed activity in the internationalisation process in the form of exporting their products during the analysed period. The next group is made up of companies that reported sales from open foreign subsidiaries during the period under study - 4 companies out of the 28 analysed in the research sample. The last group is the group reporting its international activity in the form of market acquisitions. The clothing sector shows diversity in terms of demonstrated activity in the internationalisation process. In line with data from the sector as a whole on demonstrated international activity, the clothing sector should be assessed as a forward-looking and growing sector. In view of the period under review, which also includes a pandemic period, it is recognised that it will be crucial for clothing manufacturers and retailers to make plans for the possible transformation of global value chains. It will also be important to minimise the risks associated with disruptions and increased uncertainty in international trade (e.g.: transport problems, factory shutdowns, reduced shop operations, rising raw material and energy costs, rising labour costs, inflation) (PKO BP, 2022). In the next stage of the study, the capital structure ratio (foreign capital/total capital) was calculated.

Table 2.

Capital structure indicators in selected companies

N	K	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	1	0,60	0,95	0,85	0,89	0,88	0,86	0,47	0,88	0,87	0,56	0,46	No
2	1	0,83	0,28	0,72	0,04	0,94	0,83	0,97	0,98	0,30	0,31	0,39	No
3	2	0,30	0,36	0,36	0,37	0,47	0,63	0,64	0,21	0,20	0,28	0,36	0,30
4	2	0,75	0,10	0,07	0,07	0,09	0,09	0,09	0,14	0,14	0,74	0,13	0,06
5	3	0,14	0,12	0,92	0,53	0,50	0,54	0,50	0,44	0,38	0,66	0,78	0,68
6	3	0,33	0,10	0,80	0,82	0,65	0,48	0,44	0,73	0,69	0,63	no	No
7	0	0,65	0,04	0,98	0,14	0,22	0,58	0,45	0,01	0,95	0,15	0,35	0,64

Designations in the table: N - order number of a company in the clothing sector, K - stage of the internationalisation process, O - no internationalization.

Source: own compilation based on financial data of enterprises in the clothing sector.

The capital structure for individual companies within the clothing sector varies. Across the sector, it is evident in the companies surveyed that they were making efforts to raise finance from foreign capital by indebteding their operations. It is not possible to identify one characteristic capital structure for any one group of companies that undertook a particular international activity during the period under review. Comparing the data in Table 1 and Table 2, we note that it is difficult to find significant relationships between a company's degree of internationalisation and its capital structure, as measured by the share of foreign capital in total financing.

1. Even two companies at the same stage of internationalisation have different shares of sales outside the country to total sales, as does their capital structure.
2. For both indicators, one can observe a high variability over the years, an increasing share of sales outside the country in the case of exports, with a very high volatility in the capital structure of exporting companies. In the case of sales through subsidiaries,

a low share of these sales in total sales and a rather low share of external capital in total financing, with, however, also considerable fluctuations in the capital structure. In the case of acquisitions, a rapidly increasing share of non-domestic sales in total sales and large fluctuations in the level of the capital structure.

3. Large fluctuations in the capital structure are also observed during the period under review in companies that have not entered the internationalisation process.

Therefore, it is not possible to draw far-reaching conclusions about the relationship between internationalisation and the capital structure of clothing companies on the basis of a simple comparison of the two tables.

Accordingly, in step three it was decided to carry out statistical tests to demonstrate the relationship between the reported financial variables:

1. company activity related to the internationalisation phase,
2. capital structure.

In order to verify the auxiliary hypotheses set out in the article, it was decided to use the Fisher- Snedecor statistical test. Table 3 shows the aggregate results for the obtained results of the comparative analysis of individual capital structures for different groups of international activity within the clothing sector.

Table 3.

Results of Fisher-Snedecor (tests 1-6) and Pearson (test 7) statistical tests for each group of companies

Test	Exploring group relationships	Results (+)	Results (-)	Total	Supporting hypothesis
1	Gr 0 and Gr 1	35	109	144	H1
2	Gr 0 and Gr 2	6	138	144	H2
3	Gr 0 and Gr 3	22	122	144	H3
4	Gr 1 and Gr 2	0	144	144	H4
5	Gr 1 and Gr 3	24	120	144	H5
6	Gr 2 and Gr 3	1	143	144	H6
7	Share / Structure	7	137	144	H0
x	Total	95	913	1008	x

Source: own study.

A summary of the results in Table 3 relates to the statistical tests carried out to examine significantly statistical differences in capital structures according to the degree of internationalisation for individual companies.

For test number 1, an examination of the relationship between the capital structures in group zero and the capital structures of companies in group one was performed¹. Out of 144 tests performed using the Fisher - Snedecor test, 35 of them yielded a result entitling us to accept the

¹ Group 0 - companies in this group do not have any international activities related to the internationalization process,
 group 1 - companies in this group are at the beginning of the internationalization process of their activity, in their financial reports they present the level of export of their products and/or services,
 group 2 - companies in this group report on revenues generated by subsidiaries opened on foreign markets,
 group 3 - companies in this group report information on acquisitions of companies located in host countries.

hypothesis of statistically significant differences between the capital structures of enterprises that are active in the internationalisation process (group 1 - exports) and enterprises that do not carry out any activities related to the internationalisation process. On the other hand, the remaining 109 tests carried out showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H1).

For test number 2, an examination was made of the relationship between the capital structures in group zero and the capital structures of the companies in group two. Out of 144 tests performed using the Fisher - Snedecor test, 6 of them yielded a result entitling the acceptance of the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalisation process (group 2) and companies that do not carry out any activities related to the internationalisation process. In contrast, the remaining 138 tests carried out showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H2).

For test number 3, an examination of the relationship between the capital structures in group zero and the capital structures of companies in group three was performed. Out of 144 tests performed using the Fisher - Snedecor test, 22 of them yielded a result entitling the acceptance of the hypothesis of statistically significant differences between the capital structures of companies that are active in the internationalisation process (group 3) and companies that do not carry out any activities related to the internationalisation process. In contrast, the remaining 122 tests carried out showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H3).

For test number 4, an examination was made of the relationship between the capital structures in group 'one' and the capital structures of the companies in group 'two'. Out of 144 tests performed using the Fisher - Snedecor test, none of them yielded a result entitling the hypothesis of statistically significant differences between the capital structures of enterprises that are active in the internationalisation process (group 2) and enterprises that do not carry out any activities related to the internationalisation process. In contrast, the remaining 144 tests carried out showed the need to reject the hypothesis of statistically significant differences in the two groups (auxiliary hypothesis H4).

For test number 5, an examination was made of the relationship between the capital structures in group 'one' and the capital structures of the companies in group 'three'. Out of 120 tests performed using the Fisher - Snedecor test, 24 of them yielded a result entitling the acceptance of the hypothesis of statistically significant differences between the capital structures of enterprises that are active in the internationalisation process (group 3) and enterprises that show a more advanced internationalisation process. In contrast, the remaining 94 tests carried out showed the need to reject the hypothesis of statistically significant differences in both groups (auxiliary hypothesis H5).

For test number 6, an examination of the relationship between the capital structures in group 'two' and the capital structures of companies in group 'three' was performed. Out of 144 tests carried out using the Fisher - Snedecor test, 1 of them yielded a result entitling us to accept the hypothesis of statistically significant differences between the capital structures of enterprises that are active in the internationalisation process (group 3) and those that are more advanced in the internationalisation process than group two. In contrast, the remaining 143 tests carried out showed the need to reject the hypothesis of statistically significant differences in the two groups (auxiliary hypothesis H6).

Test 7 examined the relationship between the share of international sales in total revenue and capital structure. In Test 7, no grouping was carried out according to the degree of internationalisation. An examination of the relationship within the clothing sector as a whole was carried out. Therefore, a total of 28 companies participated in the level 7 statistical test for which two financial indicators were calculated: the degree of internationalisation and the capital structure. The result of the tests carried out showed that out of 144 tests, only 7 tests confirm the existence of a relationship between the degree of internationalisation and the capital structure of the respective company. In all of the examined relationships, the tests showed a relationship between internationalisation and capital structure only in a small number of cases. Therefore, based on the results obtained, the main hypothesis and the auxiliary hypotheses should be rejected. In order to indicate the reasons for rejecting the research hypotheses, it was decided to use the Case Study method, which was applied to the LPP company.

5. Internationalisation and capital structure on the example of the LPP group

The results obtained in the course of researching the clothing sector in Poland clearly indicate that there is no relationship between the internationalisation of companies and their capital structure. It is therefore possible to examine the reasons for the lack of this relationship using the example of Poland's largest apparel company, namely LPP.

The LPP Group (as at 30.04.2022) had 1,760 shops, including:

- 969 shops in Poland,
- 577 in Europe,
- 214 in the rest of the world.

In total, the shop network covers 38 countries. Revenues from individual brands were (in PLN million in 1Q 2022 compared to 1Q 2021):

- Reserved 956,4.
- Cropp 251,7.
- House 196,1.

- Mohito 178,3.
 - Sinsay 739,6.
 - others 28,3.
- total 2350,3.**

Growth is therefore very dynamic. However, very significant is the exceptionally high growth in sales using electronic tools (e-commerce). Thus, for example, online sales represented a value of PLN 1,272.8 million in Q4 2021, which, of course, involved a lockdown, but offered the opportunity to reduce a number of costs that the company would have had to incur then if it had not launched online sales.

Also noteworthy is the growing share of foreign revenue in total revenue. In Q1 2022, sales in Poland already accounted for only 48.1% of total sales. The proportions were as follows:

- Poland 687.7 million sales,
- Europe 568.9 million,
- other regions 201.5 million.

The countries in which LPP sells the most included:

- Romania 274.4 million sales,
- Czech Republic PLN 219.4 million,
- Germany PLN 148.5 million.

The company withdrew from sales in the Russian Federation and partially withdrew from sales in Ukraine. The sale of the entire shop chain in Russia took place in May 2022. This resulted in an increase in the company's inventory. Nevertheless, the share of sales outside the country is high.

The Distribution Centre in Brześć Kujawski is being expanded and an e-commerce warehouse is being established in the Podkarpacie region (in Jesionka near Rzeszów). This second facility of 69,000 m² is expected to be operational by the end of 2022. The LPP Group is an example of the fact that the progress of internationalisation, while at the same time increasing online sales, does not necessarily cause such an increase in costs that it would force an increasing need for foreign capital and, as a result, it did not contribute to changes in the capital structure. This may have been a similar situation in other companies in the clothing industry. Testing to what extent this hypothesis is valid requires further research.

6. Summary

The research carried out in clothing companies showed that in the majority of the companies surveyed there was no relationship between the internationalisation of the company and its capital structure, as only in a small number of companies in the groups surveyed was such a relationship confirmed by statistical tests.

At the same time, comparing the data in Table 1 and Table 2, it is not possible to conclude that an increasing share of sales outside the country results in a reduction in the share of debt in corporate financing, as suggested by the results of the study of Malaysian firms cited in the theoretical section of the article. There is also no basis for concluding that as internationalisation increases the share of debt in total financing.

The example of LPP demonstrates that the increasing volume of online transactions means that internationalisation does not incur additional costs and therefore there is no pressure to increase foreign funding.

It should be noted that research should always take into account the specificities of the sector. Therefore, it would be appropriate to investigate other factors that may determine the lack of correlation between internationalisation and the need for foreign capital. These include:

- Profitability of clothing companies.
- Willingness to take risks.
- The total value of assets held by the company.
- The prestige of the company in the domestic and international markets, and the associated ease of raising foreign capital.

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CURRENT CONCERNS IN DIGITAL ECONOMY ERA. LESSONS LEARNT FORM POLISH ADVANCED INTERNET USERS

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Purpose: Digital Economy development is influenced by many factors, including the users' acceptance of the technology. The interesting group of users are technologically advanced and may shape the technology's use and enhance its development. The purpose of the study is to explore the way customers are present on the Internet, and their attitudes to ethics and responsibility in the virtual environment.

Design/methodology/approach: The study was conducted on a representative group of 1002 adult Internet users from Poland. The CAVI method on the research consumer panel was used. The authors empirically examine the developed research hypotheses using statistical tests.

Findings: The study results show that advanced technology users have a more conscious approach to their presence on the Internet. Technology advanced users are familiarised with the tools and applications that may support them with everyday activities and ease their professional duties. They are also more concerned about ethical and safety issues. At the same time, as consumers of technology, they are ready to disclose personal data if some benefits are seen.

Originality/value: Research results support the development of understanding online activities of Internet users. They indicate some crucial points for a technology provider in designing and improving new tools and applications. Technology advanced users as testers can spread the technology appliances and support their acceptance if they find them ethical and safe. It leads to the development of the digital economy and benefits the whole society.

Keywords: digital technology, advanced technology users, online consumers, ethical concerns, customers responsibility, the safety of the technology.

Category of the paper: Research paper.

1. Introduction

Technological development is not only the sum of activities undertaken by the business. It also includes the approach of Internet users who are ready to use new solutions and tools and accept solutions proposed by companies to accelerate their progress (Amoroso, Hunsinger, 2009; Reisdorf, Groselj, 2017).

The Digital Economy and Society Index (DESI) for EU countries allow monitoring of countries' progress in digitisation. As an example of a Central and Eastern Europe (CEE) country in this index, Poland occupies one of the last positions, despite the readiness of enterprises to be technologically advanced. The development of artificial intelligence and the availability of modern technologies and resources for further digitisation are noticed in Poland (DESI EU). However, they are insufficient for real growth, as evidenced by their position in the classification. The article examines the issues related to how technology is used by a representative group of adult Poles, referring to the use of Internet services, human capital and the integration of digital technologies that are the dimensions of the DESI index.

Technology use means several issues that should be considered when planning the development of an offered solution. These are how users approach a presented technology, the level of acceptance, ethical dimension and attitudes towards responsibility and safety related to its use (Hesselman et al., 2020). Especially the area of ethics and safety can show what is a priority for users when introducing technological opportunities.

The paper aims to understand how Internet users use new technologies and what challenges they perceive regarding their presence in the digital world.

2. Conceptual background and hypotheses development

2.1. Digital economy - state – of – the art in Poland

Nowadays, the access to information, models of its processing and management, and economic competence, including the so-called reengineering of business processes (Chancellery of the Prime Minister, 2020). According to the McKinsey report *Digital Challengers in the next normal. Central and Eastern Europe on a path to digitally-led growth* (McKinsey & Company, 2020), Poland shows great growth potential for the digital economy although its current level of digitization is lower than in the countries of Northern and Western Europe. This is also confirmed by the Digital Economy and Society Index (DESI) (European Commission, 2021), according to which in 2021 Poland was ranked 24th among the 27 EU Member States. The dynamics of the observed changes in the CEE countries belonging to the EU, except Bulgaria and Romania, were faster than in Poland. Access to broadband Internet,

digital public services and possibilities of using open data were highly rated. Unfortunately, it is worrying that digital skills, both basic and above basic, of the Polish society as well as the level of digital technology usage by Polish enterprises are below the average for the entire European Union. Undoubtedly, Poland's fourth place among the EU Member States deserves praise in terms of actions for data openness (European Commission, 2021), including the impact of the category of open data on Polish society and business.

Acquiring, collecting, analyzing, processing and consciously using technology in various sectors and industries of individual economies is now considered a fundamental competence of market participants. In line with the assumptions of *Shaping Europe's Digital Future* (European Commission, 2020a), the implementation of activities aimed at adapting the EU to the digital age is one of the most important priorities for the coming years, while taking care of democratic values, ethics of applied solutions and sustainable development. Similar postulates can also be noticed in a number of other documents and studies, such as the European Commission's report *Liability for Artificial Intelligence and other emerging digital technologies* (European Commission, 2019), *White Paper on Artificial Intelligence - A European approach to excellence and trust* (European Commission, 2020b), *Artificial Intelligence and fundamental rights* (European Union Agency For Fundamental Rights, 2020) and in national documents of individual countries, e.g. *Policy for the Development of Artificial Intelligence in Poland from 2020" (MP2021.23)*. Even though according to McKinsey experts, both Poland and other CEE countries have a large digital potential, unfortunately, like the entire EU, they are giving way to American and Chinese BigTechs, building their position rather on the implementation of foreign technologies - they are their recipients, not creators and suppliers. A crucial problem in this respect may be the limited level of connection between the world of business and science, slowing down the dynamics of knowledge transfer and its potential rapid commercialization.

Polish enterprises generally have a positive attitude towards the potential implementation of new technologies, including in particular the use of social media in the process of communication and building the image of their brand, electronic information exchange and online sales. However, according to the indicator of the use of digital technologies, 60% of enterprises are characterized by a very low level of digitization, and only 11% of them are enterprises with a high degree of digitization, which puts Poland below the European average (European Commission, 2021a). Unfortunately, extensive changes can be seen primarily in large enterprises employing over 250 people. In the case of enterprises from the SME sector, only 32% increased their use of digital tools and platforms, and 18% invested in new hardware or software (McKinsey & Company, 2020).

In the opinion of 63% of Poles, the activities carried out in this area by enterprises are primarily the result of generating innovations aimed at a better understanding of clients and the increasing intensification of the process of satisfying their needs, so as to provide them with the widest range of benefits (customer-centric orientation). At the same time, however, almost a quarter believe that the introduced changes are driven only by the will to increase the

economic benefits related to the conducted activity (minimizing costs, increasing efficiency, maximizing profit) (PAYBACK Poland, 2021).

The interest in e-commerce public administration services has increased significantly, including in the area of food products and entertainment (McKinsey & Company, 2020; PWC, 2021). In 2020, almost 42% of respondents appreciate technologies although to a large extent they were limited to simple activities, such as submitting completed e-forms. A significant limitation in the use of the Internet potential in various spheres of activity of Poles seems to be the level of difficulty in their absorption, determined by their digital skills. Unfortunately, this indicator in Poland is below the EU average and is at the level of 44% (the EU average is 58%) (European Commission, 2021). In the population of people aged 16-74 who use the Internet, people with a low level of general digital skills accounted for 31.5%, people with basic digital skills – 24.1%, and people with above basic digital skills - 26.1% (GUS, 2020). However, this does not change the dominant belief among Poles that modern technologies are a necessary condition for the development of the economy, as indicated by 94% of respondents by Payback (Payback Poland, 2021). Obviously, this requires a comprehensive look at the connection and dependencies of various stakeholder groups in accordance with the quadruple helix model (business, state administration, research and development entities, society).

2.2. Digital economy – ethics, safety and responsibility

The Digital Economy and the development of new technologies caused a lot of ethical and moral concerns raised. There are some ethical principles and references developed which are designed to frame the scope of activities of all parties engaged in the virtual presence (e.g., Stahl, Timmermans, Mittelstadt, 2016; Saltz, Dewar, 2019; Allen, 2019; Floridi, 2019). The separate principles of ethical approach in AI are studied too e.g., Jobin and others identify 11 principles for ethical AI (Jobin, Ienca, Vayena, 2019). The moral challenges of AI have their own place in the debate about the need to define the limits of AI development without limiting the possibility of maintaining the autonomy of decisions, process control or data protection (e.g., Oxborough et al., 2018; Green, 2018; Floridi et al., 2018; Royakkers et al., 2018). Equality, non-discrimination, respect and dignity issues are additional matters in this discussion (Algorithm Watch, 2019). Ethical aspects of technology are associated with different kinds of risks to be managed (Meek et al., 2016).

A security risk is any possible event or sequence of actions that may lead to a breach of one or more security components (Tsiakis, Stephanides, 2005). From the consumer's perspective, security is an important decision-making factor. Privacy issues are positively related to the likelihood of buying online (Miyazaki, Fernandez, 2001; Salisbury et al., 2001; Yang, Jun, 2002; Milne, 2000; Chang, Chen, 2009).

There are two dimensions of security: objective and subjective from the point of view of new technology users (Linck et al., 2006). Regardless of the applied technological solutions and legal guidelines, the customers' sense of security is necessary to create the required level of trust enabling online transactions (Chellappa, Pavlou, 2002; Ally, Toleman, 2005).

Security and privacy can be considered as two separate constructs (Belenger et al., 2002). However, due to the fact that security mainly relates to shared data, this aspect is often associated with privacy concerns (Miyazaki, Fernandez, 2000; Gurung, Raja, 2016; Sheehan, Hoy, 2000; Ariffin et al., 2018).

The extent to which internet users are concerned about their online safety and privacy varies from country to country. A 2019 study on internet security and trust conducted by the Center for International Governance Innovation (CIGI) and Ipsos, in collaboration with UNCTAD and the Internet Society, found that 78% of internet users in 25 economies are at least somewhat worried about their own online privacy (CIGI-Ipsos et al., 2019).

One of the most important aspects of security is data security. (Smith et al., 1996; Kshetri, 2016). A key factor influencing privacy concerns is the user's perception of control over personal information (Xu, et al., 2012; Hong, Thong, 2013; Sheehan, Hoy, 2000). It is also noted that the magnitude of the impact of online privacy concerns may depend on consumer characteristics such as gender, age and education (Riquelme, Roman, 2014).

Research shows that concerns about the misuse of personal data are the main cause of distrust on online markets (Gupta, Dubey, 2016; Fortes, 2017; Hofacker, 2016; Boone et al., 2019).

Concerns are growing about issues related to privacy and security, democracy and ethical challenges, as well as the risk of mass surveillance and digital colonialism (Couldry, Mejias, 2019; Mayer-Schönberger, Ramge, 2018).

According to the Ipsos Global Trends Global Survey (2020), concern about Today, nearly three-quarters of the world is concerned about how companies collect and use our digital data. 67% of respondents are also concerned about how governments use our personal information - an increase of 6% from 2013. More than eight out of ten respondents believe that companies should provide more details about the data their websites collect.

Our data and privacy are becoming an element of commercial exchange (Acquisti et al., 2013; Martin, Murphy, 2017). While there seem to be growing concerns around the world about data privacy and online security, there is a "data privacy paradox" - users of new technologies are willing to share personal data, and thus their privacy, in exchange for various services or better offer (Kokolakis, 2017; Mosteller, Poddar, 2017). The scale of this phenomenon is growing. (Ipsos, 2020). Despite the perceived risk, more people would prefer not to know much about data privacy (Milne, Culnan, 2004).

However, the terms of use that should detail the company's practices are unclear and complex (Mukherjee, Nath 2003; Kim et al., 2010). They are designed to ensure organizational compliance and limit liability, not to understand the consumer (MacDonald, Cranor, 2008; Reidenberg et al., 2015).

Security, and in particular theft and misuse of information, as well as privacy issues, are also key matters undertaken by various government agencies and consumer organizations (European Commission, 2021; OECD, 2016).

The increasing digitization of economic activity and the development of data-driven and IoT business models are raising new security concerns (Tawalbeh et al., 2020). Protection of digital data and internet security should be a shared responsibility.

The provisions on consumer protection also overlap with public policies on national security, data privacy, law enforcement, and data flow and ownership (Ferracane, 2017; Ciuriak, 2018).

Despite these actions, a decline in trust among all stakeholders can be observed. Consumers begin to lose confidence in the way organisations and governments use data about them, and organizations lose confidence in their ability to secure data and use it to value creation (UMCTAD, 2016).

3. Research method and results

The survey was addressed to people who use the Internet and meet the connectivity condition. The study encompassed 1002 adult Internet users from Poland to achieve statistically significant results. The CAWI method was used. The data collection stage was done by Kantar Polska S.A. The sample is representative of Polish society. Respondents were divided into two main groups: “technologically advanced users” and “the rest”. The differentiation was made on the basis of one of the questions. The respondents assigned to the advanced users’ group replied “I rather agree” or “I strongly agree” to the following statements:

1. I am interested in technological news, I try to keep up to date.
2. I am one of the first among my friends and family to test new solutions (3) I handle most of my everyday matters (financial management, ticket purchases, fees, shopping) online.

This group included 266 respondents.

Two statistical tests were employed to verify the study’s research hypotheses. A Chi-square test and test comparing two independent population proportions were used to verify the assumed hypotheses. The second test aimed to verify the hypotheses concerning the value of proportions in the general population.

The readiness of this group to test and use technological solutions in everyday activities was the basis for the formulation of the first research hypothesis:

H1: There are differences in the use of the Internet by technologically advanced users and other users.

The test statistic (Pearson Chi-Square = 90,19, p-value = 0,00, df = 16) shows that there is a significant difference in the distribution of the use of technology between technologically advanced users and other users. Association between analyzed variables, measured by Cramer's V (0,1032) is moderate.

The results comparing answers in both groups are presented in the table below (Table 1). Technologies used both for private and professional purposes are listed in the table. Due to the fact that it was the first study of this type, it was decided not to categorize a given type of technology into work, home, private life, etc.

Table 1.

The use of technology by technologically advanced and other Internet users

Technologies	Technologically advanced	Rest of respondents	u
Online shopping (in online stores, auction platforms, e.g. Allegro, OLX)	86%	84%	0,773
Use of electronic mail (e-mail)	84%	85%	- 0,39
Use of internet / mobile banking (financial management via a computer or smartphone)	80%	79%	0,34
Use of messaging services (e.g. Facebook Messenger, WhatsApp, Skype, Zoom) for private purposes.	82%	77%	1,70
Use of social media (Facebook, Twitter, Instagram, Pinterest)	83%	75%	2,66*
Geolocation, the use of navigation, maps on the phone	71%	66%	1,49
Use of messaging services (e.g. Facebook Messenger, WhatsApp, Skype, Zoom) for professional purposes.	64%	54%	2,82**
Cloud data storage and sharing (OneDrive, Google Drive, DropBox, iCloud etc.)	67%	48%	5,32**
SMS micropayments e.g. sent for charity	52%	40%	3,39**
Biometric security (fingerprints, facial recognition)	57%	36%	5,96**
Intelligent health monitoring devices (smartwatches, fitness bands, heart rate monitors, blood pressure monitors, glucometers, scales)	51%	34%	4,88**
Online purchase of insurance	47%	31%	4,68**
Online medical advice, telemedicine	42%	28%	4,21**
Communication with chatbots/machines serving clients on the chat via instant messaging.	43%	25%	5,50**
Smart home - control of house/apartment elements using remote channels, e.g. via a smartphone	28%	12%	6,06**
Virtual or augmented reality (e.g. VR goggles)	26%	11%	5,87**
Use of drones	15%	9%	2,73**

u – Test for two structure indicators.

* - statistically significant at the level of significance of 0,05.

** - statistically significant at the level of significance 0,01.

Source: Own elaboration based on study results.

Another key point of technology use that has been discussed for several years is its ethical dimension. The importance of digital ethics increases. Hypothesis 2 was based on the assumption that there is a difference in the approach to ethical issues among the group of respondents who use various technological solutions in their daily activities.

H2: There are differences in the approach to the ethical aspects of new technologies in the group of technologically advanced users and the rest of the respondents.

The test statistic (Pearson Chi-Square = 4,04, p-value = 0,67, df = 6) shows that there is no significant difference in the approach to the ethical aspects of new technologies between technologically advanced users and other users. In order to determine a difference in the approach to each ethical aspect questions in the estimated proportions reflects a difference in the population proportions, and respondents' statements and test statistic were presented (Table II).

Table 2.

Do you agree or not with the following statements (% of respondents who answered yes to the following statements)

	Technologically advanced	Rest of respondents	u
I am concerned about the growing phenomenon of 'fake news' - the deliberate duplication of false information	80%	65%	4,53**
I am concerned that companies have my personal data or data about my behaviour on the Internet, e.g. the history of pages viewed	72%	65%	2,08*
I am concerned about the lack of control over the collection and storage of data about me by companies operating on the Internet	73%	62%	3,22**
I wonder to what extent I have real control over the content I receive on the Internet	73%	58%	4,32**
There are situations when I do not know why a given advertisement reaches me on the Internet or over the phone	60%	55%	1,41
I don't know how to reduce the amount of advertising and unsolicited information I receive.	48%	50%	-0,56
Companies on the Internet divide their customers into 'better' and 'worse' and they approach each group differently	55%	36%	5,40**
It seems to me that the scope of information I have contact with, e.g. in the media, is inappropriate for my interests.	48%	30%	5,28**
It seems to me that the scope of information with which I have contact, e.g. in the media, is not appropriate to my values and beliefs	43%	29%	4,17**

u – Test for two structure indicators

* - statistically significant at the level of significance of 0,05

** - statistically significant at the level of significance 0,01

Source: Own elaboration based on study results.

Table III completes and develops the thread outlined in the previous question about the context of data appearance, data access, processing and aggregation. The respondents could refer to such topics as: rules of using data, the risk of information manipulation, but also the development of technologies that are still not very common. People who consider themselves technological advanced generally have more concerns about the use of digital technologies except "the development of wearables technology".

The test statistic (Pearson Chi-Square = 15,49, p-value = 0,16, df = 11) shows that there is no significant difference in approach to the ethical aspects of new technologies between technologically advanced users and other users.

Table 3.

Do you agree or not with the following statements (% of respondents who answered yes to the following statements)

	Technologically advanced	Rest of respondents	u
Information manipulation on the Internet, no possibility of selecting real information	82%	69%	4,07**
Collecting and connecting with an individual data on Internet activity and data trading	75%	63%	3,55**
Privacy restrictions related to the development of monitoring	72%	58%	4,03**
Showing ads with inappropriate content for the recipient	68%	58%	2,86**
Using data relating to internet activity to advertise products and services	68%	57%	3,14**
The growing amount of information reaching people, information overload	64%	52%	3,37**
Unclear rules of operation of financial systems	63%	48%	4,20**
Chips that extend human capabilities	63%	55%	2,26*
Accurate life expectancy determination based on continuous health monitoring	58%	45%	3,64**
Development of wearables technology	52%	45%	1,96
The development of artificial intelligence (AI / SI)	47%	37%	2,86**
Introduction of autonomous cars	46%	32%	4,08**

u – Test for two structure indicators

* - statistically significant at the level of significance of 0,05

** - statistically significant at the level of significance 0,01

Source: Own elaboration based on study results.

The issue of autonomy and decision-making undoubtedly raises concerns. Technology is designed to facilitate the implementation of tasks, not to take control of our decision-making or cause external organizations to obtain data that we do not want to disclose. Table IV shows which elements related to these dimensions are of concern among two different groups of respondents. The test statistic (Pearson Chi-Square = 4,04, p-value = 0,67, df = 6) shows that there is no significant difference in approach to the ethical aspects of new technologies between technologically advanced users and other users.

Table 4.*Autonomy and privacy concerns (% of respondents agree with the statement)*

	Technologically advanced	Rest of respondents	u
I am afraid that I will be under surveillance (without my knowledge and / or consent)	74%	66%	2,40*
I'm afraid that thanks to technology, people will know more about me than they want	75%	65%	2,99**
I am concerned that a third party will take control of my phone/email/bank account	70%	66%	1,19
I am afraid that knowing myself will become the basis for manipulating my decisions/opinions/behaviours	72%	57%	4,30**
I am afraid that an improperly designed system will discriminate me	62%	47%	4,19**
I am afraid that a third party will take control of my smart home appliances / smart home, car	55%	47%	2,24*
I am afraid that the robot will take my job in the future	48%	39%	2,55*

u – Test for two structure indicators

* - statistically significant at the level of significance of 0,05

** - statistically significant at the level of significance 0,01

Source: Own elaboration based on study results.

The last hypothesis concerned the scope of responsibility that technologically advanced users take for the use of technology. The aim was to check whether people who follow technological news and use technology to ease their daily tasks have a sense of responsibility for the information provided and data protection.

H3: Technologically advanced users take more responsibility for the use of technology comparing the rest of the respondents. The research results are presented in table V. Test statistic (Pearson Chi-Square = 19,56, p-value = 0,00, df = 3) shows that there is a significant difference in responsibility for the use of technology between technologically advanced users and other users. Association between analyzed variables, measured by Cramer's V (0,0885) is weak.

Table 5.*Perception of responsibility for activities related to the online presence (% answers of respondents who agreed with the statements)*

	Technologically advanced	Rest of respondents	u
As technology advances, the boundaries of what is ethical are shifting	92%	77%	5,34**
All unethical activities are unacceptable	83%	71%	3,83**
As technology develops, greater emphasis should be placed on online threats and data privacy	72%	58%	4,03**
I can agree to some concessions regarding the security of my data if I am offered better terms, e.g. a contract or purchase	51%	25%	7,80**

u – Test for two structure indicators

* - statistically significant at the level of significance of 0,05

** - statistically significant at the level of significance 0,01

Source: Own elaboration based on study results.

The verification of research hypotheses revealed that there are statistically significant differences between technologically advanced and other users in the researched sample and the general population. Research hypotheses 1 and 3 were verified positively. The second hypothesis was not verified positively for the researched sample but there are some differences on the level of the general population for particular statements measuring the approach to the ethical aspects of new technologies. Additionally, thanks to the additional statistical verification it was revealed that the differences between two groups of Internet users are statistically significant in the general population.

4. Discussion

It seems to be particularly important to recognize the factors which may prevent technology acceptance or make it less beneficial for the users. The “technological advanced” group is characterized by high awareness of the risks related to the transfer of data or the use of technologies to facilitate everyday functioning.

Users' fears stem from the feeling of lack of control over the process of obtaining information about them. For designers and technology suppliers, the area of education should become a necessity. Users who understand technology will be able to use it properly. This is especially important for less advanced users. The role of education was also indicated as important by other authors (Kim et al., 2017).

Automation and robotisation are essential factors in developing the digital economy. Enterprises implementing such technologies should also address the processes of information in their projects. Familiarizing with technology and building a sense of security as well as showing possible alternatives in those areas where robotisation may dominate the performance of certain tasks seem to be the priority.

Technologically advanced users have more concerns about losing control of what happens when the information is disclosed to companies. For companies, it is a great challenge not only because of law but also ethical issues (Buchanan et al., 2007).

The topic highlighted by the surveyed group is data manipulation and information bubble. It is a significant factor that influences the social development of a technologized society. In this dimension, the ethics of business activities becomes crucial. Not only technologies should be devoid of features that determine discriminatorily, excluding or limiting access to complete information and freedom of decision, but also the information itself made available on the web. This includes advertising, press releases, reports and other types of communications received by people using the Internet. This supports the other studies about the potential risks of online discrimination (Speicher et al., 2018). With the limitation of autonomy, apart from manipulating the content, there is also a problem of a loss of decision-making.

5. Limitations and conclusions

There are some limitations to this study. The survey answers were collected based on one country so it would be interesting to compare results with other countries located at different positions in the DESI index. The study is broad and does not specify the concrete areas of the Digital Economy and was oriented on the broad context of activities undertaken online. The study did not analyse the factors influencing the potential paradox that arises between the awareness of threats and the readiness to disclose data that may favour the use of unethical behaviour and other abuses by enterprises. Future research may go deeper to understand the mechanisms of ethical and security concerns in specific contexts and situations.

Ethics and a sense of security are crucial factors for designing and developing new technologies. These elements should be implemented on several levels. Transparent, data-driven and factual presentation of information in communication processes will satisfy the need to have access to reliable information about the technology. Technological ethics in which designed solution is free from violations of human rights. Ethics of the technology provider is understood as ethical behaviour in relations with users, including the process of establishing formal relations through contracts. The ethics of the technology provider also covers the way how the obtained data is used, combined and processed. The development of the digital economy requires sustained efforts on the part of businesses as well as authorities and users.

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THE COVID-19 PANDEMIC AS A MODERATOR OF RELATIONSHIP BETWEEN APPLIED PROJECT MANAGEMENT METHODOLOGIES AND EMPLOYER BRAND ATTRACTIVENESS

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Purpose: The purpose of the paper was to investigate the relationship between the applied project management methodologies and the perception of the employer's brand attractiveness. In addition, an attempt was made to identify the variability of this relationship due to the COVID-19 pandemic.

Design/methodology/approach: Empirical research was conducted to verify the existence of the predicted relationship and to reach the aim of the paper. The set of hypotheses was built based on the theoretical research and then verified in two differently constructed research (the study was conducted using the CAWI method) on two separate samples of respondents: 92 students (potential employees) and 81 employees working on projects in organizations operating in Poland. The calculations were made using the PS Imago Pro ver. 7.0 and Process macro for SPSS ver. 4.1 by Andrew F. Hayes.

Findings: It has been shown that the crisis caused by the COVID-19 pandemic did not directly affect the perception of the employer's brand attractiveness, but it is a moderator of the relationship between the applied project management methodologies and the attractiveness of the employer's brand. However, although the authors found the basic relationship true for both groups of respondents, the moderating effect is valid only for a group of employees.

Research limitations/implications: The analysis is based on a limited number of cases in particular groups. In order to generalize the results in future research larger samples can be collected. There is also space to search for factors explaining why and under what conditions the type of project management methodology affects the attractiveness of the employer's brand.

Practical implications: The obtained results contribute to the practice of management, showing that among the various groups of factors determining the attractiveness of the employer's brand, the attributes of the work processes (which include also the selection of project management methodology) are important as well. Organizations that apply agile project management methodologies can be more attractive to employees, especially in times of crisis and attract the more qualified specialists in the industry. Thus emphasizing the use of agile project management methodologies can be part of an employer's branding strategy shaping.

Originality/value: The research makes an important contribution to the body of human resources and project management literature by demonstrating COVID-19 as a significant moderator for the relationship between the applied project management methodologies and the attractiveness of the employer's brand.

Keywords: employer brand attractiveness, project management methodology, COVID-19, management.

Category of the paper: Research paper.

1. Introduction

In times of volatility and uncertainty in the market, recruiting new and retaining existing employees, especially specialists, is a challenge for all companies. The outbreak of the COVID-19 pandemic, disrupting the world of work, has only created additional pressure on this issue. Now more than ever, a strong employer brand can help an organization differentiate itself from competitors and attract or maintain highly qualified employees. “Building and fostering an attractive employer brand helps organizations inspire and attract the right employees and ensures that employees strongly identify with their employer” (Nelke, 2021, p. 388). Moreover, organizations with strong and attractive employer brand can potentially reduce the cost of employee acquisition, improve employee relations, increase employee retention and even offer lower salaries for comparable staff to firms with weaker employer brands (Alniaçık, Alniaçık, 2012; Dalsfeld, 2021; Kurniawan et al., 2020; Nandakumar, Bhat, 2015; Wojtaszczyk, 2012), but also leads to achieving higher financial results, increasing customer satisfaction and reducing costs (Fulmer et al., 2003).

Literature research provides information on many factors determining employer brand attractiveness (Ambler, Barrow 1996; Dabirian et al., 2017, Dabirian et al., 2019; Kurniawan et al., 2020), both instrumental (the tangible, product-related, physical or in broad ‘job/organization’ related attributes) and symbolic (that describe the organization in terms of subjective, abstract and intangible traits) (Lievens, Highhouse, 2003). Among those concerning the attributes of the work process the project management methodologies, that determine the way work is organized, can be pointed out. In the context of the COVID-19 pandemic, which dramatically changed the way the work was performed, arises a question if an applied project management methodology has the power to influence employerbrand attractiveness. This question has not been answered and is a research gap that needs to be addressed.

In order to fill the observed gap the purpose of the paper was to investigate the relationship between the applied project management methodologies and the perception of the employer brand attractiveness. In addition, an attempt was made to identify the variability of this relationship due to the COVID-19 pandemic. Such research intent was structured by a literature review on the subjects of employer brand attractiveness and project management

methodologies, which subsequently laid the foundation for the development of a conceptual model. Further on, empirical research with data collected from two separate samples of respondents: 92 students (potential employees) and 81 employees working on projects in organizations operating in Poland was performed. Discussion of the obtained results leads to the conclusion that performed research contributes to the body of academic knowledge on human resources and project management literature by demonstrating COVID-19 as a significant moderator for the relationship between the applied project management methodologies and the attractiveness of the employer's brand.

2. Literature overview and hypotheses development

2.1. Employer's brand attractiveness and its determinants

Employer brand can be defined as “the package of functional, economic and psychological benefits provided by employment, and identified with the employing company” (Ambler, Barrow, 1996, p. 187). There are several terms that are used to address this concept: recruitment image, employer brand image or employer attractiveness (Berthon et al., 2005; Gatewood et al., 1993; Rampl, Kenning, 2014; Ronda et al., 2018). However, in this study, the concepts of employer brand and employer brand attractiveness will be clearly demarcated. According to Ronda et al. (2018) employer brand refers to employer attributes that are employer-extrinsic traits set by companies that constitute an organization’s offering to employees (i.e. salary, working hours, available training or promotion possibility). Those attributes are shaped by organizations in a process of employer branding – “a targeted, long-term strategy to manage the awareness and perception of employees, potential employees and related stakeholders with regards to a particular firm” (Sullivan, 2004 in: Alnıaçık, Alnıaçık, 2012, p. 1337) aimed at building an image in the minds of the potential or present employees. Employer branding determines thus employer brand attractiveness, that can be understood as an attitude or general positive feeling towards the specific organization perceived as a “good place to work” and defined as the envisioned benefits that a potential employee sees in working for a specific organization (Berthon et al., 2005). Therefore, in assessing the attractiveness of the employer's brand, the subjective point of view of the employee (or potential employee) is adopted.

In contemporary research employer brand attractiveness is perceived as a multidimensional construct. There is a lot of research focusing on finding the factors that determine the attractiveness of the employer's brand, however, there is no single consistent classification of these factors. According to Ambler and Barrow (1996), three dimensions should be taken into consideration when assessing employer brand attractiveness: psychological benefits, functional benefits and economic benefits. Kurniawan et al. (2020) suggest that employees will accept a new job because of 5 top factors: work culture and team dynamics, employee benefit,

new challenges and industry exposure, maximization of skills and abilities, and monetary benefits. Berthon et al. (2005) developed a scale for measuring employer attractiveness in terms of employer branding concept, containing five factors which are social value, interest value, development value, economic value and application value. According to Dabirian et al. (2017, 2019) this proposition can be extended by the role of management, work/life balance, economic issues tied to compensation, opportunities for professional development, the image of the employer on the market or interesting and challenging work tasks. In particular, this last factor concerns the values of the attributes of the work process. In the context of the COVID-19 pandemic, which dramatically changed the labor market and the way the work was performed, appears a question if one of those factors creating an interesting and challenging work environment could be project management methodology used, and in a broader context if an applied project management methodology has the power to influence employer brand attractiveness.

2.2. Overview of project management methodologies

Undoubtedly, efficient project realization requires efficient project management. Project management means “planning, organization, monitoring and control of all aspects of a project, with the motivation of all included parties to achieve project goals in a safe manner, within the agreed schedule, budget and performance criteria” (Radujković, Sjekavica, 2017, p. 608). There are a lot of different methods, tools and techniques that can be used to deliver project results, however, according to different specificity, duration, type of expected result, level of innovation, scope or size of the project there are different ways of project management, and it is simply impossible to indicate which one is the best. To ensure the repeatability of the success in projects realization, attempts were made to unify and standardize the methods of project management, which led to the development of project management methodologies (PMMs).

PMM is usually defined as a set of methods, techniques, procedures, rules, templates and best practices used on a project (Pace, 2019; Project Management Institute, 2008; Radujković, Sjekavica, Klepo, 2021; Špundak, 2014; Trocki, 2012; Wyrozębski, Trocki, 2011) or wider as a set of guidelines and principles that can be tailored and applied to specific project situation (Charvat, 2003; Karaman, Kurt, 2015). Such understood PMM is still a philosophy rather than a detailed recipe for project implementation. The use of PMM is always aimed at increasing the probability of successful project delivery (Joslin, Muller, 2015; Kerzner, 2001; Pace 2019; Špundak, 2014). It must be also underlined that there is no one unique, singular, universally accepted PMM that would be adequate and applicable across all projects in all sectors (Charvat, 2003; Cockburn, 2004; Pace 2019).

There are different classifications of PMMs. Taking into account the scope and specificity of the application of a particular methodology, the following PMMs are distinguished: universal, industry-specific, corporate-specific and author-specific (Wyrozębski, Trocki, 2011). Universal PMMs are methodologies intended for use in various fields and situations of project management, usually developed by institutions dealing with the development and dissemination of model methods of project management (i.e. PRINCE 2, PMBoK, PCM, P2M, APM etc.). Industry-specific PMMs are developed by professional associations of specific industries and adapted to the industry specificity of projects (i.e. HERMES: Management and Execution of Projects in Information and Communication Technologies, Project management BundOutline, MSF: Microsoft Solution Framework, EVO: Evolutionary Project Management, XP: Extreme Programming etc.). Corporate-specific PMMs are developed by organizations in which projects are the basis of activity. The area of their application is usually limited to the organization for which they were created. They are rarely original solutions, being rather adaptations of universal or industry-specific methodologies (i.e. NASA methodology for managing space projects and programs, CPMM Cornell University Project Management Methodology, Kansas PMM etc.). Author-specific PMMs are a synthesis of the knowledge and individual experiences of their authors and do not always present sufficient quality (Wyrozębski, Trocki, 2011).

Taking into account the manner of proceeding in the project management process we can distinguish sequentially driven (waterfall, traditional) and iterative (agile) PMM. The core of the traditional approach involves the mechanistic division of work and strict planning of the successive stages of the project. As the work of one phase continues downstream into the next stage it is often referred to as a waterfall. This highly structured approach gives the assumption of manageability and predictability, and helps with the delivery of project success (Laufer et al., 2015, Saynisch, 2010). Agile PMM is the answer to the perceived weaknesses of traditional PMM in a highly changing environment. The basis of agile PMM is a series of recurring iterations that are continued until the delivery of a final product meets customer requirements (Leybourne, 2009; Settina, Hörz, 2015; Pace, 2019). An interesting, two-dimensional classification of PMM was proposed by R. Wysocki (Wysocki, 2014). In his opinion, the PMMs could be classified (and also selected for the project) depending on the features of the project. The key characteristics of the project here are: the clarity and precision of the goal formulation and how obviousness and acquaintance of project solutions. To these two features R. Wysocki assigns only two values: understandable (clear, well-known) and incomprehensible. According to this, each project can be classified into one of the four quadrants, where different PMM can be used:

- traditional – when the purpose of the project and its solution are clear and obvious,
- agile – when the goal is clear but the solution is not obvious,
- emertxe – when the solution is known, but the purpose is unclear,
- extremal – when both the goal and the solution are incomprehensible or unknown (Wysocki, 2014).

2.3. The relationship between the project management methodologies used by the employer and the attractiveness of the employer brand

Particular PMM determines the way work is organized, in particular giving team members a greater or lesser degree of decision-making, influencing the degree of complexity and formalization of tasks performed by employees or influencing predictability of organizational behavior. According to Humprey et al. (2007) organizational practices, structures and work characteristics have a large impact on the feelings and cognitions of the organization's employees. This may determine the attractiveness of the organization as a workplace, and in a broader context the attractiveness of the employer brand.

A cascade model of work in traditional PMM, which assumes the execution of work stages one after another in a strictly defined sequence, involves careful planning and a lack of flexibility. On the other hand, tasks performed in traditionally run projects will be characterized by a greater degree of formalization and, at the same time, will be more understandable and less complex. Such invariability and predictability of curtains may be attractive to some groups of workers, especially those who tend to choose less complicated and more precise tasks than more complex ones (Kouchaki, 2020). This observation may therefore be translated into the perception of the attractiveness of the employer brand through the prism of the project management methodologies used by organizations. From that point of view, the assumptions of traditional methodologies should constitute a higher level of attractiveness than the others. On the other hand, agile PMM whose basic assumption is to break the project into smaller parts, (so-called iterations or sprints) allows each project to be broken down into short stages, which gives great flexibility. Employees often do not work with a predefined plan and have the opportunity to introduce various types of changes and modifications at every stage of the work. At the same time, the tasks are less formally defined, which may translate into the degree of their complexity, but also into the possibility of a large share of employees in the management processes. Self-organization and iterative work nature, combined with a strong emphasis on teamwork and regular task feedback, can be attractive to employees. The observation of Kraimer et al. (1999) saying that "if individuals can regularly assess the immediate results of their work, they are more likely to perceive having an impact in an organizational unit" may confirm this assumption.

The applied project management methodology has an impact on how clearly the goal of the project is formulated. B. Dik claims that employees who know that their work is aimed at a specific goal more often experience a sense of the importance of their work (Dik et al., 2013). Moreover, this aspect will also be related to the independence of decision-making and the influence of the team on the formulation of project goals. In this context, extreme and emertxe methodologies may seem to be the least attractive, because as a rule, in the case of tasks implemented in projects carried out in these methodologies, the goals seldom will be easily understandable and the purpose of their implementation will not be fully known.

An indirect relationship between an agile project management methodology and attracting people to the organization was shown by J. Koch and C. Schermuly (Koch, Schermuly, 2020), justifying it with the modern empowerment theory (Spreitzer, 1995). Particular PMM gives team members a greater or lesser degree of decision-making. Involving employees in the decision-making process means that they automatically take more responsibility for the activities undertaken within the project and increase the sense of belonging to the team (Schermuly et al., 2013). However, the research of Zaleski & Michalski (2020) showed that there exist negative correlation between agile PMM and team (employees) engagement, which seems to contradict the benefits of empowerment theory. In this way, the choice of project management methodology may indirectly translate into how managers manage and motivate employees. Moreover, correctly implemented agile project management methodologies ensure that the team independently decides about the goals of the project and resource allocation, and that each team member has certain freedom as to how to perform the tasks entrusted to him (Ruhe, Wohlin, 2014). Therefore, agile project management methodologies should have a positive impact on the perception of the employer brand attractiveness. At the same time, it should be noted that with the same assumption, traditional methodologies, in which the aspect of granting decision-making to the entire team is smaller, should adversely affect the perception of the employer brand. The effect of extreme and emertxe methodologies should be analogous to agile methodologies because they provide employees with a high degree of decision-making, even higher than in the case of agile methodologies (Sawicki, 2022).

In addition, when considering the preferences and impressions that accompany the perception of brand attractiveness among employees, one should also take into account the effect of pure exposure to agile project management methodologies, ignored in this context in the literature. In recent years, agile project management methodologies have strengthened their position and have de facto become a standard project management methodology in many industries, especially in the IT industry. Therefore, employees, and in particular applicants who do not yet have work experience, may not be able to consciously recognize the presence of such a stimulus and automatically evaluate as more attractive the brands of those employers who use agile methodologies (Sawicki, 2022).

To summarize, the strength and direction of the relationship between the applied PMM and the attractiveness of the employer brand is unclear. However, there are good indications of such a relationship. Therefore, the following research hypothesis is proposed:

H1: There is a relationship between the applied project management methodologies and the attractiveness of the employer brand.

The attractiveness of the employer's brand will be perceived differently by external recipients (job applicants) and by internal recipients (employees) associated with a given organization through an employment relationship (Kalinska-Kula, Staniec, 2021). They will have different experiences with a given brand, as well as different experiences with the PMMs used, so the assessment of its attractiveness among these two groups will probably be carried

out by two different sets of factor categories. Therefore, the above hypothesis has been made more specific:

H1a: There is a relationship between the applied project management methodologies and the attractiveness of the employer brand perceived by job applicants,

H1b: There is a relationship between the applied project management methodologies and the attractiveness of the employer brand perceived by employees.

2.4. Project management methodologies and the attractiveness of the employer brand in the context of a pandemic

Employer brand attractiveness reflects the generalized attitude towards an organization as a potential employer. In 2020, at the beginning of the COVID-19 pandemic, the MJCC Employer Branding Consultants agency predicted that the pandemic crisis would undoubtedly affect the attractiveness of Polish employers - "as many as 74% of respondents admitted that they were following the activities of employers (other than their own), and nearly 30% of respondents, they even convinced them to apply for a given company "(Juchimiuk, 2021). It turns out that among the factors shaping the attractiveness of the employer brand, economic and social values played the greatest role in this case. Potential and current employees, apart from the stability of employment and the level of remuneration, also paid attention to the possibility of remote work and the level of security provided by the employer. Moreover, 67% of respondents admitted that the information provided by their employer had a calming effect on them.

In view of such facts, it can be seen that there has been a certain shift in job security from the group of hygiene factors to the group of motivational factors. However, one should consider whether this is only a temporary phenomenon, or perhaps one that will have long-term effects. It is worth noting that in the context of employer branding, long-term actions are much more important than short-term ones. In view of this, it would perhaps be unjustified to communicate based on creating an image of a safe (in the context of a pandemic) workplace. It is also worth noting that such actions as withholding recruitment, not participating in trade shows, industry conferences or recruitment events can make a negative impact on the perception of employer brand attractiveness (Mazur, 2020). An employer whose number of touchpoints with employees has shrunk may seem less interesting.

The COVID-19 pandemic crisis changed the way people thought about employer brand attractiveness. Employees expected organizations not only to communicate their values but also to actually demonstrate them. Ways of motivating employees that worked well just a few years ago now play no significant role in attracting and retaining a highly skilled workforce (Adams, 2022). SmartDreams and Firstbird - global organizations active in the human resource management industry - indicate that enhancing employer brand appeal is one of the key aspects for companies in the post-pandemic era (Jelena, 2022; SmartDreamers Team, 2022).

The crisis related to the COVID-19 pandemic caused employees to think more deeply about their careers, working conditions and long-term goals (Beilfuss, 2021; Hsu, 2021). Such a situation may also have an impact on the perception of the attractiveness of the employer's brand. Professional goals and conditions in the workplace are components of the values that have a direct impact on the perception of the employer brand. Moreover, the pandemic has created confusion among previously binding economic and social norms, which has changed people's expectations of the brands they work for and buy from. Today, brand audiences judge organizations more holistically than before. Therefore, to build trust and compete for the best candidates, organizations must conduct consistent communication with all recipients and stakeholders (Palmer, 2022). Empathetic and responsible behavior of employers, as well as consistent communication in a crisis such as caused by the COVID-19 pandemic, will create employees' awareness and attention, and make employer brand more attractive.

To summarize, the following hypotheses can be formulated (similarly to the previous hypothesis, it will be verified in 2 groups of respondents: job applicants and employees):

H2: The crisis caused by the COVID-19 pandemic affects how potential employees – job applicants (a) and current employees (b) perceive the attractiveness of the employer brand.

COVID-19 shook the labor market and changed the way work was performed in many industries. Expectations related to hybrid and remote work have changed. More and more employers around the world have started to use flexible work schedules for their teams, and this led to the emergence of new trends in the labor market - increasing the possibility of remote work. According to a study conducted by Owl labs during the COVID-19 pandemic, nearly 70% of full-time employees worked from home (OWL Labs, 2020).

An environment in which employees work in a hybrid or completely remote format provides a better environment for projects conducted in a "flexible" manner. It was likely that projects conducted in a traditional manner were hindered here. On the other hand, projects managed with agile, extreme or emertxe techniques could have been implemented much more easily. It should be noted here that the problem is not with the flexibility of task complexity alone, but also with the flexibility of deadlines for delivering results. The shift toward a remote work model has led employees to appreciate this multi-faceted flexibility more and thus put pressure on the employer to provide working conditions that support it (Jelena, 2022).

Because of the pandemic and the radical upheaval it caused in the labor market, many employees began to rethink their jobs, their employment conditions and what is important to them in a professional environment (Hsu, 2021; Beilfuss, 2021). According to LinkedIn Business, this caused many of them to apply for open positions internally within the company, or even seek new opportunities outside the organization where they worked. An important factor here was maintaining the ability to work remotely. Given this re-evaluation of values in working life, it can be assumed that employees in their new assessment of reality also paid more attention to the project management methodologies used by employers. Such a situation would directly contribute to how attractive a particular employer's brand appears to be in terms of the

project management methodologies it uses (Sawicki, 2022). Considering all the above, the following research hypothesis can be formulated:

H3: The COVID-19 pandemic is a moderator of the relationship between the applied project management methodologies and the attractiveness of the employer's brand perceived by job applicants (a) and employees (b).

Below figure (Figure 1) presents the diagram illustrating the adopted research hypotheses.

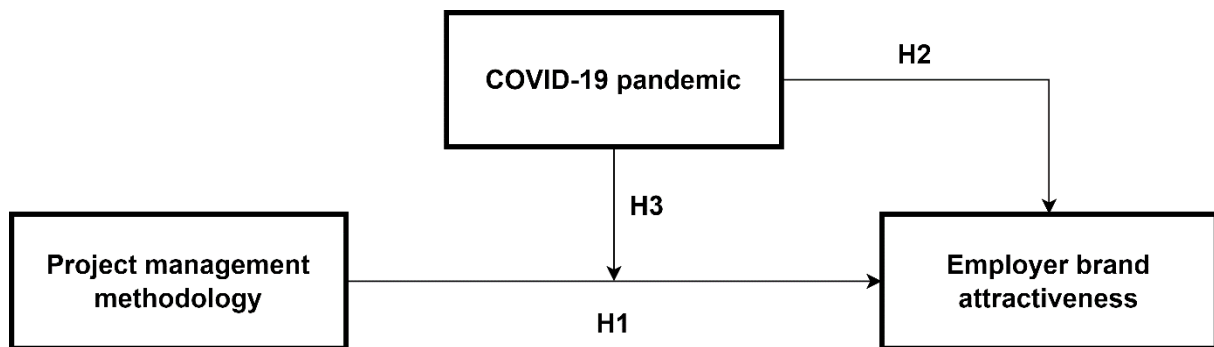


Figure 1. COVID-19 pandemic as a moderator of relationship between the applied PMM and the attractiveness of employer's brand.

Source: own research.

3. Research methodology description and results of research

Aiming to verify the proposed hypotheses quantitative research was conducted. The purpose of the research was to verify the relationship between the project management methodologies used and the perception of employer brand attractiveness among two groups of respondents - potential and current employees. In addition, each time it was examined whether the COVID-19 pandemic could be a factor that affects the strength of this relationship. Due to the two disjointed groups of respondents, two different survey tools and methods were designed. The studies were conducted using the CAWI method. The research was conducted to complete a master's thesis (Sawicki, 2022).

Study No. 1 was conducted as an experiment among potential employees. It consisted of presenting respondents (students, for whom the specifics of various management methodologies are known only in theory) with descriptions of three fictional organizations conventionally named ABC, DEF and XYZ, and then collecting their opinions on the attractiveness of the potential employer's brand. All of the organizations were described as well-established businesses that provide their services/products to customers in a project manner. The ABC organization was described as an enterprise that implements projects in a traditional methodology. The DEF organization was described as an enterprise implementing projects in an agile methodology, and the XYZ organization was described as an enterprise implementing

projects in an extreme/emertxe methodology. The descriptions did not explicitly state in which methodology the organization executes its projects, but described the characteristics of the methodology. Respondents were asked whether they would find the organization in question as an attractive employer if they were looking for a job, with each respondent evaluating the company in question twice: once to express their opinion on how attractive the employer brand would have been to them before the COVID-19 pandemic and a second time to express how they perceived the attractiveness of the organization's employer brand during the pandemic. To minimize the influence of other determinants of employer brand attractiveness, respondents were asked to express their opinion under the assumption that the industry of each organization was in line with their interests or education, and that the salary offered would be attractive. All descriptions were identical in design.

In study No. 2, the respondents were employees - people who work in project teams daily, using their organizations' preferred project management methodologies. The method used here was a questionnaire survey (CAWI). Each respondent provided answers about the last project they were involved in before the COVID-19 pandemic outbreak and about the project they were involved in during the COVID-19 pandemic. The study examined what methodology was used for projects in which the respondent was involved. Indication of the methodology was done by directly asking respondents to indicate the project methodology in question as well as through a series of questions examining the characteristic features of each project management methodology.

3.1. Study 1 - impact of project management methodologies on the perception of the employer brand attractiveness in times of a pandemic by potential employees

3.2. Data gathering process and characteristics of the research sample

The planned experiment was conducted in April and May 2022. The hypotheses were tested on a group of Polish students from universities in Wroclaw and Poznan., invited to participate in the study by a link to the survey published on social media platforms (i.e. Facebook, and LinkedIn) as well as through direct requests.

The sample was selected using a non-random method. The sampling was partly voluntary (posted on social media platforms) and partly purposive - people studying specific majors were asked to participate in the survey.

Project management is mainly known to students of management and IT-related majors - little quantitative data is available for populations that are outside these fields. However, the research presented in this paper was not closed to students of any major in order to gather additional data.

The sample consisted of 92 students from various disciplines. Almost one-third of them were studying IT-related fields (30 respondents), 16 of them were in other engineering and technology fields, 17 students were majoring in management-related disciplines, 26 students were involved in other social sciences and 3 students were from other disciplines.

In the survey, the question about the age of respondents was optional. It was answered by 69.56% of respondents. For this group, the average age was 23.61 (SD = 1.62) and the median was 24. The survey included 50 females, 41 males and 1 person who identified their gender as other.

More than half of the respondents (60.1%) declared previous experience with at least one of the project management methodologies, however it has not been checked to what extent this experience is related to the knowledge acquired during studies, and to what extent it is related to work. Detailed data on the respondents' experience with each methodology can be found in table (Table 1).

Table 1.

Percentage of respondents claiming to have experience with given methodologies

PERCENTAGE OF PEOPLE CLAIMING TO HAVE EXPERIENCE WITH						
traditional	agile	extreme/emertxe	all methodologies	two methodologies	one methodology	no experience
45%	35%	15%	8%	18%	35%	39%

Source: Sawicki, 2022.

3.3. Overview of variables

Conducting the survey, each respondent was the source for 6 statistical observations. All respondents answered the same questions about the three companies, and what's more, questions about a particular company were answered twice - firstly due to the distinction between the situation that existed before and secondly during the outbreak of the COVID-19 pandemic.

The proposed hypotheses were verified using the following research variables:

- *project management methodology* - a nominal, three-value variable: traditional methodology, agile methodology, extreme/emertxe methodology; describes the method of project management addressed by a given statistical observation; was measured by assigning each of the three organizations one of the project implementation methodologies,
- *COVID-19 pandemic* - a dichotomous variable with values of *yes, no*; describes whether a given statistical observation expresses the respondent's opinion of the situation before or during the outbreak of the COVID-19 pandemic,
- *overall impression* - this variable was designed to examine the attractiveness of the employer brand; it was constructed from five items in the form of quantitative variables reflecting general feelings about the organization in question, each item was rated on a 5-point Likert scale; the variable was constructed based on the literature analysis (Fisher et al., 1979; Turban, Keon, 1993);

- *intentions to take action* - this variable was designed to examine the behavioral aspects of respondents that influence perceptions of employer brand attractiveness; it was constructed from five items in the form of quantitative variables, each item was rated on a 5-point Likert scale; these items were based on previous research (Ployhart, Ryan, 1998; Schwoerer, Rosen, 1989);
- *employer brand attractiveness* - this variable was designed to examine the attractiveness of the employer brand; it was built on the *overall impression* and the *intention to take action* (computed as an average of these two variables); in contrast to the approach of the literature analysis, a component related to the prestige of the organization was not included here, since the offers presented to the respondents were descriptions of fictitious organizations; therefore, it was concluded that this component would not be relevant in measuring employer brand attractiveness under such conditions.

3.4. Descriptive statistics and reliability analysis of scales

The reliability analysis of scales was conducted using Cronbach's alpha method. The values of Cronbach's alpha for the variables *overall impression* and *intentions to take action* are very high ($\alpha = 0.925$ and $\alpha = 0.959$, respectively), which means high consistency and thus high reliability of scales. Removing any of the component items for any of the two variables would not increase Cronbach's alpha coefficient. None of the items after deletion obtains a value of this coefficient higher than without deletion. Similarly, the value of Cronbach's alpha for the research variable *employer brand attractiveness* is very high ($\alpha = 0.953$). The summary of the reliability analysis of scales is presented in table (Table 2).

The normality test for the research variables was performed using the Kolmogorov-Smirnov and the Shapiro-Wilk tests.

Table 2.

Reliability analysis of scales for study no. 1

RELIABILITY ANALYSIS		
variable	Cronbach's alpha	number of items
OVERALL IMPRESSION	0.925	5
INTENTIONS TO TAKE ACTION	0.959	5
EMPLOYER BRAND ATTRACTIVENESS	0.953	2

Source: Sawicki, 2022.

3.5. Results of the research

To verify the relationship between an *employer brand attractiveness* and *project management methodology*, a correlation analysis was performed. Since the former variable is quantitative and the latter variable is nominal the eta squared measure was used. The results of the analysis are presented in table (Table 3). Obtained result shows that the relationship between *employer brand attractiveness* and *project management methodology* is strong ($\eta^2 = 0.472$). This means that hypothesis H1a can be accepted.

Table 3.
Correlation analysis results for study no. 1

NON-LINEAR CORRELATION		
variable	EMPLOYER BRAND ATTRACTIVENESS	
PROJECT MANAGEMENT METHODOLOGY	η	0.687
	η^2	0.472
	N	552
COVID-19 PANDEMIC	η	0.026
	η^2	0.001
	N	552

N – number of observations, each respondent was source for 6 statistical observations ($552 = 6 \times 92$).

Source: Sawicki, 2022.

To further investigate this phenomenon, it was analyzed which types of methodologies make the employer brand perceived as more attractive. For this purpose, average values were calculated for the variables overall impression, intention to take action and employer brand attractiveness by category - project management methodologies. The results of the analysis are presented in table (Table 4).

Table 4.
Average values of the variables overall impression, intention to take action and employer brand attractiveness by category for study no. 1

category	AVERAGE VALUE		
	OVERALL IMPRESSION	INTENTIONS TO TAKE ACTION	EMPLOYER BRAND ATTRACTIVENESS
TRADITIONAL METHODOLOGY	2.6696	2.3065	2.4880
EXTREME/EMERTXE METHODOLOGY	3.4359	3.3989	3.4174
AGILE METHODOLOGY	4.2978	4.5000	4.3989

Source: Sawicki, 2022.

The results obtained show that the highest average values for all three variables were achieved for agile methodologies. In contrast, traditional methodologies achieved the lowest average values for all variables. For extreme/emertxe methodologies, the values of individual averages were between those for agile and traditional methodologies.

In order to verify the relationship between *employer brand attractiveness* and the *COVID-19 pandemic*, a correlation analysis was performed, again using the eta squared measure (Tab. 3). The obtained result shows that the relationship between the attractiveness of the employer's brand and the occurrence of the COVID-19 pandemic does not exist ($\eta^2 = 0.001$). This means that there is no basis for accepting hypothesis H2a.

Based on the positively verified hypothesis H1a, it was possible to verify the change in the relationship between *employer brand attractiveness* and *project management methodology* during the *COVID-19 pandemic* as a moderator of the relationship. The testing of the moderation model was carried out using the additional tool "PROCESS macro for SPSS". Detailed data on moderation analysis are presented in table (Table 5).

Table 5.*Moderation analysis results for study no. 1*

SUMMARY OF THE MODERATION MODEL					
	R ²	F	df1	df2	p
INTERACTION OF VARIABLES <i>PROJECT MANAGEMENT METHODOLOGY</i> AND <i>COVID-19 PANDEMIC</i>	0.0012	0.7135	1.0000	548.0000	0.9870

Source: Sawicki, 2022.

The interaction effect of *project management methodology* and the *COVID-19 pandemic* is not statistically significant ($p = 0.3987$). This means that there is no basis for accepting hypothesis H3a.

3.6. Study 2 - impact of project management methodologies on the employee's perception of the employer brand attractiveness in times of a pandemic

3.7. Data gathering process and characteristics of the research sample

The study was conducted in April 2022. Respondents were active members of project teams and were invited to participate in the study by a link to the survey published on social media platforms (i.e. Facebook, and LinkedIn) as well as through direct requests.

The sample was selected using a non-random method. The selection was partly voluntary (link to the survey on social media) and partly purposive - people from the IT industry were asked to participate in the survey. The hypotheses were tested on a group of Polish employees from various industries. The sample consisted of 83 employees. Two of the respondents were excluded from the study because they stated that they were not or had not been members of the project team. Statistical analysis and demographic data are presented for the remaining respondents.

In the survey, the question about the age of respondents was a range question. The average age was 27.07 (SD = 8.9). 42 males and 32 females participated in the survey. Detailed info on the respondents' backgrounds is presented in table (Table 6).

Table 6.*Characteristics of sample group for study no. 2*

	sample	
	<i>N</i> = 81 n	%
age	< 25	22 27%
	25-40	59 73%
education	secondary	7 9%
	higher	74 91%
professional experience	< 2 years	5 6%
	2-5 years	56 69%
	6-10 years	12 15%
	> 10 years	8 10%
have experience working with ... methodology	traditional	43 53%
	agile	69 85%
	extreme/emertxe	5 6%

N – number of respondents after exclusion.

Source: Sawicki, 2022.

3.8. Overview of variables

Conducting the survey, each respondent was the source for 2 statistical observations. All respondents answered the same questions about the employer and the project they worked in before and during the outbreak of the COVID-19 pandemic.

The proposed hypotheses were verified using the following research variables:

- *project management methodology* - a nominal, three-value variable: traditional methodology, agile methodology, extreme/emertxe methodology; describes the method of project management to which a given statistical observation applies; this variable was indirectly measured by 12 items, each item was rated on a 5-point Likert scale; the value of the variable *project management methodology* was determined by comparing auxiliary variables: *the power of traditional methodology*, *the power of agile methodology*, and *the power of extreme / emertxe methodology* - the one with the highest value was then selected; each of the auxiliary variables was measured as the average of the items describing the characteristics of a given methodology and the declarative item (e.g., the project in which I participate is implemented in traditional methodology);
- *COVID-19 pandemic* - dichotomous variable with values *yes*, *no*; describes whether a given statistical observation expresses the respondent's opinion of working on a project before or during the outbreak of the COVID-19 pandemic;
- *overall impression* - this variable was designed to examine the employer brand attractiveness; it was constructed from five items in the form of quantitative variables reflecting general feelings about the organization in question, each item was rated on a 5-point Likert scale; the variable was constructed based on the literature analysis (Ployhart, Ryan, 1998; Schwoerer, Rosen, 1989);
- *employer brand values* - this variable was designed to examine the factors that influence perceptions of employer brand attractiveness; it was constructed from twenty-two items in the form of quantitative variables, each item was rated on a 5-point Likert scale; these items were selected based on a literature analysis (Berthon et al., 2005; Dabirian et al., 2019);
- *empowerment* - this variable was designed to examine aspects related to the process of psychological empowerment that affects perceptions of employer brand attractiveness; it was constructed from five items in the form of quantitative variables, each item was rated on a 5-point Likert scale;
- *employer brand attractiveness* - this variable was designed to measure employer brand attractiveness; it was built as an average of *overall impression*, *brand determinants* and *empowerment*.

3.9. Descriptive statistics and reliability analysis of scales

As a first step in a research process, the reliability of scales of each variable was verified. The values of Cronbach's alpha for the variables *power of traditional methodology* and *power of agile methodology* are high ($\alpha = 0.922$ and $\alpha = 0.917$).

Cronbach's Alpha for the variable *power of extreme/emertxe methodology* is low ($\alpha = 0.211$). It may be caused by item no. 3: *The project in which I participate is implemented in extreme/emertxe methodology*, in which respondents marked high values also when their project was implemented in the eXtreme programming paradigm, which is a representative of agile project management methodology.

It can be noted that the values of Cronbach's alpha for the variables *overall impression*, *employer brand values* and *empowerment* are high ($\alpha = 0.786$, $\alpha = 0.873$ and $\alpha = 0, 802$, respectively), which indicates high consistency and thus high reliability of the scales. Removing any of the component items for any of the two variables will not increase Cronbach's alpha coefficient. None of the items after deletion obtains a value of this statistic higher than without deletion. Similarly, the value of Cronbach's alpha for the research variable *employer brand attractiveness* is high ($\alpha = 0.827$). The summary of the reliability analysis of scales is presented in table (Table 7).

The normality test for the research variables was performed using the Kolmogorov-Smirnov and the Shapiro-Wilk tests.

Table 7.
Reliability analysis of scales for study no. 2

RELIABILITY ANALYSIS		
variable	Cronbach's alpha	number of items
THE POWER OF TRADITIONAL METHODOLOGY	0.922	6
THE POWER OF AGILE METHODOLOGY	0.917	7
THE POWER OF EXTREME/EMERTXE METHODOLOGY	0.211	6
OVERALL IMPRESSION	0.786	5
EMPLOYER BRAND VALUES	0.873	22
EMPOWERMENT	0.802	4
EMPLOYER BRAND ATTRACTIVENESS	0.827	3

Source: Sawicki, 2022.

3.10. Result of the research

In order to verify the relationship between *employer brand attractiveness* and *project management methodology*, a correlation analysis was performed using the eta squared measure. The result shows that the relationship is strong ($\eta^2 = 0.320$). This means that hypothesis H1b can be accepted.

In order to expand the study of the phenomenon, a regression analysis was also performed. This analysis was performed for the items 1 - *The project in which I participate is implemented in traditional methodology*, 2 - *The project in which I participate is implemented in agile methodology* and 3 - *The project in which I participate is implemented in extreme/emertxe*

methodology. The advantage of regression analysis over linear correlation is the ability to predict values. The results of the analysis are shown in table (Table 8).

Table 8.

Correlation analysis results for study no. 2

variable	R ²	β	N	p-value
1 - THE PROJECT IN WHICH I PARTICIPATE IS IMPLEMENTED IN TRADITIONAL METHODOLOGY	0.304	-0.556	162	<0.001
2 - THE PROJECT IN WHICH I PARTICIPATE IS IMPLEMENTED IN AGILE METHODOLOGY	0.193	0.445	162	<0.001
3 - THE PROJECT IN WHICH I PARTICIPATE IS IMPLEMENTED IN EXTREME/EMERTXE METHODOLOGY	0.030	0.189	162	0.16

N – number of observations, each respondent was source for 2 statistical observations (162 = 2 x 81).

Source: Sawicki, 2022.

The result of the regression analysis indicates that a causal relationship exists between the use of traditional methodology and employer brand attractiveness ($R^2 = 0.304$, $p < 0.001$). Moreover, the relationship is negative ($\beta = -0.556$). There is also a causal relationship between the use of the agile methodology and employer brand attractiveness ($R^2 = 0.194$, $p < 0.001$), however weaker. The relationship is positive ($\beta = 0.445$).

In order to verify the relationship between *employer brand attractiveness* and the *COVID-19 pandemic*, a correlation analysis was performed the eta squared measure. The obtained result shows that the relationship does not exist ($\eta^2 = 0.023$). This means that there is no basis for hypothesis H2b. Detailed data on the correlations can be found in table (Table 9).

Table 9.

Correlation analysis results for study no. 2

NON-LINEAR CORRELATION		
variable	EMPLOYER BRAND ATTRACTIVENESS	
PROJECT MANAGEMENT METHODOLOGY	η	0.566
	η ²	0.320
	N	162
COVID-19 PANDEMIC	η	0,151
	η ²	0,023
	N	162

N – number of observations, each respondent was source for 2 statistical observations (162 = 2 x 81).

Source: Sawicki, 2022.

Based on the positively verified hypothesis H1b, it was possible to verify the change in the relationship between *employer brand attractiveness* and *project management methodology* with the *COVID-19 pandemic* as a moderator of the relationship. Detailed data on moderation analysis are presented in table (Table 10).

Table 10.*Moderation analysis results for study no. 2*

SUMMARY OF THE MODERATION MODEL					
	R ²	F	df1	df2	p
INTERACTION OF VARIABLES <i>PROJECT MANAGEMENT METHODOLOGY</i> AND <i>COVID-19 PANDEMIC</i>	0.3611	6.6912	1.0000	158.0000	0.0106

Source: Sawicki, 2022.

It can be concluded that the interaction effect of the variables *project management methodology* and the *COVID-19 pandemic* in the employee group is statistically significant ($p = 0.0106 < 0.05$). In light of this, the variable *COVID-19 pandemic* is a moderator of the relationship between the previously described research variables in the case of current employees. This means that hypothesis H3b can be accepted.

4. Discussion

In an ever-changing world and dynamic environment, attracting new talent and maintaining existing employees can be challenging. A strong employer brand should be used as a primary tool to achieve these goals. It is worth putting substantial effort into communicating content and work culture, as they are determinants of the employer's brand attractiveness (Kalińska-Kula, Staniec, 2021). The conducted research shows that the attributes of the work processes (including PMMs used) can play important role in employer branding strategy.

As a result of the research, it was proven that there is a statistically significant relationship between the project management methodologies used and employer brand attractiveness. In addition, it was shown that there is a causal relationship between project management methodologies used with traditional characteristics and employer brand attractiveness. The fewer characteristics of traditional methodologies present in used project management methodology, the more attractive the employer brand is in the eyes of the employee. This is certainly an indicator for employers who want to retain highly qualified employees in their organization.

Study no. 2 showed no connection between the COVID-19 pandemic crisis and employer brand attractiveness. This means that employees' perceptions of the employer brand did not change due to the pandemic. This is rather a surprising finding given the literature study presented. Previously conducted studies show that the pandemic crisis affects the attractiveness of employers (Agencja MJCC, 2020). Furthermore, due to the COVID-19 pandemic employees think more deeply about their workplaces (Beilfuss, 2021; Hsu, 2021). However, although the change in the perception of the employer brand attractiveness was not demonstrated in the survey the research confirmed the moderating role of the COVID-19 pandemic on the

relationship between the employer's project management methodologies and perceptions of the employer brand attractiveness.

It has to be underlined that surprisingly the H3 hypothesis was only confirmed for a group of internal audiences of an employer brand. Upon closer inspection of the structure of the study no. 1 sample, one finds a simple explanation for this. All of the respondents were students, so it can be assumed that most of them did not yet have work experience, and certainly few of them had work experience related to their field of study. In view of this, the COVID-19 pandemic crisis could not have changed their perception of the employer brand.

5. Conclusions

The paper was devoted to analyzing the relationship between the applied project management methodologies and the perception of the employer brand attractiveness. The research was conducted on two groups of respondents: a specific group of job applicants (students) and employees. It has been shown that the crisis caused by the COVID-19 pandemic did not directly affect the perception of the employer brand attractiveness, but it is a moderator of the relationship between the applied project management methodologies and the attractiveness of the employer brand. However, although authors found basic relationship true for both groups of examined respondents, the moderating effect is valid only for group of employees.

The obtained results contribute to the practice of management, showing that among the various groups of factors determining the attractiveness of the employer brand, the attributes of the work processes (which include also the selection of project management methodology) are important as well. Organizations that apply agile project management methodologies can be more attractive to employees, especially in times of crisis and attract the more qualified specialists in the industry. Thus emphasizing the use of agile project management methodologies can be part of an employer branding strategy shaping.

However, the performed research has some limitations. As the research was conducted only in one business context (in Poland) and the analysis is based on a limited number of cases in particular groups, it should be treated rather as a pilot study. In order to generalize the results in future research larger samples should be collected. There is also space to search for factors explaining why and under what conditions the type of project management methodology affects the attractiveness of the employer brand.

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ONLINE FORMS AND SPREADSHEET AS MEANS TO SUPPORT THE ABCD METHOD

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Purpose: The main purpose of the study was to develop and demonstrate a concept enabling application of popular and commonly available online forms combined with a spreadsheet to support data collection and processing under the ABCD (Suzuki) method.

Design/methodology/approach: The factors which determine the various ways in which the method in question is applied were first identified, and then it was established which of them affected the manner in which the form to be filled by experts is designed. Different variants of the method were identified on such a basis. For individual variants, the possibility of using different types of questions was discussed by considering the features available in the most popular and free-of-charge solutions enabling online forms to be developed. Diverse data layouts were also identified to establish the frameworks in which data are represented in spreadsheet files. Solutions which make it possible to automatically produce the consolidated reports required for purposes of the ABCD method were identified for each of the data layouts originally defined.

Findings: When combined with a spreadsheet, popular online forms enable highly efficient data collection and processing with the ABCD method in use. Where the said method is applied according to the variant in which every cause is rated, an adequate data collection form can be created using both the online form solutions subject to analysis. If the method is applied according to the variant in which every rating must be used precisely once, developing a useful tool becomes significantly more complicated. Where this is the case, one can create a suitable form to validate the input data only by using the solution delivered by Google. Additionally, the layout of such a form must be reversed compared to the traditional form functioning under the ABCD method. Considering the diverse variants of the ABCD method linked with various kinds of questions used to build the form, 3 different layouts of the data collected by means of a spreadsheet were identified. With respect to each of them, one can devise a solution to ensure automated generation of the consolidated reports typical of the method in question.

Practical implications: The solution proposed in the paper can be applied in practice while using the ABCD (Suzuki) method.

Originality/value: The concept described in the paper is the author's signature solution.

Keywords: spreadsheet, quality management, data processing.

Category of the paper: Conceptual and technical paper.

1. Introduction

Functioning in the era of information, each contemporary organisation processes growing amounts of data in virtually every operational sphere. The increasingly complex and advanced integrated information systems, which are becoming more and more common, are greatly supportive to the implementation of information processes. Application of highly specialised tools which are continuously improving to support clearly defined and limited operational areas of organisations has also become common. Irrespective of the growing availability and popularity of such solutions, there are many cases in which data can be processed using conventional and widespread office tools, among which spreadsheets deserve special attention. Their high flexibility makes them suitable for both ongoing processing of the data set in disposal and for designing dedicated tools to automate such a processing operation. The literature on the subject provides numerous suggestions as to the way of using spreadsheets to support diverse operational areas in organisations. These include investment decision making, finance management, controlling, marketing analyses, sales planning, or pricing (Kusztelak, 2020; Winston, 2019; Próchnicki, 2012) as well as work time planning (Szczęśniak, 2010a; Zasadzień et al., 2017). Many of the solutions proposed also entail quality management. The literature refers to diverse concepts of using spreadsheets as means to support statistical process control (Knight, 2009; Szczęśniak, Molenda, 2013), nonconformity analysis (Szczęśniak, 2017), the ABC method (Szczęśniak, 2010b), work quality assessment (Szczęśniak, 2012), and service quality measurement by the SERVQUAL method (Szczęśniak, 2021). Also the ABCD method, also known as the Suzuki method, belongs to the quality management sphere. Known from the literature is a concept of using spreadsheets to support one of eight identified variants of this method (Szczęśniak, 2020). The solution in question is based on an assumption that a spreadsheet is used both to collect and to process data. However, what seems to be a more convenient data collection solution is using online forms, continuously growing in popularity, once they have been combined with a spreadsheet tool enabling the data previously acquired to be processed. The concept underlying such a comprehensive solution has been discussed further on in this paper.

2. Collecting data for the ABCD method using online forms

ABCD is a relatively straightforward method. It is aimed at defining the most relevant causes underlying a specific problem or phenomenon. The method is based on opinions obtained from experts familiar with the sphere being analysed. Step one of this approach

requires identification of the causes subject to assessment. Once they have been defined, a form is designed according to the general layout shown in Figure 1.

Cause	The rank of the cause					
	0	1	2	3	4	5
Cause_01						
Cause_02						
Cause_03						
...						
Cause_nn						

Figure 1. General form layout according to the ABCD method.

Using this form, each expert participating in the analysis provides their subjective assessment of the relevance of every cause by giving it a specific number of points. The points are assigned by crossing adequate fields in the form. Even though the method in question is really simple, one can come across its variants characterised by different ways in which experts evaluate causes. One of the factors which make them dissimilar is the rating system applied. It is not pre-defined in the literature, which is why there are different perspectives of this matter. The most popular assessment scheme is a ten-point rating scale (Łańcucki, 2003; Łuczak, 2007) where individual causes are assigned numbers ranging from 1 to 10. A six-point scale can also be encountered (Cholewa-Wójcik, 2014). Where it is applied, the relevance is assessed using integers ranging from 0 to 5. This is precisely the scale illustrated in the general form shown in Figure 1. Another differentiating factor is the manner of highlighting the causes of the lowest and highest relevance. Some concepts assume that the most relevant causes are indicated by assigning them the highest score, while low ratings indicate the least relevant ones (Miller, 2011). A reverse procedure is also proposed, where the lowest score is given to the most relevant causes (Łuczak, 2007).

The third and final factor differentiating the manner in which causes can be assessed by experts is the number of ratings which individual causes should receive while a form is filled by an individual expert. The first of the foregoing potential concepts assumes that each expert must rate each cause accordingly. Consequently, the number of ratings assigned in this case corresponds to the number of causes assessed. As per the second approach, an expert can use an individual rating exactly once. Where this is the case, some causes may remain unrated in a form being filled, while the total number of ratings assigned will equal the number of ratings envisaged in a given scale.

The first two of the aforementioned factors which determine the differences between the cause relevance assessment methods do not have any significant effect on how a data collection form is designed. Regardless of whether a six- or a ten-point scale is used, and if the lowest rating is assigned to a cause considered the most or the least relevant, the form layout will be very similar, differing only in terms of the set of available ratings to be used. Nevertheless, how a form is designed depends on the latter of the foregoing factors which determine the

difference between individual cause assessment procedures. Depending on whether or not the experts participating in the survey are expected to rate all or just a selected number of causes, what the form must surely contain is adequate questions. The approaches differentiated by considering the third factor are referred to as variant *a* and variant *b* of the ABCD method further on in this paper.

The most popular free-of-charge solutions used to create online forms are undoubtedly those provided by Microsoft and Google. The manner in which they can be used to develop forms for data collection for purposes of the ABCD method has been discussed below. These solutions, on the other hand, are referred to as variant *I* and variant *II* of online forms in this study.

Where variant *a* of the ABCD method is used, one should build a form in such a manner that assigning a rating to each of the identified causes is obligatory and verified. This can be achieved by means of many of the available diverse types of questions. Many of the analysed question types can accurately determine the set of available answers, and each of them can define whether providing answers within an entire question is optional or not.

In this respect, two options are available when a form is being built. Option *1* assumes that each cause is addressed in a separate question and is represented as the main phrase of this question. As per option *2*, all the causes are addressed in one question and are represented as the text of the consecutive components of this question. When building a form according to option *1* combined with variant *I* of the forms, one can pose type *choice* or *rating* questions. Where questions of the *choice* type are used, the available answers are displayed in vertical arrangement or, if the *dropdown* option has been additionally selected, they can be chosen from a drop-down list. Thus created, the form makes it possible to collect the assumed data, yet in terms of appearance, it varies considerably from the layout shown in Figure 1. A form with a layout similar to the foregoing would be created using questions of the *rating* type, where the available ratings are displayed horizontally arranged. With this question type in use, the rating scale must start with 1, and so in the case of a six-point scale, one must use ratings ranging from 1 to 6 instead of the 0-5 scale, as proposed in the literature on the subject. Where option *1* is combined with variant *II* of the forms, one can make use of the following question types: *multiple choice*, *checkboxes*, *dropdown*, or *linear scale*. Using the first three of the aforementioned question types triggers a deviation from the layout shown in Figure 1, similarly to the case where the *choice* type question is used under variant *I*. One can aim at higher conformity with the model pattern by using the *linear scale* type questions where – much like with the *rating* type questions – the available answers displayed are arranged horizontally. However, full conformity is not an option with both these question types, since consecutive answers are placed in separate paragraphs, and the available answers are to be found below them.

When a form is built according to option *2* combined with variant *I*, questions of the *Likert* type can be used. In the main phrase of this question, one should provide some general information about the survey; the identified causes should be displayed as successive *statement*

elements, while the available ratings – as successive *option* elements. If option 2 is combined with variant II, one of the available question types is *multiple-choice grid*. Where this is the case, the main phrase of the question should also contain the general information, the relevant causes should be provided using the *row* elements, and the ratings to choose from – using the *column* elements. Option 2 makes the form being created most similar to the layout shown in Figure 1. With either variant I or II in place, the successive causes are presented in a compact format, one below another, and the available ratings are displayed next to them, arranged horizontally. A disadvantage of this solution is the form’s reduced transparency in a case where cause descriptions are longer. Facing this problem, one can make the form more legible using option I, even though the layout departs from that depicted in Figure 1.

The data collected can be stored in a spreadsheet file. Where variant I is used, both under option I and 2, the data are entered in a table corresponding to the one shown in Figure 2.

	A	B	C	D	E	F	G	H	O
1	ID	Start time	Completion time	Email	Name	Cause_01	Cause_02	...	Cause_10
2	4	6.24.22 13:35:26	6.24.22 13:37:15	anonymous		0	1	...	2

Figure 2. Data layout in a spreadsheet for variant a I.

The table contains five technical columns as well as columns with ratings of individual causes. Headers of the rating columns match the main phrase of the questions formulated for option I or the content of the *statement* type elements for option 2. Where questions of the *choice* or *Likert* type are used, the collected ratings are stored in a text format, while they are stored in a numerical format if the *rating* type questions are asked. A table of almost identical layout contains the data acquired by applying variant II combined with option I. In this case, there is but a single technical column, and all the ratings are stored as numerical values.

If variant II is applied in combination with option 2, the data thus collected are stored in a table which matches the layout depicted in Figure 3.

	A	B	C	D	E
1	Timestamp	Main phrase [Cause_01]	Main phrase [Cause_02]	...	Main phrase [Cause_10]
2	25.06.2022 11:17	0	1	...	2

Figure 3. Data layout in a spreadsheet for variant a II and option 2.

This table features one technical column, while the remaining columns contain the ratings of individual causes. The header text in these columns represents a combination of the question’s main phrase and the text of the *row* type element to be found in square brackets.

Where variant *b* of the ABCD method is used, one should build a form in such a manner that, as the form is being filled, the action of rating exactly the number of causes which matches the number of available ratings in the scale applied is obligatory and verified, and that every rating has been assigned precisely once. On account of the fact that the validation mechanisms available in both the online form solutions analysed comprise only verification of the correctness of the answers provided against a single question, the only question types which can be used are those which assume that all causes are covered by a single question. With variant *I* in place, it is the *Likert* type question, while in variant *II* – the *multiple-choice grid* type question. It seems natural to make use of these questions similarly to the way in which they are used under variant *a* of the ABCD method, meaning that consecutive causes are presented in consecutive rows, and the available ratings are placed next to them in horizontal arrangement. However, it appears that the available validation options are insufficient in both cases to ensure complete correctness of the data collected for variant *b*. The only option for the *Likert* type question is *Required*, which assumes that it is possible to define optionality for the entire question. If this option has been chosen, the expert filling the form must assign ratings to all the causes stated in the form. If it is inactive, a form can actually be submitted even without any of them rated. Unfortunately, it is not possible to define a specific number of ratings which should be assigned. Neither is it possible to impose an obligation that each rating is used precisely once. The *multiple-choice grid* type question improves this situation only a little. Using the *Limit to one response per column* option, one can prevent each rating form being assigned multiple times. Unfortunately, the other option available in this case, i.e. *Require a response in each row*, actually makes it possible only to define optionality for the entire question. Analogically to the *Likert* type question, one cannot pre-set an exact number of ratings that must be assigned in this case. However, it should be noted that the options available for the *multiple-choice grid* type question make it possible to define form filling rules ensuring that correct data are obtained in a situation where causes and ratings have switched places in the form. Where this is the case, the *row* type elements correspond to consecutive ratings, while the *column* type elements are used to represent consecutive causes. In such a layout, activating the *Require a response in each row* option imposes the obligation to assign each rating, and where the *Limit to one response per column* option has been enabled, it becomes certain that no cause will be assigned to more than one rating. According to this approach, the data layout in the spreadsheet table matches Figure 4.

	A	B	C	D	E
1	Timestamp	Main phrase [0]	Main phrase [1]	...	Main phrase [5]
2	29/06/2022 09:17:46	Cause_09	Cause_08	...	Cause_05

Figure 4. Data layout in a spreadsheet for variant *b II*.

This table features one technical column of *Timestamp*, while the remaining columns provide references to the ratings being assigned. The header of each column within this range is composed of the question's main phrase and the rating provided in square brackets. The successive rows in a given column contain names of the causes assigned to a given rating by consecutive experts.

3. Spreadsheet-based data processing

Once data have been collected, the ABCD method assumes them to be presented in a consolidated report whose overall layout matches that shown in Figure 5.

Cause	The rank of the cause						Corrected sum	Number of undeleted responses	Rank indicator	Overall rank
	0	1	2	3	4	5				
Cause_01										
Cause_02										
Cause_03										
...										
Cause_nn										

Figure 5. General consolidated report layout according to the ABCD method.

In this report, information appears next to each cause to identify how many times a given rating has been given in the forms filled by experts. Next, a corrected sum of ratings is calculated. This sum disregards one bottom and one top rating. What the next column contains is the number of ratings summed up. A quotient of the pre-established sum of ratings and the number of ratings summed up is referred to a rank indicator. Based on the rank indicator, the overall rank of each cause is determined. The last step in the procedure involves compiling a report whose layout matches that shown in Figure 5, where all the causes are sequenced from the most to the least relevant ones, judging by the overall rank.

The assumption made for the data processing tool in question is that it contains three worksheets. The first one is worksheet *Data* where raw data are stored. Depending on the variants and options envisaged, the data layout in this worksheet is consistent with Figures 2, 3, or 4. What was also assumed is that data are manually copied from the master worksheet, generated automatically with reference to the form, to the tool's *Data* worksheet. Further worksheets are *Results* and *Results_O*, containing the consolidated reports whose layout matches that shown in Figure 5, the only difference being that the latter of these worksheets stores the causes arranged on the basis of the *Overall rank*. The layout of columns and the formulas they contain in worksheet *Results* for the input data in worksheet *Data* in a layout matching Figure 2 have all been provided in Figure 6. In this worksheet, formula *FAI* is used

to determine the number of ratings of all types which have been assigned. In the next step, table formula *FA2* in auxiliary column *C1* determines the maximum rating a given cause has received. A similar table formula of *FA3* in auxiliary column *C2* determines the minimum rating for each cause. Based on the number of individual ratings, as well as the minimum and maximum number, formula *FA4* calculates the corrected sum, while formula *FA5* calculates the number of undeleted answers for a given cause. Using these values, formula *FA6* calculates the *rank indicator* value. In the final step, formula *FA7* establishes the ranking of causes with reference to the *rank indicator*.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1		FA1 Rank							FA2	FA3	FA4	FA5	FA6	FA7		
2	Cause	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	2	5	0	0	0	0		0	1		4	5	0,80	8	
4	Cause_02	3	2	2	0	0	0		0	2		4	5	0,80	8	
5	Cause_03	4	1	2	0	0	0		0	2		3	5	0,60	10	
FA1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);B\$2);"")															
FA2	={=IF(\$A3<>"";MIN(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}															
FA3	={=IF(\$A3<>"";MAX(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}															
FA4	=IF(A3<>"";SUMPRODUCT(\$B\$2:\$G\$2;B3:G3)-I3-J3;"")															
FA5	=IF(A3<>"";SUM(B3:G3)-2;"")															
FA6	=IF(A3<>"";L3/M3;"")															
FA7	=IF(A3<>"";RANK(N3;\$N\$3:\$N\$32;0);"")															

Figure 6. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 2.

The mechanism which creates the sequenced report in worksheet *Results_O* can be exactly the same in this case as the one envisaged in the concept of using spreadsheets alone to support the ABCD method (Szczeńsiak, 2020), and it is not discussed in this article.

Where the input data layout is consistent with the arrangement shown in Figure 3, one must modify the formulas which determine the number of assigned ratings of a given type as well as the maximum and minimum rating. The formulas adjusted accordingly have been provided in Figure 7.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1		Rank														
2	Cause	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	2	5	0	0	0	0		0	1		4	5	0,80	8	
4	Cause_02	3	2	2	0	0	0		0	2		4	5	0,80	8	
5	Cause_03	4	1	2	0	0	0		0	2		3	5	0,60	10	

FB1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);B\$2);"")
FB2	{=IF(\$A3<>"";MIN(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}
FB3	{=IF(\$A3<>"";MAX(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}

Figure 7. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 3.

With regard to variant *b* of the ABCD method, the literature on the subject does not mention any particular procedure of data processing. Where this is the case, using an approach which would be fully consistent with the one defined for variant *a* may actually produce incorrect results. For instance, assuming that higher ratings in the scale of 0–5 denote more relevant causes, in the event that the assessment is conducted by 20 experts, if the cause designated as *Cause_01* is given the rating of 1 by every person, and that marked as *Cause_02* is rated 2 by three experts while all the remaining persons do not give it any rating, then a more preferable *rank indicator* value will be calculated for *Cause_02*. Although as many as 17 experts have decided that it does not even deserve to receive the rating of 0, it will still be recognised as more relevant. In order to eliminate this inconvenience, it was assumed that the fact that a given cause has not been assigned any rating by a given expert means that it is assigned a rating which denotes relevance lower than the lowest value envisaged in the rating scale applied. For instance, with the scale of 0–5 in place, where 0 indicates the least relevant cause, the lack of rating means that a rating of -1 has been assigned. Where 5 indicates the least relevant cause, no rating means that a given cause has been rated 6. With regard to the foregoing, the consolidated report will feature a scale that contains one rating more than the scale envisaged in the form provided to experts. The consolidated report’s layout along with the auxiliary columns and the formulas they contain has been depicted in Figure 8.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
1			FC2	FC1	Rank					FC3	FC4						
2	Cause	-1	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	6	1	0	0	0	0	0		-1	0		-5	5	-1,00	8	
4	Cause_02	6	0	1	0	0	0	0		-1	1		-5	5	-1,00	8	
5	Cause_03	7	0	0	0	0	0	0		-1	-1		-5	5	-1,00	8	
6	Cause_04	0	0	0	2	2	2	1		2	5		16	5	3,20	3	

FC1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(CONCAT("Main phrase [";C\$2;""]);Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);\$A3);""))
FC2	=IF(\$A3<>"";COUNTA(Data!\$A:\$A)-1-SUM(C3:H3);""))
FC3	=IF(\$A3<>"";MIN(IF(B3:H3>0;\$B\$2:\$H\$2;""));""))
FC4	=IF(\$A3<>"";MAX(IF(B3:H3>0;\$B\$2:\$H\$2;""));""))

Figure 8. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 4.

Formula *FC1* determines the number of individual ratings assigned to a given cause by experts. Formula *FC2* calculates how many experts have not rated a given cause at all. This value represents the number of additional ratings exceeding the scale provided to the experts and assigned to a given cause. Table formulas *FC3* and *FC4* determine the lowest and the highest rating assigned to a given cause, respectively. Found in the remaining columns, the values of the adjusted sum, the number of the ratings taken into account, the rank indicator, and the established position are determined using formulas matching those provided in Figure 6.

4. Conclusions

The solutions proposed in the paper imply that, when combined with a spreadsheet, popular online forms enable highly efficient data collection and processing with the ABCD method in use. There are several variants to the method that one can identify. The factors which make them different from one another are the range of the scale in use, the manner in which the most and the least relevant causes are established, as well as whether experts are assumed to rate all or just a number of causes they choose. Only the latter of the differentiating factors has a significant effect on how a data collection form is built. In terms of the potential for creating such a form, two most popular free-of-charge solutions, i.e. those provided by Microsoft and Google, have been analysed. In the event that one has applied the method's variant assuming that ratings are assigned to all the identified causes, both solutions make it possible to create forms which enable collection of correct data. When using the variant in which every rating must be used exactly once, a form which provides correct data can only be generated by means of Google's solution. Moreover, the layout of this form must be reversed compared to a standard general form used under the ABCD method. For the diverse variants of the ABCD method

linked with various kinds of questions used to build the form, 3 different data layouts have been identified, enabling the data one has obtained to be collected in a spreadsheet. With respect to each of these layouts, the paper provides solutions ensuring automated generation of the consolidated reports typical of the method in question. The solutions devised by the author make use of only standard built-in spreadsheet features, and they require no code to be developed in any programming language. Currently, the presented solution is of a conceptual nature. Further research will include the possibility of its use to support specific cases of the application of the ABCD method.

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NETWORK OF TRUST RELATIONSHIPS IN THE REMOTE WORK MODEL

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Purpose: The article aimed to identify differences in the density of the trust network of team members in different work models (on-site, hybrid, and remote) and to identify opportunities for building knowledge and innovation in such work models based on the trust there. The method of experiment and a social networks analysis (SNA) was used to achieve the goal.

Design/methodology/approach: The research is based on an experiment as part of a strategic business simulation game. The participants of the investigation are MBA students. The variable in the experiment is the work model. In these three different situations, relationships developed in teams are identified. Based on the identified relationships, visualizations of the trust network were built.

Findings: The research confirmed that the hybrid and remote work models minimize the number of trust ties between team members. The network of trust based on the identified relationships is less dense. The decline in confidence leads to the conclusion that a company's innovation and ability to generate new knowledge are now under threat based only on group resources.

Research limitations/implications: Research is based on an experiment. The group subjected to the investigation is MBA students. The limited duration of the experiment may limit the formation of networks of trust (based on long-term, deep relationships). See also a summary.

Practical implications: The results indicate apparent differences in the density of trust relations between the organization's participants in the three analyzed work models. This points directly to the need to adjust tools supporting the development of innovation and knowledge creation for remote work models, different from those known from traditional (on-site) work models.

Originality/value: The study shows that trust relationships, e are more challenging to achieve in remote working conditions than in traditional work models. It gives managers guidelines on what tools (such as SNA) they can use to identify relationships between people in new work models.

Keywords: social networks analysis, trust networks, work models.

Category of the paper: Research paper.

1. Introduction

The economy that we know more and more often develops based on the flow of information and knowledge, resulting in increased innovation. The exchange of thoughts and experiences in the teams dynamically took place, mainly through the excellent organization of the cooperating groups. Of course, the organizations were working on new forms of this cooperation, including remote forms of work, but no one expected such a rapid breakthrough.

The outbreak of the COVID-19 pandemic resulted in an unprecedented development of methods supporting remote work. The need to change the model of daily work does not seem to be a temporary situation. Many changes resulting from the need to adapt to the COVID-19 pandemic quickly will remain with us and become the new standard. Within a few weeks, we had to change our operating methods, and now we have started to recognize the advantages and disadvantages of a new way of working.

Both managers and employees increasingly admit that there is no going back to previous operating models. The new remote-driven digital business models will be much more complex. Thus, the traditional tools and methods used to analyze these complex and dynamically changing data systems no longer meet the performance and maximum coverage requirements. The amount of data collected is increasing—additionally, their complexity increases. Moreover, the relational nature of a large amount of data, such as informal employment relationships, requires appropriate research methods.

Managers currently do not have the possibility of direct observation of their colleagues. They have almost no options for detecting undesirable trends in the existing practical cooperation, exchanging ideas, and building innovative solutions. More importantly, they don't know the most pressing issues to resolve. This research is intended to indicate, to some extent, the possibility of filling this gap.

Tools used in social network analysis, including network visualization, can be a response to emerging changes. It seems that SNA makes it possible to observe dependencies between employees in the remote work model, which can intuitively reflect the differences between the formation of relationships for the three approaches explored in the experiment.

2. Identification of the relationships of the participants in the experiment

2.1. Social Networks Analysis context

Managerial SNA, or Organizational Network Analysis (ONA), connects both networks and visualizations and could provide a solution to this vulnerability. Although it has been a proven human analytics tool for almost 30 years, the level of use is still relatively low (Kutlik, 2019).

Nevertheless, due to new ways of working, changing business requirements, and the constant advancement of technology, interest in SNA is proliferating. The leaders of human analytics indicated this analytical technique as the one they most wanted to know more about (Green, 2018). This is confirmed by recent research results that show that adopting different data sources and different analytical solutions (such as SNA) allows organizations to perform more sophisticated but more efficient analyzes (Visier, 2020).

Social network analysis is a method used in management research to gain insight into the informal organizational practices of employees. Social networks of interest to modern scientists exist both at the organizational level (Gulati et al., 2017) and between organizations (Baker, Faulkner, 2017). Network research helps to explain the essence of social phenomena, from individual creativity to the profitability of enterprises (Borgatti et al., 2009). Social networks understood as organizational networks, create relationships between actors (employees), shaping the everyday work environment. The areas of network analysis, indicated by Borgatti and Halgin (Borgatti, Halgin, 2013), are used to understand labor productivity (Sparrowe et al., 2001), trade (Kilduff, Krackhardt, 1994), promotion (Burt, 1992), project management (Pyrke, 2012), innovation (Obstfeld, 2005), creativity (Burt, 2004) and even unethical behavior (Brass et al., 1998). It is also widely accepted that SNA can be very beneficial in solving various managerial problems depending on the context (Polyakova et al., 2019; Shum et al., 2011; Cross et al., 2009). Moreover, in business consulting, network analyses are diagnostic tools that guide improvement activities (Anklam, 2007; Wasserman, Faust, 1994; Cross et al., 2002).

Taking into account that the network must contain both entities and relations, it is necessary to adopt a definition of the network based on the assumption that the (social) network is a structure of relations or variable relations between actors, also understood as participants in the organization (Wawrzynek, 2015). The adopted definition is consistent with the description given by Lewis (Lewis, 2009). The network defined in this way refers to a specific set of actors $\{1 \dots n\}$ and variables (relations) X_{ij} , indicating the relationship between the actor and the actor j . Due to the existence of two types of network (directed or undirected), the dependencies X_{ij} mentioned in the definition of the network may differ. If the relationship X_{ij} is a directed relationship, it means that X_{ij} is a different relationship than X_{ji} , although they involve the same two actors. In non-target networks, the relationships X_{ij} and X_{ji} will indicate the same relationship. In an organization, relations may describe the network depending on the characteristics of the analyzed relations. Referring to the general principles of the company's operation, one can assume the existence of processes, but also those assigned to those network processes, which are characterized by activity in the field of communication, information propagation, problem-solving, knowledge building, or its distribution.

A social network is a reflection of social relationships. It arises as a result of transforming the respondents' responses in the context of the studied context (communication, cooperation, trust, etc.). As a result of transformations, various networks are built specific to selected research issues and selected areas of the organization (in this case, processes). Social networks

can be targeted or not, can be based on relationships or binary values. Some of them are subject to reversal (Borgatti, Foster, 2003). The method of building social networking sites and issues related to social networking sites are presented in Table 1.

Table 1.
Social networks descriptions

Network Name	Description
Cooperation Network	Presents the relationships arising from cooperation relationships in terms of achieving results, efficiency (doability in the sense of decision-making and agency), as well as the strength of influence of individual people
Communication Network	Presents the connections resulting from the communication of actors in the network along with the occurrence of deeper and lasting relationships based on understanding and trust. It applies to both simple and complex messages
Information Network	Presents connections in relation to informal information about the organization. The structure of informal information circulation helps to explain seemingly incomprehensible phenomena, including negative ones
Knowledge Network	Presents the flow of knowledge acquired in the network from people who are their source
Innovation Network	Presents the connections of innovation and inspiration when creating new ideas and building openness or positive energy in the process of opening up to new solutions
Trust Network	A network of strong social relationships that shape trust, rapport and positive energy, and thus a sense of security, affects the effective use of potential by employees

Source: Authors' own work.

2.2. Network visualizations

One of the possibilities of social network analysis is based on its visualization. The two primary goals of web visualizations are data mining and the transfer of results (Borgatti, Foster, 2003). Therefore, the network visualization should display relevant information from an analytical perspective. It should be mentioned that there are many ways to construct a visualization and a lot of space for designing network visualization algorithms. Web visualizations enable the presentation of otherwise unattainable knowledge. Among the numerous forms of graphic representations of the network are various types of sets, tree maps, and matrices (Welles, Xu, 2018; Alsallakh et al., 2014). The most recent research-oriented reviews can be found, for example, in the works of Munzner (Munzner, 2014) or Grant (Grant, 2018). Nevertheless, the most commonly used network visualizations are node-link diagrams, especially those whose layout is based on an analogy to physical forces between nodes - force-oriented graphs (Okoe, 2018). Their meaning is usually clear and, to some extent, intuitive, even for a person unfamiliar with SNA. In their most basic form, they are designed for general data mining. However, effectively designing a network analysis visualization requires incorporating certain key concepts or network properties to understand better and then draw conclusions on the topic (Borgatti et al., 2018). The presentation of the relationships identified during the experiment will be the basis for inferring the existence of a network of trust in individual approaches to the implementation of the work model.

2.3. Top Team business game experiment

The research is based on a computer-simulated business game. It allows you to observe people's reactions to specific situations and business events. The formula of the experiment is based on an approach in which the primary source of information is people with their knowledge, behavior, and points of view. The context of the experiment is a game in which teams of participants compete against each other in a virtual market to ensure the best competitive position and maximize the company's value. Changes in the simulated market result from the scenario. The scenario, therefore, forces the participants to adapt their strategies and tactics quickly, suggesting the need to combine the forces of individual teams to achieve the best results in the game. The game takes place in a hypothetical future-oriented technology market that creates a business decision context other than that experienced by participants in their professional experiences. The game is iterative and consists of quarterly periods.

In every quarter there are several actions that companies must take—decisions related to investments in technology, distribution channels, or systems that improve organizational development. When the organization's development reaches a certain level, and the markets are increasing, the moment of decision comes. Teams can start cooperating with other groups in the competition model. This cooperation may be based on the operational, production, and technological levels or on sharing distribution channels. It may also be related to tactical cooperation in given markets or offering complementary products.

As a result of the undertaken cooperation, both within the team and between teams, extensive social networks are created based on the emerging relationships between participants. Despite their short duration, they are strongly felt by the participants due to the emotions caused by intense competition.

As part of the experiment, three similar simulations were carried out: the first in June 2019, the second in June 2020, and the third in October 2020. The work model was the independent variable in the simulation. Each complete simulation lasted three days and involved participants for approximately 18 hours. After about ten hours of play, the increasing complexity of the simulated companies naturally stimulated various forms of cooperation between companies.

This has led to the creation of diverse relationships between participants, allowing them to enter into various forms of business collaboration leading to new solutions and business models. These relationships represent various social networks that can be critical in shaping new and efficient digital business models. Understanding the key characteristics of these inter-organizational networks can therefore help managers reposition their teams across business networks to achieve the desired digital business models.

2.4. Data collection

A specific data collection procedure must be carried out to present a network of relations. Network data is more challenging to collect and takes more time to manage than other social science data (Borgatti et al., 2014). There are two approaches to collecting network data. The first is based on the declarative definition of relationships with other people. This method is traditional and often used in social and organizational networks (Monge, Contractor, 2003). It gives a high accuracy of the obtained mapping of relations significant from the point of view of the conducted research. It is characterized by the fact that the networks obtained based on the data collected in this way are exact.

There is, to be sure, a second option based on the observations of the actors' behavior. It could work if we were talking about analyzing the network of contacts, but in exploring the web of trust, such a possibility has no grounds to apply. The researcher's lack of knowledge about the interactions between the actors and the limited options for interpreting the obtained data are among the disadvantages of this approach (Wasserman, Faust, 1994).

Therefore, the experiment used the method of collecting data based on questionnaires. They were put into the context of the conducted research. The disadvantage of this approach is the large amount of work involved in the preparation and process of data collection, inadequate response of the questionnaires, subjectivism, different interpretations of the same question by different people, or possible concealment or other manipulation of data by respondents. To prevent this, it was previously agreed with the participants that such a study would be conducted. The questions (cognitive content) were discussed with them, and the ambiguities were explained together.

To analyze how managers perceive and understand social networks in making business decisions, after 15 hours of simulation as part of the experiment, each participant received a link to a survey in which the questions related to the existence of the relationship. Of course, the questions are arranged so that the entire dependence resulting from their interpretation is reflected in the possibility of confirming the presence or absence of the analyzed relationship (in our case, the relationship of trust between individual participants of the experiment).

To ensure a high response rate, a key factor for properly conducted social network analysis research, we have offered special "market" bonuses that unlock access to interesting business opportunities in the game. The study provided 1,789 indications of network relationships for the office work model before COVID-19, 2,185 for the remote work model after COVID-19, and 1,273 for the office work model after COVID-19.

Referring to the study presented in the article, one should remember the limitations. The one is the limitation resulting from the research method. Limitations of lab-based experimental work have been noticed in literature, e.g., supporting decision-making areas (MacGeorge et al., 2016). They are mostly connected with recruiting subjects who are entirely unacquainted with the issue (lack of domain knowledge) and who form random groups, which

was not the case in our scenario (the subjects were MBA students). Although this criticism is partially justifiable, research has shown that such experiments' results contribute to improving real-life decisions and interventions, which is why this technique is often recommended in publications (Sunstein, Hastie, 2014). For management practitioners, the lessons learned involve incorporating social network analysis visualizations and trying to infer their companies' most urgent troubles, which can increase the chance of successfully progressing in the digital transformation process.

3. Trust networks in various work models - results

The conducted experiment and the data collected during the experiment on the existence of relations between the participants were first analyzed in terms of various networks. As part of the analyzed results, only the relationships constituting the trust networks were examined—trust networks which, in its assumption, may significantly differ due to the work model. Additionally, networks of trust are the ones responsible for building an atmosphere for innovation development (Nahapiet, Ghoshal, 1998; Adler, Kwon, 2002; Moran, 2005).

With regard to the cited method of data analysis, the results of the three groups were compared, and differentiated from the model in which activities related to the competitor were carried out in the market simulated by the computer. The following three figures refer to the on-site work model, hybrid model, and remote work model.

3.1. Onsite Work model visualization (a)

Graphical analysis of the social network based on the trust relationship between the participants in the Onsite work model shows the existence of connections, including indirect ones, between all network participants. There are relationships among the people cooperating in the team, as well as relationships between competing teams. The network trusts are relatively high-density, and there are no single-character gaps between connections. Naturally, more relationships exist between people within a team than between individuals from different groups. In the figure below, the circles represent individuals. Their color is associated with belonging to a team, and their size results from their trust in other participants. The links between the circles reflect the trust relationships that bind them, resulting from the indications.

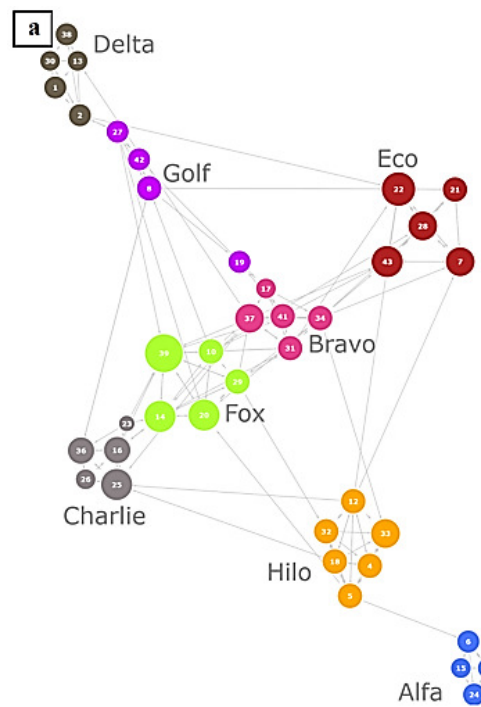


Figure 1. Office Work Model (OWM) – Trust between teams and individuals.

Source: Author's own work.

3.2. Hybrid Work model visualization (b)

The hybrid model indicates a significantly smaller number of trust relationships between participants. The density of relations between participants in individual teams is not low. There is one situation in which there is no relationship between one of the teams and the others (the team marked Golf has no relationship of trust with any of the other teams' participants). However, a detailed analysis shows a clearly more significant variation in the size of knots (circles) within the assemblies compared to the situation described previously. As in the previous visualization, the principles of using colors and the circles' sizes and connections are the same.

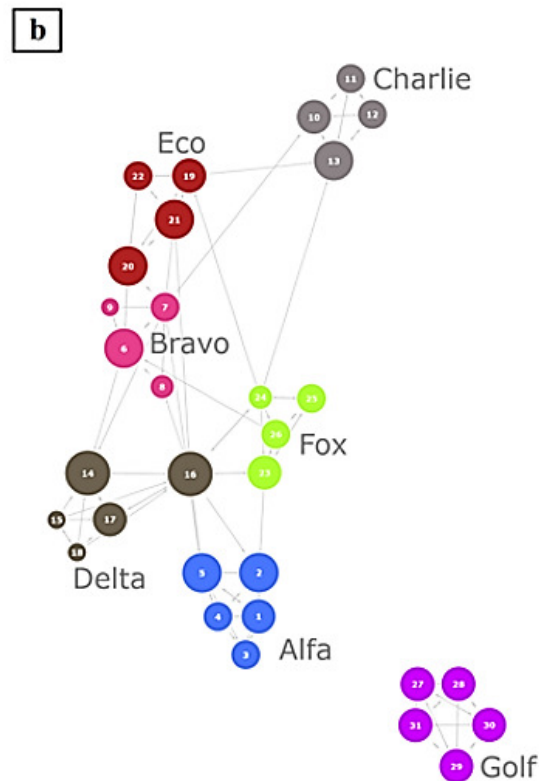


Figure 2. Hybrid Work Model (HWM) – Trust between teams and individuals.

Source: Author's own work.

3.3. Remote Work model visualization (c)

Working in the model indicates a relatively high level of relationship between the participants inside the teams. It could be assumed, based on the indicated visualizations, that the level of density is compared to the situation identified in the on-site work model. The problem is entirely different in the case of the relationship between participants from different teams. There are several teams that have no ties to others (Alfa, Bravo+Delta, Golf). As in the previous visualization, the principles of using colors and the circles' sizes and connections are the same.

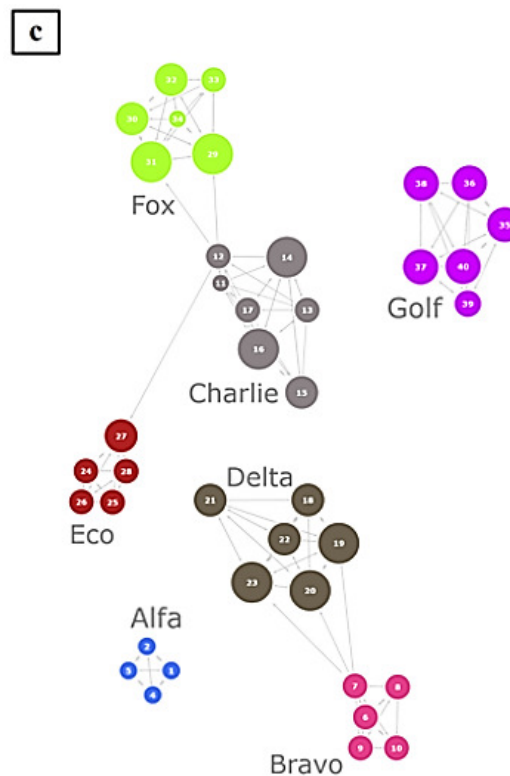


Figure 3. Remote Work Model (RWM) – Trust between teams and individuals.

Source: Author's own work.

4. From the relationship of trust to new possibilities for building knowledge

Coming to the indicated situation of the existence of a lower level of density of trust relationships, which have so far been responsible for the possibility of building new knowledge based on innovation, it is necessary to consider what other options for making knowledge will be available in the new work model (hybrid or remote). The question of the flow of knowledge between groups has been analyzed for a long time (Hansen, 1999). It indicates that necessary knowledge that builds innovation is transferred between groups based on solid relationships. However, this state of affairs does not ever apply to the relationship of trust in new teamwork; the survey research has already taken up the possibility of building new knowledge or innovation without solid relationships. Burt R.S. (1992) conducted exciting research in this area. A few years before Hansen, he formulated the problem of optimizing the intensity of group relations. He derived the theory of the structural hole, in which he proved that social value could be built based on minimizing the number of relationships. This theory applies to magnets (an actor's networks) and the relationship pattern in at least two unconnected social networks. Burt assumes a structural gap (gap) between two independent, unrelated groups. Such

a defined structural gap may occur in the organization between individual, uncoordinated areas and, at the process level, between individual tasks. The network participant who becomes the intermediary is of more importance in such a system.

There is no doubt that the existence of a lower-density network of trust is a fact. The question is whether it results only from the transition from the previous, traditional model of on-site work to the new one, which has not yet developed mechanisms of building trust relations at a similar level as in the conventional model, or whether such a density of trust networks in the new work model will not be achieved. If we assume that the new model will not be a copy of the traditional model from the point of view of network density, then we can see a chance in the new system of relationship formation.

The new system of relationships that can be identified in an organization operating in a remote or hybrid work model may be based on people important from the point of view of the network structure. It is essential because they will play a key role and will take on the burden of maintaining relationships that have hitherto been scattered among many different people.

Of course, we cannot talk about a new mechanism of creating innovation based on the one strong relationship of one of the participants in the network because the invention is defined more broadly and results not only from knowledge but also from the feeling of the possibility of developing it, looking for a new idea or the opportunity of discussing it favorably with people geared to its originator.

The challenge for managers who want to support innovation development within their organizations will not only be to understand the new mechanism of the possibility of building innovation in different ways than traditional work models. Above all, it will be a challenge to find new tools to support them. The mere understanding by the managers that we operate differently today does not give them additional mechanisms to support employees. It seems, therefore, that identifying and visualizing social networks that reflect relations between employees may be a good direction for looking for answers about tools for managers in the new work model layout.

Of course, the tools of network identification and visualization of relations provide the possibility of replacing the observation of people in their daily activities, but they will not replace the processes of supporting the construction of innovation and new knowledge, which cannot be replaced by the mere identification and visualization of relations. Therefore, it is important to identify trust relationships, but you should also constantly monitor the relationship between whether trust in new work models plays such an important role as before.

5. Summary

The postulated economic development is often based on innovation. So far, an element of action has been the flow of information and knowledge through the cooperation of closely cooperating people. However, the pandemic outbreak meant that the work model known for many years would no longer be the only one. Moreover, it can become only a secondary way of getting the job done, not only because of necessity but also because we see its advantages.

The complexity of new business models increases due to the shift in the approach to work performance towards moving away from the on-site work model. Managers no longer have the possibility of direct observation of employees; they cease understanding the group relations that arise between them. They do not see undesirable situations and problems arising on this basis.

The second important issue is that the previous innovation development was based on communicated and discussed ideas. Such communication of ideas was possible only in a situation of trust that the transferred ideas were not [the basis for a negative evaluation or were not appropriated. In the new model of work, perhaps not the high level of trust of all people in the team, but the trust of selected people from one group to chosen people from other areas of the organization may constitute a bridge for exchanging ideas and building innovative solutions.

Both these issues seem to be linked by the SNA, which on the one hand, collects this information. On the other hand, it allows for their research based on visualization. It responds to the need to understand what happens in geographically distant teams (working in remote or hybrid work models). The visualization of the network shows the possible paths of transition between groups based on selected employees who trust each other and as representatives of separate groups.

5.1. Limitations and future research

The first limitation is that market simulation simplifies the emergence and existence of competition and cooperation interactions, potentially influencing the social network structure. The second limitation is related to the inherent nature of the simulation, which obfuscates keeping the same conditions for all three cases. For instance, participants are different. However, even having the same set of people each time would hinder the hypothetical outcomes because after the first game, all people would know how to act during the simulation and the apparent bias appears. Finally, the third limitation is the use of only three simulations compared between one another, which do not provide the possibility of multiple verifications of the research method, the collected results, and conclusions.

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COVID-19: PANDEMIC MANAGEMENT IN DIFFERENT PARTS OF INDIA

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Purpose: Managing a pandemic in individual countries is a concern not only of governments but also of WHO and the entire international community. The pandemic knows no bounds. In this context, India is a special country - with a huge population and a very large diversity of cultural, geographic, economic, poverty levels, and pandemic management methods. In this work, we try to assess the sum of the impact of these factors on the state of the epidemic by creating a ranking of Indian states from the least to the most endangered.

Design/methodology/approach: As a method of creating such a ranking, we take into account two very, in our opinion, objective variables - the number of deaths and the number of vaccinations per million inhabitants of the region. In order not to make the usually controversial ascribing of weights to these factors, we relate them to the selected reference region - here to the capital city - Delhi. We apply a logical principle - the more vaccinations, the better and the more deaths - the worse.

Findings: The results are rather surprising. Many small regions are safe regions, such as Andaman, Tripura or Sikkim, many large or wealthy states are at the end of this ranking, such as Delhi, Maharashtra, Uttar Pradesh, Bihar, and Tamil Nadu.

What was found in the course of the work? This will refer to analysis, discussion, or results.

Originality/value: The method enables an indirect assessment of the quality of pandemic management in a given region of the country. It can be used for any country or even a group of countries or a continent. According to this criterion, the best state/region is intuitively the safest for residents. A small number of deaths and a large number of vaccinations may positively indicate the state of public health and good management of the fight against the pandemic by local and/or central authorities.

Keywords: Keywords: COVID-19, pandemics, computational intelligence, healthcare, pandemic management.

Category of the paper: research paper, case study.

Introduction

India, being one of the most populous country in the world, has experienced several epidemics over time. Several accounts of flu, cholera, dengue, smallpox, and many others can be found recorded throughout history. While the Indian health-care was able to eliminate some, many diseases continue to be a threat to Indian-society. Unusual health-emergencies in India are rare but many articles point to the causes for usual health-emergencies in developing countries such as malnutrition, poor sanitation, and the lack of a proper public health system (Murhekar, 2009; Swetha, 2019). Pandemic is an outbreak of a sudden, serious illness in different parts of world that already exists in some specific countries. It is shown in the literature that there is a link between pandemic and natural disasters and confirms that there is an increasing number of post-disaster epidemics even though events in India have not been emphasized. Pandemic symptoms are similar to common health problems that need to be organized properly in the interest of human beings (Watson, 2007).

An epidemic occurs when another new or evolved type of virus emerges, which is resistant to existing available medications and hence, the danger posed by them to human society is unthinkable. It, therefore, brings deadly diseases worldwide with high mortality and dreariness ((Nongkynrih, 2004). There are a number of infectious diseases that have caused worldwide epidemics in the past, some of them are Flu, Spanish Flu, Asian Fever and Hong Kong Flu spread in the in the year 1918, 1957 and 1968 respectively (Kumar, Sharma, 2013). Some notable examples of the emergence of highly-viral infectious diseases are flu virus swine-origin (A/H1N1) (Brookes, Khan, 2005), the Severe Acute Respiratory Syndrome (SARS) virus from the previous epidemic reported in 2003 in southern China and the Middle East Respiratory Syndrome coronavirus (MERS-CoV) reported in middle-east in 2012.

The SARS virus and the COVID-19 virus are genetically, almost, the same type but the disease and mortality rate caused by both are different (Shereen, 2020). India filed its first case on May 13, 2003. Majority of the cases declared in this way were travel-related cases and spread was among those taking trips to India from influential countries (Boulos, Geraghty, 2020). In the following we present a quick survey of some key references that present relevant studies conducted in relation to the Indian COVID-19 pandemic scenario.

Novel Corona virus is a new and challenging virus of our time. It is so extensively and globally spread today that it is very difficult to know the direct distribution of COVID-19 in different parts of the world. Day by day the cases are still increasing, therefore, it becomes necessary to take this disease seriously (worldometers.info; who.int). The World Health Organization (WHO) reports (WHO, 2021) that the virus mainly affects a subset of people with low immunity, diabetes, high blood pressure, aging, and lung-related medical problems (Vashisht, Prakash, 2020). Because of COVID-19 millions of people are forced-confined to their own homes and the world economy has been declining. COVID-19 is a highly

contagious disease and its spread is unpredictable. There are cases where a person has not been in direct contact with an infected person or has no history of travel, yet carrying the COVID-19. The prediction of the rate of growth of the novel corona virus has been discussed in (Jamwal et al., 2019; Vashisht et al., 2020) and the epidemiology and status of COVID-19 in different parts of India has been considered in (Kumar et al., 2020; Khan et al., 2020; Chowdhur, Oommen, 2020). The socio-economic implications of the coronavirus and COVID-19 pandemic in several countries from different aspects like effect on tourism etc., has been discussed in (Nicola et al., 2020; Senbeto et al., 2020). Lockdown has been the only containment tool of the public-health managing bodies to control the spread of COVID-19. Initially, twenty one days lockdown was imposed in INDIA and it's effect has been elaborated in (Sardar et al., 2020). Artificial Intelligence (AI) - based systems are preferred in urban health monitoring (Allam, Jones, 2020) and hence, AI applications were used in abundance for COVID-19 pandemic management (Vaishya et al., 2020).

In order to manage (contain the spread and prevent the death) the pandemic in India, the assessment and prediction of new active COVID-19 cases is very much required so that proper medical facilities be provided and administrative measures like lockdown, night curfew etc. can be planned effectively. Therefore, mathematical modelling of the spread of COVID-19 was required which is also studied in (Bhatnagar, 2020a; Arti, Bhatnagar, 2020; Roy, Bhattacharya, 2020; Sinha, Klahn, 2020; Banerjee, 2020; Koczkodaj et al., 2020, Mazurek, Nenickova, 2020; Mazurek et al., 2020, Wilinski, 2021; Wilinski, Szwarc, 2021; Shereen et al., 2020; Wilinski et al., 2022). Initially, there were only limited testing kits were available and number of patients were very high. Considering this some work with limited medical facility has been proposed in (Bhatnagar et al., 2020). Signal processing based analysis, specifically statistical modelling, relay based study of COVID-19 has been discussed in (Bhatnagar, 2020b; Bhatia, Mitra, 2020; Arti 2020). The aspect of uneven territorial distribution in terms of post-COVID-19 deaths is presented in (Arti, Wilinski, 2021). Most of the discussed problems used data located e.g. in sources such as (CSSE (2021); Worldometers (2021); EconomicsHelp (2021); WorldPop (2021); Gisanddata (2021); Statista (2021).

The aim of this article is to present a certain criterion regarding the severity and consequences of the COVID-19 pandemic by considering two factors - the number of deaths and the number of vaccinations.

The authors intend to use these data to show differences between administrative units of a given country in terms of the severity of a pandemic, on the one hand, and the intensity of remedial measures, on the other. This may help various states manage a pandemic nationwide by reducing regional contrasts. An example considered in the study is India, a diverse country, divided into 36 states.

The method

It is assumed that the assessment of the effectiveness of pandemic management in a given state is influenced by two factors - the number of deaths per million inhabitants and the number of complete vaccinations performed also per million inhabitants. The first effect is assumed to be negative, the second as positive. This is a simple assumption that can be discussed, for example, in terms of the strength of impact on public health in the region. In this work, the equal weight of both factors is assumed.

Let us define:

$$S(i, t) = (P(i, t), D(i, t), V(i, t)); i = 1, 2, \dots, N, t = 1, 2, \dots, T \quad (1)$$

This means the time series of health assessment (one of the many components of this assessment related to the pandemic) - for the i -state and on-the-day t since the beginning of the pandemic.

For day $t = 1$, the authors assume the beginning of pandemic index quotations (Confirmed Cases, Deaths, and Recovered) conducted for the whole world by WHO and the CSSE Institute of John Hopkins University in Baltimore, USA (gisanddata.maps.arcgis.com). This day $t_c = 1$ is January 22, 2020.

Later in the article, the authors abandon the notation (1), replacing it with a simpler one, devoid of t indices, assuming that the calculated ones are carried out for an unequivocally determined pandemic day t_c . In this paper, the first calculations were made for $t_c = 574$ on (18 Aug. 2021).

Therefore, hereinafter:

$$S_i = (P_i, D_i, V_i), i = 1, 2, \dots, N \quad (2)$$

where:

P_i - population vector in particular regions (states) of India.

D_i - vector of the number of deaths in each i -th state on day t_c .

V_i - vector of the number of vaccinations in each i -th state on day t_c .

The study considers the administrative division into 36 states presented in alphabetical order in Table 1. The table contains the following columns: names of states, number of inhabitants in thousands, number of deaths since the beginning of the pandemic, and number of vaccinations (the second or last dose in thousands).

Table 1.

Basic data for the calculation of the state threat indicator as at $t_c = 574$ (18 Aug 2021). Population in mln, Vaccination in thousand, deaths without a multiplier

No.	State	Population	Deaths	Vaccines
1	Andaman and Nicobar	0.417	129	98
2	Andhra Pradesh	53.903	13715	6653
3	Arunachal Pradesh	1.57	257	204
4	Assam	35.607	5566	2582
5	Bihar	124.8	9649	5016
6	Chandigarh	1.158	812	256
7	Chhattisgarh	14.0	13552	2895
8	Dadra and Nagar Haveli	0.615	4	96
9	Delhi	18.71	25070	3355
10	Goa	1.586	3184	342
11	Gujarat	63.872	10079	9925
12	Haryana	28.204	9666	3329
13	Himachal Pradesh	7.451	3563	1553
14	Jammu and Kashmir	13.606	4401	1611
15	Jharkhand	38.593	5132	2201
16	Karnataka	67.522	37123	8119
17	Kerala	35.699	19428	6776
18	Ladakh	0.289	207	74
19	Lakshadweep	0.073	51	18
20	Madhya Pradesh	85.123	10515	6244
21	Maharashtra	123.09	135820	13307
22	Manipur	3.366	1747	277
23	Meghalaya	3.312	1269	263
24	Mizoram	1.285	194	221
25	Nagaland	2.249	609	175
26	Odisha	46.356	7289	4612
27	Puducherry	1.413	1808	160
28	Punjab	30.141	16352	2655
29	Rajasthan	81.032	8954	9237
30	Sikkim	0.69	364	cze.00
31	Tamil Nadu	77.841	34686	5037
32	Telangana	38.51	3856	4222
33	Tripura	4.169	785	833
34	Uttar Pradesh	237.88	22792	9483
35	Uttarakhand	11.25	7377	1773
36	West Bengal	99.609	18356	9532

Source: <https://worldpopulationreview.com/country-rankings/gini-coefficient-by-country/>, 16 Aug 2022; <https://gisanddata.maps.arcgis.com/apps/dashboards/>, 1 Sep 2022; <https://www.statista.com/statistics/1104709/coronavirus-deaths-worldwide-per-million-inhabitants/>, 10 Sep 2022.

Taking into account the huge diversity of states in terms of population, it will be logical to introduce new variables in which the above-mentioned factors will depend on the population, obtaining respectively:

- the number of deaths per million inhabitants

$$d_i = D_i / P_i \quad i = 1, 2, \dots, 36 \quad (3)$$

where P_i is expressed in millions for each state,

- number of vaccinations per million inhabitants

$$v_i = V_i / P_i \quad i = 1, 2, \dots, 36 \quad (4)$$

where P_i - as for (3).

In this way, we obtain a completely different distribution of the potential pandemic threat in India, presented in Table 2. This table consists of three columns, in which, apart from the state names, we also present the above-defined variables d_i and v_i .

Table 2.

The number of deaths due to the pandemic in individual Indian states relative to one million inhabitants and the number of vaccinations per thousand inhabitants

No.	States	Population	Deaths _{pm}	Vaccines _{pt}
1	Andaman and Nicobar	0.417	309.35	235.01
2	Andhra Pradesh	53.903	254.44	123.43
3	Arunachal Pradesh	1.57	163.69	129.94
4	Assam	35.607	156.32	72.514
5	Bihar	124.8	77.316	40.193
6	Chandigarh	1.158	701.21	221.07
7	Chhattisgarh	14	968	206.79
8	Dadra and Nagar Haveli	0.615	6.50	156.1
9	Delhi	18.71	1339.9	179.32
10	Goa	1.586	2007.6	215.64
11	Gujarat	63.872	157.8	155.39
12	Haryana	28.204	342.72	118.03
13	Himachal Pradesh	7.451	478.19	208.43
14	Jammu and Kashmir	13.606	323.46	118.4
15	Jharkhand	38.593	132.98	57.031
16	Karnataka	67.522	549.79	120.24
17	Kerala	35.699	544.22	189.81
18	Ladakh	0.289	716.26	256.06
19	Lakshadweep	0.073	698.63	246.58
20	Madhya Pradesh	85.123	123.53	73.353
21	Maharashtra	123.09	1103.4	108.11
22	Manipur	3.366	519.01	82.294
23	Meghalaya	3.312	383.15	79.408
24	Mizoram	1.285	150.97	171.98
25	Nagaland	2.249	270.79	77.812
26	Odisha	46.356	157.24	99.491
27	Puducherry	1.413	1279.5	113.23
28	Punjab	30.141	542.52	88.086
29	Rajasthan	81.032	110.5	113.99
30	Sikkim	0.69	527.54	233.33
31	Tamil Nadu	77.841	445.6	64.709
32	Telangana	38.51	100.13	109.63
33	Tripura	4.169	188.29	199.81
34	Uttar Pradesh	237.88	95.812	39.864
35	Uttarakhand	11.25	655.73	157.6
36	West Bengal	99.609	184.28	95.694

With indicators such as d_i and v_i related to one million inhabitants, it is still not clear how to fairly determine the ranking of states regarding a pandemic threat. While comparing two states, it is obvious that if in the first one there is a higher death rate per million d_i and at the same time a lower vaccination rate per million v_i , then the former is more at risk. However, this is only a general observation that will not allow for the preparation of a ranking for the entire administrative division.

So it was decided to find a measure of the relative deterioration or improvement of both indicators d_i and v_i relative to one selected state. The following were selected as the basis for the comparison:

$$R_{di} = d_i / d_{iD} \quad (5)$$

$$R_{vi} = v_i / v_{iD} \quad (6)$$

where d_{iD} , v_{iD} - indicators for Delhi.

Each state can therefore be assessed against Delhi. If $R_{di} > 1$, the number of deaths per million inhabitants in the i -th state will be greater than for Delhi, if $R_{vi} > 1$, it will mean a greater number of vaccinations per million inhabitants in i -th state than per million inhabitants of Delhi. The R_{di} and R_{vi} indicators are already some kind of normalization that allows comparing the threats in states.

Index_D introduced allowing reference to Delhi. It could be any other state (but only one):

$$\text{Index_D} = R_{vi} - R_{di} \quad (7)$$

Since the R_{vi} and R_{di} values for Delhi will be 1 according to the definitions (5) and (6), Index_d will be 0. All states in better positions from the pandemic from the capital will have the Index_D a little bigger, those in worse - lesser.

In tab. 3 shows the results of these calculations.

Table 3.

Comparison of pandemic threat states in Indian states compared to the capital state - Index_D = R_{vi} - R_{di}

No.	States	Population	Deaths_D	Vaccines_d	Index_D
1	Andaman and Nicobar	0.417	1.3106	0.1795	1.1311
2	Andhra Pradesh	53.903	0.6883	0.1805	0.5078
3	Arunachal Pradesh	1.57	0.7246	0.0953	0.6293
4	Assam	35.607	0.4044	0.1156	0.2888
5	Bihar	124.8	0.2241	0.06	0.1642
6	Chandigarh	1.158	1.2329	0.517	0.7158
7	Chhattisgarh	14	1.1532	0.7484	0.4048
8	Dadra and Nagar Haveli	0.615	0.8705	0.0122	0.8583
9	Delhi	18.71	1	1	0
10	Goa	1.586	1.2026	1.4156	-0.2131
11	Gujarat	63.872	0.8666	0.1172	0.7494
12	Haryana	28.204	0.6582	0.2654	0.3929
13	Himachal Pradesh	7.451	1.1624	0.3516	0.8108
14	Jammu and Kashmir	13.606	0.6603	0.2475	0.4128
15	Jharkhand	38.593	0.318	0.097	0.2211
16	Karnataka	67.522	0.6706	0.4101	0.2605
17	Kerala	35.699	1.0585	0.3774	0.6812
18	Ladakh	0.289	1.428	0.5179	0.91
19	Lakshadweep	0.073	1.3157	0.5126	0.8625
20	Madhya Pradesh	85.123	0.4091	0.0879	0.3211
21	Maharashtra	123.09	0.6029	0.8208	-0.2179
22	Manipur	3.366	0.4589	0.378	0.081
23	Meghalaya	3.312	0.4428	0.2712	0.1717
24	Mizoram	1.285	0.9591	0.0582	0.9009
25	Nagaland	2.249	0.4339	0.1997	0.2343

26	Odisha	46.356	0.5548	0.113	0.4418
27	Puducherry	1.413	0.6315	0.9534	-0.3219
28	Punjab	30.141	0.4912	0.3973	0.094
29	Rajasthan	81.032	0.6357	0.0831	0.5526
30	Sikkim	0.69	1.3012	0.3254	0.9759
31	Tamil Nadu	77.841	0.3609	0.3269	0.034
32	Telangana	38.51	0.6114	0.0777	0.5337
33	Tripura	4.169	1.1143	0.1257	0.9886
34	Uttar Pradesh	237.88	0.2223	0.0724	0.15
35	Uttarakhand	11.25	0.8789	0.4657	0.4132
36	West Bengal	99.609	0.5337	0.1352	0.3984

Source: <https://worldpopulationreview.com/country-rankings/gini-coefficient-by-country>, 16 Aug 2022; <https://gisanddata.maps.arcgis.com/apps/dashboards/>, 1 Sep 2021; <https://www.statista.com/statistics/1104709/coronavirus-deaths-worldwide-per-million-inhabitants>, 10 Sep 2022.

The results

The most important result from the above table 3 is presented in the form of histogram in Fig. 1. It shows three bars with negative values, so these states are worse than Delhi according to the established criterion. The capital city, on the other hand, as a reference state, has a value of zero. All states with a positive index are better than the capital city, while a negative index means that the state is worse than Delhi.

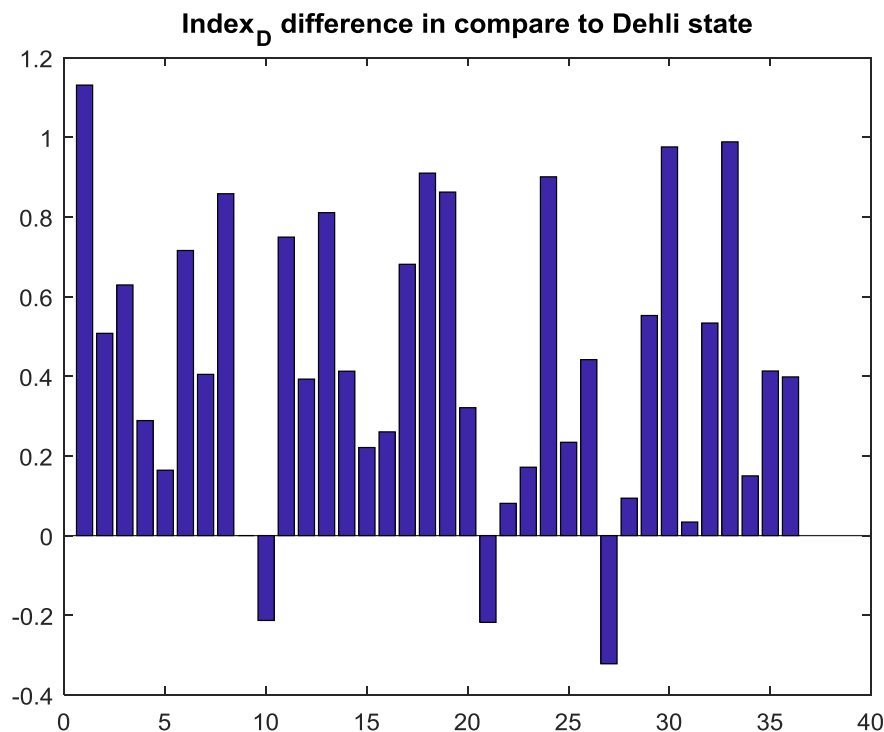


Figure1. Histogram of the main Index_D index for the states of India; For Delhi (number 9) Index_D equal to 0.

We then sort the Index_D column in Table 3 to rank the Indian states by pandemic risk. In the Matlab environment, in which the research was carried out, this can be performed using the sort function that allows us to determine the input data vector in ascending or descending order, along with the possibility of determining the vector of indices. We sort from the best to the worst values of Index_D, and we get:

$$[W \text{ Ind_states}] = \text{sort}(\text{Index_D}, 'descend') \quad (8)$$

where:

W - is the vector of Index_D values from the largest to the smallest,

Ind_states - it is a vector of indices/state numbers according to this order.

Table 4 was obtained after sorting.

Table 4.

The states after sorting by (8)

Order	State_Number	State	Index_D
1	1	"Andaman and Nicobar"	1.1311
2	33	"Tripura"	0.9886
3	30	"Sikkim"	0.9759
4	18	"Ladakh"	0.91
5	24	"Mizoram"	0.9009
6	19	"Lakshadweep"	0.8625
7	8	"Dadra and NagarHaveli"	0.8583
8	13	"Himachal Pradesh"	0.8108
9	11	"Gujarat"	0.7494
10	6	"Chandigarh"	0.7158
11	17	"Kerala"	0.6812
12	3	"Arunachal Pradesh"	0.6293
13	29	"Rajasthan"	0.5526
14	32	"Telangana"	0.5337
15	2	"Andhra Pradesh"	0.5078
16	26	"Odisha"	0.4418
17	35	"Uttarakhand"	0.4132
18	14	"Jammu and Kashmir"	0.4128
19	7	"Chhattisgarh"	0.4048
20	36	"West Bengal"	0.3984
21	12	"Haryana"	0.3929
22	20	"Madhya Pradesh"	0.3211
23	4	"Assam"	0.2888
24	16	"Karnataka"	0.2605
25	25	"Nagaland"	0.2343
26	15	"Jharkhand"	0.2211
27	23	"Meghalaya"	0.1717
28	5	"Bihar"	0.1642
29	34	"Uttar Pradesh"	0.15
30	28	"Punjab"	0.094
31	22	"Manipur"	0.081
32	31	"Tamil Nadu"	0.034
33	9	"Delhi"	0
34	10	"Goa"	-0.2131
35	21	"Maharashtra"	-0.2179
36	27	"Puducherry"	-0.3219

In column 2 of the table, the numbers of states are indicated in order from best to worst, i.e. 1, 33, 30, 18, 20 ... that is Andaman, Tripura, Sikkim, Ladakh, Madhya, ...

The worst is 9,10,21,27, i.e. Delhi, Goa, Maharashtra, Puducherry.

Discussion

A discussion on the ranking of Tab. 4, thus prepared, appears necessary and logical to put forth this work in right perspective. A recent study (Lahariya and Bhardwaj, (2019) does point out the fact that the traditional vaccination paraphernalia in India, which actually targets the traditional vaccination age-group (children) more, has improved in recent past but the immunization for the age-group beyond this traditional group does require improvement in strategies for the benefit of the adult population. Another study (Gurnani et al., 2018) presents the outcome of an Intensified Mission Indradhanush (IMI), a project conceptualized, coordinated and implemented by ministry of Health, central government of India, which was also closely monitored by Prime Minister of India office, targeted to improve the traditional (children) vaccination mechanisms in selected 190 centers all over country. In these two studies (Lahariya, Bhardwaj, 2019; Gurnani et al., 2018) presented, it does appear that the ground reality in the improvement of existing traditional immunization mechanism has visibly shown upward trend but these work also highlight the urge for further improvement.

The suggested mechanisms for improvements therein (Gurnani et al., 2018) have included involvement of cross-sectoral participation, strengthening of systems and practice change, sustained high-level political support with flexibility to earmark resources afresh, staff capacity enhancements, better communication and coordination, and to tackle the vaccine hesitancy by involving non-health stakeholders (such as religious leaders) in planning and messaging (as mentioned in (Gurnani et al., 2018). Also, (Gurnani et al., 2018) highlights that the IMI project did not cover Punjab, J&K, Himachal Pradesh, Uttarakhand, Chhatisgarh, Goa, Telangana, Tamilnadu, Kerala (only one district), Andhra Pradesh (only two district), Jharkhand (only two). Puducherry, Haryana, West Bengal (only one). Out of 190 priority centers most of them were from Northeast, UP, Bihar, MP Rajasthan, Maharashtra. In light if IMI coverage, the higher rankings, as reflected by Tab. 4 above, of states or union territories, which are smaller in area and low population-density is understandable such as those at rank 1-8. This is also, precisely, due to these state's ease of managing the pandemic-mitigating paraphernalia, that is, their medical support systems looking after the outbreak containment and the inoculation mechanisms in their regions.

So, in light of the availability of the above stated existing improved immunization paraphernalia (Lahariy, Bhardwaj, 2019; Gurnani et al., 2018) all over country in general and in the states and union territories covered under IMI project (Gurnani et al., 2018) in

particular, the state rankings as reflected in Tab.4 look fairly convincing and consistent. However, there are also element of surprises in rankings such as that of Maharashtra, Goa and Pudduchery which has been indicated relatively worse than Delhi. The other relatively higher rankings of states in comparison among themselves, also, do indicate surprising status but that is precisely identical to other commonly observable chaotic pandemic-responses of countries to the COVID-19 globally. India being hugely diverse in its federal setup, in many ways, does undergo variety of push-and-pulls of socio-political nature at the centre and at various state levels. These broader social and political determinants also affect coordination and decision, thereby making it arbitrary and chaotic at various levels of central and state governments. The observance of some kind of chaotic rankings as shown in Tab. 4 may also have got affected by some kind of influences of political diversities at work in centre and in states. The potentially influential public utterances by political leaderships do affect the affirmative-vaccination and vaccination hesitancy and such news in relation to utterances by few key world leadership has been in the public domain in the recent past of the ongoing COVID-19 pandemic which is found true in the case of India too. Hence, the diverse political establishments all over country in India have not been unaffected from this and its effect may also be linked to rankings. With above in mind, in general, the rankings appear pretty consistent with the national perception of the intellectuals about the pandemic response by state and regional administrative bodies as observed during COVID-19 till the time the data for this article were collected.

In the aftermath of Ebola outbreak 2014, there has been efforts in the direction for preparing an indexing mechanism showing the pandemic preparedness index globally. This conceptualization and commissioning of Global Health Security Index (GHS Index, 2021) endeavor happened at John Hopkins University's Bloomberg School of Public Health in collaboration with the Nuclear Threat Initiative a think-tank based at Washington DC. It is worthwhile to note that the 2019 GHS Index indicated US and UK as the two best countries prepared to address any future pandemic catastrophe, however, the data from the ongoing COVID-19 pandemic narrate story otherwise. The GHS indexing mechanisms, thus, are also being questioned (Mahajan, 2021) as they appear to have overlooked some important broader social and political determinants of public health which also affect the contagion preparedness of respective countries. Thus, any indexing effort including the indexing work of this article, is never a complete work. We have only tried to suggest a way forward in this direction which would attract subsequent refinement.

India is a country with many faces and enormous diversity. For example, Figure 2 shows the Gini coefficients for two variables considered in this study as significant for the pandemic risk - the number of deaths per million and the number of vaccinations per million. The number of deaths indicates a variation between states that is unprecedented in other countries (Wilinski and Szwarc, 2021), a much smaller variation is shown by the Gini index for vaccinations, but also very large.

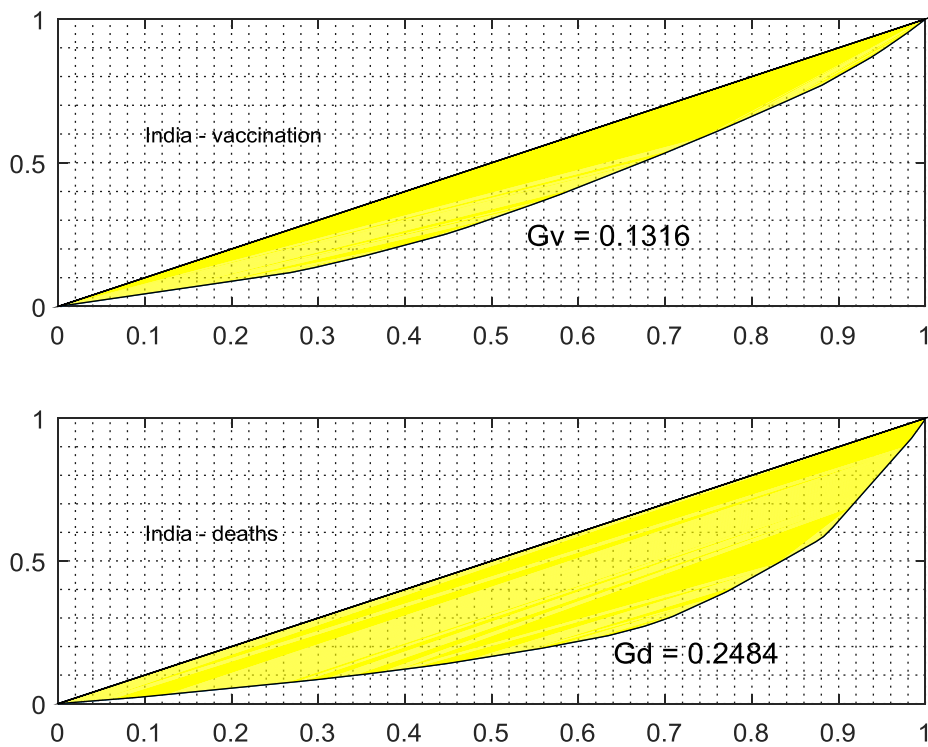


Figure 2. The Gini Index for the Distribution of Deaths and Vaccinations in India.

Interpreting these two graphs in Fig. 2 as a summary of a relatively up-to-date picture of the results of the fight against the pandemic of this enormous country, it is possible to state the superiority of the power of human influence over the forces of nature.

Conclusions

Summing up the work, there are some obvious conclusions and some unexpected ones. First, the authors would like to convince the reader of the fairly obvious criterion expressed by Index_D - it is good to have few deaths and a lot of vaccinations in a given state. The comparison of the meaning of these two variables could be obtained through various mathematical procedures, e.g. using weights. Here it was decided to compare it with the criterion for the capital of the country and introduce relative variables. This simple procedure allowed for a fairly obvious comparison and could cause different ratings among readers, as not all ratings (positions in the ranking) will be considered as expected. However, the authors justify each position in the ranking with reliable data obtained from government websites.

However, one can consider the reasons for these large discrepancies in the values of the comparative criterion (7).

As in many countries, the overall picture of India's fight against the pandemic as a country with large regional differences consists of various factors, for example, such as:

- the state of vaccination of the society,
- strength of influence and degree of organization of vaccines opponents,
- condition of the health service and funds of potential support for this service (state of readiness and speed of operation, availability of infrastructure and qualified medical personnel,
- the advancement of the IMI project,
- the power of influence of central and local authorities of various nature - political, social, religious and scientific,
- demographic factors - density of residence, migration intensity, tourist traffic, culture, and religion,
- climatic conditions.

In fact, each of these factors can be the subject of separate independent scientific research, be it for India or any other country. Attempts to apply quantitative methods can be observed, for example, through the GHS Index (Worldometers, 2021).

These factors, as well as many others of greater or lesser importance, cause such a large variation in the distribution of the two factors in question in this study - the number of deaths per million inhabitants and the number of vaccinations per million inhabitants. Figure 2 could therefore be considered a good summary of the Indian authorities' prudence in fighting the pandemic - the forces of nature represented by the Gini chart of deaths reveal a much greater variation in the number of deaths per million inhabitants by the state than the Gini chart for vaccination. Here, the discrepancy measured by the Gini index is much smaller, although still very high compared to other countries. It should be remembered that in both Gini characteristics the states are arranged in a different order - resulting from sorting, so it is impossible to read information about the role and place of individual states in these charts from Fig. 2.

Compliance with Ethical Standards:

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

The co-authors give their informed consent to the publication.

Authors declare no conflict interests.

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INNOVATIONS IN INDUSTRY 4.0 CONDITIONS

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Purpose: The aim of the paper is to analyze the innovations in Industry 4.0 conditions.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The publication concentrate on problems connected with various aspects of relations between Industry 4.0 and innovativeness. In the paper we presented the main presumptions of Industry 4.0 concept and it's nowadays usage. In the second part of the paper there is an analysis of main trends of today Industry 4.0 implementation approaches and innovativeness. Especially there is a description of main innovative trends of 2021 described from Industry 4.0 relations point of view. Also the paper deals with the social innovation aspect of Industry 4.0. There are very interesting and innovative concepts that can be used in today business environment and also governments. Some of them like universal basic income are a bit controversial but it needs to further more detailed analysis if it is possible and could benefit to the society. Other trends can be for example: new forms of employment or new types of organizational culture.

Originality/value: Detailed analysis of all subjects related to the problems connected with the innovations in Industry 4.0 conditions.

Keywords: Industry 4.0; innovation, industrial enterprise, research and development, innovative trends.

Category of the paper: literature review.

1. Introduction

Today, industrial production is driven by global competition and the need to quickly adapt to ever-changing market requirements (Zhong et al., 2017). Modern production was built on the experiences of the first industrial revolution, streamlining the operations of manufacturing plants; the second revolution, introducing electricity to industry; and the third revolution, automating uniform tasks for production workers (Zhong et al., 2017; Pilloni, 2018; Zunino et al., 2020; Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018; Grabowska et al., 2019, 2020,

2021). The fourth industrial revolution—Industry 4.0—differs from its predecessors in that it applies to all areas of life (Herceg et al., 2020), including the dangerous phenomenon of an ageing population and the consequent decline in the workforce (Habek, Wolniak, 2013, 2016; Hys, Wolniak, 2018). This revolution is also connected with the fact that the opportunities for increasing the profit of industrial production are exhausted despite the use of the “lean” manufacturing concept and outsourcing (Lee et al., 2014; Longo et al., 2017). Industry 4.0 determines changes in production—from mass production to personalized production—which make the production processes more flexible and provide the means to meet the individual needs of different customers more effectively.

The aim of the paper is to analyze the innovations in Industry 4.0 conditions.

2. Basic aspects of Industry 4.0

The concept of Industry 4.0, although initialized in Germany (Nagaro et al., 2020; Zimmermann et al., 2020), is spreading around the world, and the countries implementing the idea define it differently. In the United States and English-speaking countries, it is called the industrial Internet. In others, it is called the Internet of Things or a smart factory (García-Muiña, et al., 2020; Jonek-Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021). Apart from the non-uniform term, the terminology used for Industry 4.0 is not consistent either. The variations depend on how individual business circles interpret this term. In the United States, it is seen as the integration of people with things and things among themselves, combining the analysis of large data sets with the Internet of Things (Ashton, 2009; Sitton-Candanedo et al., 2020).

In France, the concept of “Industrie du futur” is based on the cooperation between industry and science. It is built on five pillars, namely: (i) state-of-the-art technologies, including additive manufacturing, virtual factories, the Internet of Things, and augmented reality; (ii) support to French companies to adapt to the implementation of new technologies; (iii) intensive training of workers; (iv) strengthening international cooperation on industrial standards; and (v) promoting the French industry of the future (Tran et al., 2019). In China, on the other hand, the concept consists of a comprehensive modernization of the Chinese industry, taking direct inspiration from the German concept of Industry 4.0 and adapting it to its own needs (Zhang, 2020; Kwiotkowska et al., 2021, 2022; Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecula, Wolniak, 2022; Olkiewicz et al., 2021).

In the digital age, an organization should adjust their production and logistics systems to meet new technologies. Business has evolved to improve in effectiveness and cost-efficiency.

Production systems should be customer-centric and should drive agility within the business. To meet these objectives, the implementation of Industry 4.0 is needed. We can distinguish the following reasons for why the conception of Industry 4.0 is so important (Zezulka et al., 2016, Veselovsky et al., 2018):

- Cost efficiency.
- Agility and flexibility of the production system.
- Customer-centric production systems, with customization of products.

In the Industry 4.0 environment, producers should better understand the patterns of consumption and based on that, be able to adjust the product to the specified requirements of the end-users (Brozzi et al., 2020; Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). We can distinguish many technologies used in the Industry 4.0 concept. They may affect the methods of projecting, manufacturing, and delivering products to customers. The main technological conceptions supporting digitalization and servitization in Industry 4.0 are the following (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023):

- adaptive robotics,
- cyber-physical infrastructure embedded systems,
- additive manufacturing,
- cloud technologies,
- visualization technologies, such as virtual reality and augmented reality,
- simulations,
- data analytics and artificial intelligence,
- industrial internet—communication and networking,
- RFID (Radio-frequency identification) and RTLS (Real-time locating system) technologies,
- cybersecurity,
- sensors and actuators,
- mobile technologies.

The main objective of Industry 4.0 is to increase automation so as to contribute to the operational efficiency and effectiveness of the company (Shahhazi et al., 2016). Industry 4.0 is based on the integration of new technical solutions. Particularly important, in this case, is the process of combining smart machines and systems, as well as changes in the production processes (Shanhazi et al., 2016).

Industry 4.0 is not only a technological revolution. It is also now connected with the problem of linking different devices together for achieving traceability and trackability. We can distinguish the following dimensions of the Industry 4.0 concept (Duflou et al., 2012; Müller, 2018):

- Internet of Things—the ability to conveniently access data from anywhere and exchange data between devices. All production systems become interconnected. There are real-time flows between all elements of the supply chain.
- Common digitalization—the process of ensuring digitalized, constant communication between all people and all devices and between people and devices themselves.
- Autonomous manufacturing systems—creating intelligent factories that organize production processes autonomously and can react flexibly to changes to the requirements of the manufacturing processes. Smart factories perform virtually the entire production processes themselves with minimal human input.
- Customization of the product—delivering a customized product to the customer, precisely according to their orders.
- Robotization—implementation of flexible production sockets, based on industrial robots, using robots adapted to cooperate with humans.
- Implementation of architecture based on cyberphysical systems.
- Widespread use of disruptive innovations—these can allow a rapid increase in the efficiency and effectiveness of the socioeconomic and operation system in an organization.

Technical structures are flexible and open, they permit autonomy to the employees and can help organize a structure with fuzzy boundaries. The likelihood that innovations will emerge in such an open and flexible organizing structure is high. We are dealing with this kind of situation in the Industry 4.0 conditions.

For example the widespread of Industry of Things can have positive effect on innovativeness. Using this method organizations can gain access to new sources of data and new information which can be used for decision-making process in a more comprehensive way. Such data systems may contribute to detection of new patterns of behaviour or machine interactions. The access to those data can enable managers at the strategic level of researchers to create new innovations. The development of new Industry 4.0 applications and novel business models change from pure production to customer-oriented and personalized services for special solution possible (Wilkesmann, 2018).

3. Innovations in Industry 4.0

Innovation ecosystems are collaborative networks focused on the cocreation of value (Russell, Smorodinskaya, 2018). The structure of innovation ecosystem can be self-organized or managerially designed with multilayer networks of actors with different attributes to provide a system of innovative product and services (Tsujimoto, 2018). As in other innovation ecosystem, Industry 4.0 innovation ecosystem will also need to deal with lifecycle stages. The regional consolidation process while many technologies emerge and different economic aspects of the ecosystem tend to consolidate in the condition of industry 4.0. The capability dimension of innovative ecosystem in industry 4.0 conditions reflects the organization's capability to organize itself to provide value and foster growth in the ecosystem (Benitez, 2020).

According to international research it can be distinguished the list of Top 10 Industry 4.0 Trends and innovations in the year 2021. The authors of this research analysed sample of 770 global start-ups and scaleups. The result of the research was data-driven innovation intelligence that improves strategic decision-making by giving an overview of emerging technologies in the Industry 4.0 (Top 10, 2021). The Top 10 Industry 4.0 innovative trends in 2021 are described in the table 1.

Table 1.
Top 10 Industry 4.0 innovative trends in 2021

Trend	Explanation
Cyber Security, Transparency & Privacy	The flow of information due to the connectedness in Industry 4.0 is raising concerns about security, transparency, and privacy. As the manufacturing practices are increasingly becoming personal and customizable, the data management practices done outside and within the shop floor will hugely influence the appeal of the company. The transmission and processing of sensitive industrial data need to be done securely to avoid cyberattacks on critical industrial facilities. Digital ethics and privacy, privacy-enhancing technologies, self adaptive security, zero-trust security, end-to-end communication security, blockchain are some of the new developments in this front. The focus on cybersecurity needs to be balanced with transparency and privacy.
Edge, Fog & Cloud Computing	The immense amount of data being generated by the industrial internet of things (IIoT) is propelling the adoption of edge, fog, and cloud computing capabilities in Industry 4.0. Custom hardware and software solutions like connected clouds, distributed clouds, distributed compute and storage, hybrid computing, low code development platforms, microservices, mobile computing, and multi-access edge computing are shaping up this industry 4.0 trend.
Artificial Intelligence	AI and machine learning are driving innovations across industries and functional areas. AI-specific hardware and new algorithms are being developed to optimize the existing systems and tackle new challenges facing manufacturing. Factories are beginning to integrate AI across their production systems and processes. Advanced AI makes it possible to conduct predictive maintenance, cognitive computing, swarm intelligence, context-aware computing, smart machines, hardware accelerators, and generative design. All of these technologies propel manufacturing facilities to move towards complete lights-out manufacturing.

Cont. table 1.

Human Augmentation & Extended Reality	The physical and cognitive augmentation of humans forms another major industry 4.0 trend. The limitations in humans are being augmented with the help of technologies such as wearables and exoskeletons. Further, industrial mobile devices, natural and intuitive UI, and portable machine control screens enhance the ease of using such technology. XR technologies like mixed reality (MR), augmented reality (AR), and virtual reality (VR) are already in use in Industry 4.0 from the research and development (R&D) to full-scale production and post-production processes. This multi-experience paradigm is changing the way industrial manufacturing systems function. The nature of human-machine interaction is aligning more toward machine-enabled workers.
Network & Connectivity	Network and connectivity are among the main driving forces in enabling Industry 4.0. A number of technology developments such as edge-to-cloud, gigabit ethernet time-sensitive networks, low-power wide-area network (LPWAN), 5G, machine-to-machine communication (M2M), real-time deterministic ethernet, time-sensitive networking (TSN), ubiquitous radio access, unified IoT framework, and zero-touch networks nudge factories to implement IIoT to transform into Industry 4.0 facilities.
Advanced Robotics	Advancements in robotics make the processes in industry 4.0 faster, efficient, and safer. The most prominent robotic technologies impacting manufacturing include autonomous robots, collaborative robots (cobots), collaborative autonomous mobile robots, humanoid, mobile robots, cloud robotics, APIs, pick and place robots, and robot swarms. The use of robots offers higher precision and agility while improving the capability of rapidly developing customizable robots. Robots also free up time for the human workforce to focus on other non-repetitive or high-value tasks.
Internet of Everything	The machine-machine, human-machine, and human-human real-time connectedness together comprise the internet of everything in manufacturing. It includes IIoT, internet of skills, internet of services, internet of systems, and shop floor IoT. The internet of everything combines together real-time data, machine intelligence, and human skills, resulting in faster, efficient, and cost-effective manufacturing processes. Interoperability and a unified internet of things framework are crucial for the smooth implementation of industry 4.0 facilities.
Digital Twin	Digital twin technology creates virtual models of industrial assets by combining dynamic real-time sensing and visualization data. Some of the promising use cases of digital twins include model-driven design, virtual prototyping, virtual system validation, throughput optimization, and evolutionary design. The use of digital twins is propelling industry 4.0 manufacturing towards hyper-automation. Digital twins provide valuable insights into all steps of the manufacturing process.
Additive Manufacturing	Manufacturers constantly search for new technologies to cater to all aspects of the growing market demand. Additive manufacturing, which started out as a prototyping technique, is revolutionizing and decentralizing production. Hybrid manufacturing aims to integrate both additive manufacturing and subtractive manufacturing. The advancement in material science and techniques such as stereolithography and metal 3D printing enables simpler fabrication of intricate structures and complex components. Additive manufacturing is making highly-customizable and sustainable cloud-based production a reality.
Big Data & Analytics	The scale of industrial data collection eventually enables factories to make the transition into industry 4.0 facilities. Big data is complex and is valuable only when it is captured, stored, and analyzed in a quick and cost-effective manner. Advancements to utilize data for gaining valuable insights into the manufacturing systems, along with the availability of immediate and real-time data, open up opportunities for prescriptive, predictive, and augmented analytics at different levels of a company's manufacturing facilities.

Source: On basis. (Top 10, 2021).

Disruptive Industry 4.0 innovative startups in the world include (Industry 4.0 Innovation Map, 2023):

- Israeli startup Augury allows “machines to talk”. By “listening” to machines the startup anticipates malfunction or failure and currently further develops the machine diagnostics backend of the Internet of Things (IoT).
- Waylay masterminds an intelligent SaaS decision-making platform. The Belgian startup generates a compact logic for easy maintenance – dynamic processes in the cloud, for the cloud.
- German Additive Works makes additive manufacturing less costly. The startup’s solution entails a four-step system called the ASAP Principle (Assessment, Simulation, Adaption, Process), on which their software solution “Amphyon” is built.
- UK-based SQR Systems bridge the secure communications gap between mobile & IoT by enabling companies to protect their data and build secure products by taking away the pain of regulatory compliance and security assurance.
- Netherland-based Semiotic Labs works with Artificial Intelligence (AI), specifically machine learning algorithms and sensors, to optimize the process of predictive maintenance in smart factories.

We can find definition of Industry 4.0 where an attention on innovativeness is taken place. For example the Working Goup prepared following definition of Industry 4.0: Industry 4.0 regards it as a series of disruptive innovations in production and leaps in industrial processes resulting in significantly higher productivity. It is viewed as the fourth time such a disruption took place (Oluyisola et al., 2020; Industry 4.0 and fourth, 2023).

In the time of Industry 4.0 we can invent not only technical innovation but also invent and use social innovations. In the table 2 we put some example of emerging social innovations which are strictly connected with fourth industrial revolution.

Table 2.
Main social innovations connected with Industry 4.0

Innovation	Characteristic
Universal basic income	To a varying degree, this proposal seems to be supported by both liberals and conservatives. As early as in 1979, Friedrich Hayek referred to this concept in his work <i>Law, Legislation and Liberty</i> . In general, it is assumed that the value of such income should correspond to an existential minimum. This idea is very controversial however, nowadays it seems to be a robust, even though not perfect, social solution which can combat the negative effects of technological unemployment and make “life financing” possible.
Education	It is significant encouragement to create forms of supported structurally lifelong learning, which do not concentrate on professional qualifications, but rather on the development of skills as “something that whatever job you’re in there’s something that you can do about. And if you invest the right skills, you can leave yourself in a better place to benefit from the opportunities of the future”. Modernisation of education systems should also be accompanied by innovative support programmes for grassroots forms of learning. An example can be the Fab Labs/ FabLearn Labs, the essence of which is knowledge and skills sharing on the basis of coaching or Internet mentoring. Voluntary organisations or education crowdfunding can also be considered the grassroots forms of learning in both cases, digital communication technologies (DCT) are used to share knowledge.

Cont. table 2.

New forms of employment	It is mostly about sharing economy solutions that need to be identified both with the concept of sharing various resources with other members of the community to use them better and of sharing new models of business practice that use Internet platforms. We can also consider crowdfunding to be a new form of work – it is about putting own project into action, which is financed by the community that believes in its meaning and chance of success based on donation culture that fully implements existential dimensions of work; similarly as “community entrepreneurship” based on benefit corporations, the profit from such ventures is the result of implementation of e.g. social and environmental goals, that is goals that improve the quality of life.
Development of socially useful activities	Currently, the traditional forms of voluntary service, such as participation in social life, were extended with all open source forms, the flagship example of which can be Wikipedia. It is crucial to notice that communication platforms and IoT created completely new possibilities in this scope, starting from sharing computing power of one’s devices through search for new drugs to predicting climate change in searching for new planets, etc.
Establishing a culture of “new” values	Creating social initiatives, the goal of which is to boost creativity and develop community cooperation, as the sources of high quality of life. In the economy paradigm, work was a source of wealth that not only conditioned survival, but also expressed one’s social position and defined one’s identity, etc. Nowadays, this simple correlation is not so obvious anymore. This is due to several factors, including the sense of wealth in developed countries as well as research on the sense of life satisfaction, proving that material values are not able to ensure our well-being, therefore, work or other activities we undertake should also refer to other values.

Source: On basis. (Osika, 2019).

4. Conclusion

The publication concentrate on problems connected with various aspects of relations between Industry 4.0 and innovativeness. In the paper we presented the main presumptions of Industry 4.0 concept and it’s nowadays usage. In the second part of the paper there is an analysis of main trends of today Industry 4.0 implementation approaches and innovativeness. Especially there is an description of main innovative trends of 2021 described from Industry 4.0 relations point of view. Also the paper deals with the social innovation aspect of Industry 4.0. There are very interesting and innovative concepts that can be used in today business environment and also governments. Some of them like universal basic income are a bit controversial but it needs to further more detailed analysis if it is possible and could benefit to the society. Other trends can be for example: new forms of employment or new types of organizational culture.

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TEAM INNOVATIONS

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Purpose: The aim of the paper is to analyze the team innovation processes in industrial enterprise.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The publication concentrate on problems connected with various aspects of team innovations. In the paper we presented the system of interactions which exist between negotiators in team especially from innovativeness point of view. Also we analyzed problems connected with team creativity and boasting it because team creativity is indispensable to boast innovativeness in industrial company. On the basis of the literature analysis it can be pointed out that the satisfying level of innovativeness can be achievable without appropriate level of creativity. To enhance it within company we need to give the people enough freedom and appropriate leadership adjusted to the culture of people. Also it is important to integrate creativity concepts and methods enhancing creativity into day-to-day operation of the organization. The organization should careful plan the division of the resources between innovative tasks.

Originality/value: Detailed analysis of all subjects related to the problems connected with team innovation in an industrial enterprise.

Keywords: Industry 4.0; innovation, industrial enterprise, team innovation, research and development.

Category of the paper: literature review.

1. Introduction

The issues of innovation are very important for the modern economy (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018; Grabowska et al., 2019, 2020, 2021). In this paper there is an analysis of problems connected with preparing and enhancing team innovation in today economy.

The aim of the paper is to analyze the team innovation processes in industrial enterprise.

2. Team negotiations

We can distinguish four interaction processes in teams that promote team innovations:

- exchanging innovation,
- learning,
- motivating,
- negotiating.

We have described those function in the table 1.

Table 1.
Interactions in team negotiations

Interaction	Characteristic
Exchanging negotiations	Exchanging information refers to the accumulated individual inputs of information, knowledge, and experience necessary for team functioning. Exchange of information expands knowledge and experience resources available to team members, improves the analysis of the problem, and allows better assessment of the usefulness of potential solutions all of which are important in regard to innovation. In implementing innovation, information exchange leads to a more complete and accurate specification of the needs of the different parties, to interventions and solutions that suit the characteristics of the organization, and to more realistic expectations. Nevertheless, information exchange is not sufficient for innovation, because it does not ensure changes in subsequent behavior.
Learning	The learning function is defined as the extent to which team members overtly reflect on the team's objectives, strategies, and processes for the purpose of creating a team-level intellectual product that initiates change. Empirical evidence indicates that organizational and collective learning is a prerequisite for the development and adoption of innovation at the organizational level. Although not directly investigating innovation, research has revealed that team learning results in improvements in detecting and identifying problems, scanning the environment, and producing creative solutions, all of which might be crucial to team innovation.
Motivating	Motivating focused on the cognitive processes whereby team members become committed to their innovative goals. The issue of motivating innovation is complex. Empirical research has indicated that external rewards can often serve to diminish creativity. Hence, in describing the motivation of those involved in an innovation process, process-oriented motivation theories offer more support than those that are mostly based on reinforcement or oriented to the content of motivation. This approach led researchers to focus more on the cognitive motivating processes that foster innovation, as suggested by Locke and Latham's goal-setting theory. In the context of innovation, research findings have emphasized the role of team participation in goal setting to establish a high level of acceptance of goals, to overcome resistance, and to generate commitment to team projects.
Negotiating	The negotiating function constitutes the political dimension of team interaction and is evident when team members strive to express their opinions, which allows mutual influence. Although not directly examining the negotiating process, research has shown that teams exposed to minority views prove to be more original and use a greater variety of strategies to invent novel solutions. In addition e can say that allowing opposing opinions within teams promoted mutual influence of team members and, consequently, team effectiveness and innovation.

Source: On basis: (Drach-Zahawy, 2001).

3. Attributes of innovations

The enhancing innovative solution in teams depends on the attributes of innovations – we described them in the table 2. Those attributes have an impact on the innovativeness and dissemination of innovative solutions in teams.

Table 2.
Attributes of innovations

Attribute	Characteristic
Relative advantage	Potential adopters want to know that an innovation will be worth the cost, in terms of time, effort, and money. Incentives and rewards can play a role by increasing the relative advantage or reducing the costs of implementation.
Compatibility	Closely related to relative advantage is compatibility—not only with professional activities but also with the values and beliefs that affect an instructor’s behavior.
Complexity	complexity is negatively related to the rate of adoption, and once again his insights are consistent with experiences in the dissemination of innovations.
Trialability	This quality refers to the degree to which an innovation can be tried experimentally. In innovations generally, trialability seems more important among early adopters.

Source: On basis: (Gafney et al., 2018; Adair, 2007; Sloane, 2006).

4. Boasting team creativity

When we organize anything we can impose upon it sequential or spatial form. People or things are put together; they are fitted into their proper place in relation to one another (Ali et al., 2021; Habek, Wolniak, 2013, 2016; Hys, Wolniak, 2018). The end result of this process is an organization: a complex structure of independent and subordinate elements whose relations and properties are largely determined by their function in the whole (Liu et al., 2021; Jonek-Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021). The main important factors in the process of enhancing teams creativity are described in the table 3. We can distinguish following key point how to boast team creativity within an organization (Adair, 2007; Kwiotkowska et al., 2021, 2022; Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021):

- Order banishes chaos. Organizing reduces confusion and introduces formality into relationships. But chaos, confusion and informality are the seedbeds of creativity.
- Organizations can delegate or subcontract the work of innovation, in the form of research and development, to specialist units. They can also seek to transform themselves into innovative organizations. These options are not mutually exclusive.

- Any organization falls somewhere on the Creative/Productive continuum. It is important to establish both where you are now and where you want to be on that continuum, for it affects your whole understanding of leadership and management.
- Innovative organizations do not happen by chance. They are the end products of good leadership and management. The essence lies in getting the balance right between freedom and order, between the anatomy of the parts and the integrity of the whole.

Innovative organizations outside your field of work may hold secrets for you. Suspend your natural impulse to discard the experience of others in different walks of life as irrelevant to your purposes. In this context you can learn from other organizations that may have a much higher requirement for creativity than your own. How do they go about organizing themselves?

Table 3.
Factors enhancing team creativity

Attribute	Characteristic
Order and freedom	Now serious creative thinking demands a great deal of freedom. The less constraints you are under – subjective or objective – the better. Although creative thinking is much more of a social activity than most people imagine, creative thinkers are often markedly individualistic. They can be rather solitary, more by necessity than temperamental preference. They need fairly long periods of time on their own. Nor can they always predict when they will need to be alone with their thoughts. This is why creative thinkers do not tend to make good organizational men or women.
Integrating creativity into industry	Good communication between researchers within a large group of companies is essential, for many creative developments. To separate the functions of creating and developing new products or services from the functions of production, marketing and accounting – in the sense of having them take place in different organizations or sub-organizations within the group – does therefore offer to solve a lot of problems. It still leaves the possibility of the more commercial sides of the organization employing managers and work people who can suggest detailed and more incremental improvements in existing products and services, and actively encouraging them to do so.
Getting the balance right	There is a general trend for research organizations to become more like businesses, while at the same time industrial organizations are beginning to take on a more creative and innovative role. There are, of course, natural limits to both these processes which wise leaders will recognize and respect. No organization today is wholly creative or completely productive. The latter cannot be the case; partly because organizations employ people, and people by their nature cannot avoid thinking, and thinking in turn leads to new ideas; and partly because an organization which solely interested itself in reproducing existing goods and services, regardless of technological or market change, would soon – as we have seen – cease to exist.
Leadership for innovation	It follows from this analysis that the direction of research or ideas-oriented institutions does call for the distinctive qualities of leadership, coupled with management knowledge and abilities, especially in the areas of management finance and marketing (remembering that you have to market your services within a large group or organization as well as to outside potential clients).

Source: On basis: (Adair, 2007).

Successful gig organizations plan for innovation and allocation of resources to enhance innovativeness should fulfil the following points (Sloane, 2006; Han et al., 2021; Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022):

- They identify outmoded and ageing products and processes, and schedule them for replacement. These organizations recognize that everything in business has a life cycle, and the end of a life cycle has to be anticipated so that replacements can be planned. Even systems that are running successfully and profitably today must be examined to see if it is time to replace them with something better. It is much better to make your own products obsolete by introducing superior versions than to find that the competition has beaten you to it.
- They set targets and deadlines in each area and department for the generation of new initiatives in order to replace the items selected as outworn. The general rule is that three new initiatives should be started for each new process needed. A one in three success rate for trials of new products is a good batting average, so it is best to generate a large list of ideas and then whittle down to at least three to be prototyped. Each innovation project should have a project plan, with a deadline for customer feedback and a planned date for a go/no go decision.
- They measure progress against targets for individual projects and for the organization as a whole. They monitor key metrics, including how many new products or processes have been implemented in the last year, what proportion of revenues are coming from new products or services, how many new launches are scheduled for the coming period, and so on. They also try to assess more subjective parameters, such as who is seen as the innovative leader in the industry, and how the organization compares to its competitors in innovation in the marketplace.
- They systematically search for sources of new ideas, from trends in the technology and the industry, from unexpected successes in the marketplace, from customer feedback and from input from employees at all levels.
- They apply gating processes to projects and prototypes to check that they meet their milestones. They ensure that projects pass marketing, technology and financial hurdles in order to progress and have additional financial and development resources released to them.

When you want to have a good team of innovative peoples a very important thing is a proper recruiting system. Recruiting creative people to the company is not easy (Hu et al., 2021; Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022). You should look carefully for the particular traits and behaviour of people to achieve the sufficient level of creativity and innovativeness within the organization. We can distinguish

following list of main characteristics to look for during interviews of potential employees (Adair et al., 2007):

- Superior general intelligence. That includes analytical powers, as well as the ability to store and recall information.
- A high degree of autonomy, self-sufficiency and self-direction.
- Relatively little talkativeness or gregariousness. Creative thinkers tend to be ambivert: a balance of introvert and extrovert. If anything they tend towards introversion, although they need contacts with stimulating colleagues.
- Marked independence of judgement. They are resilient in the teeth of group pressures towards conformity in thinking. They see things as others do, but also as they do not.
- They often express part-truths vividly. It is their way of drawing attention to the unobserved or unrecognized. They may sound unreasonable. But remember George Bernard Shaw's provocative comment: 'The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man'.
- A broad range of interests. A special interest or motivation in the kind of 'wagering' which involves pitting oneself against problems or opportunities in which one's own effort can be the deciding factor. 'There is no greater joy in life,' said the inventor Sir Barnes Wallis, 'than first proving that a thing is impossible and then showing how it can be done'.
- Sustained curiosity and powers of observation. Often they are good listeners.
- Dedication and commitment to hard work.
- A truly creative individual lives closer to his or her purposeful unconscious mind than other people. He or she listens to the truth from within, in the form of intuitions. They inhabit more the world of imagination, reverie and fantasy.
- They are able to hold many ideas – often apparently contradictory ones – together in creative tension, without reaching for premature resolution of ambiguity. Hence they can sometimes reach a richer synthesis.

In the process of creating innovation it is important to engineer the complex system of measuring the team performance towards innovations (Meinel, Leifer, 2020; Hu, Zheng, 2021; Gajdzik, Wolniak, 2023). This team performance is a complex phenomenon that involves person, behaviour and environment parameters interacting with and influencing each other over time (Sonalkar et al., 2018). Besides mentioned points it is important to use following points to increase the level of team innovativeness within your organization (Sloane, 2006):

- Hold meetings that are focused on opportunities rather than problems. Communicate the benefits to the whole organization of investing in innovation.
- Set targets for innovation in products, services and processes.
- Identify existing products and processes that are scheduled for retirement.

- Target three new initiatives for every innovation needed.
- Set up cross-functional teams with clear innovation objectives, and motivate them to be radical and take risks.
- Put prototype implementation into a separate department or function (the ‘innovation incubator’) staffed by go-getters who have a good diversity of skills.
- Set goals and deadlines.
- Implement a gating procedure to evaluate ideas and prototypes using a system such as Stage-Gate (a trademark of R G Cooper and associates).
- Measure innovation performance for people, products and processes against targets. Put someone with clout and prestige in charge of innovation efforts.
- Encourage people to move laterally within the organization from department to department to cross-fertilize ideas and cultures.
- Put your best people on innovation projects, and ensure that such projects are seen as good for career development.

The conceptions of enhancing team innovativeness are very useful because of the increasing complexity of the scientific and technical innovations required to address social, economic, health, energy, defence, and others national problems (Bozeman, Boardman, 2014). In the case of strategic approach to team management boasting innovativeness, senior executives must remember that (Russell, Shane, 2016; Mitchell et al., 2021):

- Every authorized program and project clearly supports an approved strategic objective of the organization.
- All significant innovations are achieved through application of the principles of project, program, and portfolio management.
- Each project’s risks are identified, evaluated, and managed using currently available methods and systems.
- All projects are evaluated, prioritized, and approved on the basis of the same corporate criteria.

5. Open and close innovations and team approach

The team management to create innovative environment should go towards open innovations (Lei et al., 2021). Open innovation is commonly seen in contrast to closed innovation (we compared them in the table 5). Closed innovation refers to an innovation model where a company develops, evaluates, test and commercialises only internal innovations using only internal resources and employees (Riedl, 2011; Ziegert, Dust, 2021; Mitchell, Boyle, 2021).

Table 5.
Close innovation versus open innovation

Close innovation	Open innovation
The smart people in our field work for us.	Not all the smart people work for us. We need to work with smart people inside and outside our company.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	The company that gets an innovation to market first will win.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our intellectual property, so that our competitors don't profit from our ideas.	We should profit from others' use of our intellectual property, and we should buy others' intellectual property whenever it advances our own business model.

Source: (Riedla, 2011).

6. Conclusion

The publication concentrate on problems connected with various aspects of team innovations. In the paper we presented the system of interactions which exist between negotiators in team especially from innovativeness point of view. Also we analyzed problems connected with team creativity and boasting it because team creativity is indispensable to boast innovativeness in industrial company. On the basis of the literature analysis it can be pointed out that the satisfying level of innovativeness can be achievable without appropriate level of creativity. To enhance it within company we need to give the people enough freedom and appropriate leadership adjusted to the culture of people. Also it is important to integrate creativity concepts and methods enhancing creativity into day-to-day operation of the organization. The organization should careful plan the division of the resources between innovative tasks.

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THE IMPACT OF PROJECT EXCELLENCE ON THE LEVEL OF PROJECT MATURITY OF AN ORGANIZATION

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Purpose: The main research objective entails identification of the project excellence manifestations in project-immature organizations as well as delineation of the areas of excellence positively affecting the PMMM-model-accordant organizational project maturity.

Design/methodology/approach: To achieve the research objective, the methods of bibliometric analysis and literature review, as well as an opinion survey, statistical analysis and LOGIT modeling, were used in the theoretical and the empirical dimensions respectively. The study covered a group of large organizations registered in Poland, which were assessed with respect to their levels of project maturity and excellence. The statistical analysis carried out allowed a delineation of the excellence areas positively impacting project maturity in organizations at low stages of project maturity.

Findings: The vast majority of the examined group of large organizations is characterized by low levels of project maturity and excellence. The entities surveyed meet the excellence criterion mainly in the areas of process integration and culture. Statistically, the area of excellence supporting organizational project maturity is informal project management. Areas of project excellence, which, if properly managed, will positively affect the level of organizational project maturity have been identified.

Research limitations/implications: The use of non-probabilistic sampling is a research limitation restraining the conclusions formulated to the surveyed group of 48 large organizations. The study carried out can serve as an inducement of extended empirical investigations. Future research should be focused on the search for the factors supporting and hindering the achievement of higher levels of project maturity, in order to formulate assumptions regarding a strategy enabling organizations' transition to higher levels of project maturity.

Practical implications: The research results indicate important interdependencies between the stages of project maturity and the areas of excellence. These interdependencies call the attention of business and project-management practitioners to the prospect of achieving higher levels of organizational project maturity through targeted management of the key, from the positive-impact perspective, areas of project excellence. Recognition of these mechanisms should encourage businesses to take deliberate steps aimed at improvement of organizational project management.

Originality/value: The article fills an important cognitive gap by indicating that management activities focused on the project excellence areas identified in the paper can positively impact the levels of project maturity. The results can be of significance for both the researchers exploring for the factors supporting the achievement of higher project-maturity levels as well as the practitioners, i.e., organizations keen on methodical improvement of project maturity levels.

Keywords: project maturity, project excellence, project management, PMMM, computer science.

Category of the paper: Research paper.

1. Introduction

The contemporary organizational environment is characterized by complexity (Schneider et al., 2017) uncertainty (Sanchez, 1997), hypercompetition (Moravveji et al., 2007), fast pace (Constanzo, 2004) as well as dynamism and turbulence (Camillus, Datta, 1991; Salmela et al., 2000; Lee, 2000). The above features of economic environment generate a state, in which organizations seek management formulas allowing dynamic response to the changing structure of the exogenous factors. This requires a design of highly flexible operating systems and organizational structures enabling simultaneous focus on the activities aimed at increasing, inter alia, productivity, process efficiency of genotypic (indigenous) activity, as well as research and innovation activities, the purpose of which should entail the search for new areas of added value generation. This fits in with the assumptions of the *ambidexterity* concept, and thus necessitates implementation of management activities aimed at balancing the exploitative and exploratory activities (Tushman, O'Reilly, 1996), ergo, calls for focus on activities that are grouped into such operational categories as processes (exploitative and exploratory) and projects (cf. Kohlborn et al., 2014; vom Brocke et al., 2016; Bitkowska, 2019). The article centers on the exploratory layer, the key object of the construction of which encompasses both the project area and the management of this operational category.

To identify the degree of organizations' conscious implementation of project management elements, models of project maturity (cf. Kohlegger et al. 2009) and project excellence (Kerzner, 2001, 2003) assessment are used.

The starting point for addressing the issue of project excellence manifestations in project-immature organizations entailed the results of literature studies. The research results published in the Polish literature indicate a low level of project maturity in the organizations operating in Poland (e.g., Juchniewicz, 2009a; Spalek, 2013). This, in the Authors' opinion, makes the attempts to identify the manifestation of project excellence in project-immature organizations and to delineate the areas of excellence positively affecting the achievement of higher levels of maturity a worthwhile and constructive task. Project immaturity, according to the PMMM model adopted in the study, should be defined as an organizational system allowing

classification of a given organization within one of the first four stages (levels) of maturity, whereas a project-mature organization is identified as an organizational state characteristic of the fifth stage (level) of maturity. It should be noted here that, for the purpose of this article, the target level of organizational project maturity has been set at the strategic level. This means that, from the perspective of organizational strategy and goals, it is not always necessary to aim for the highest level of maturity, but to set a desired target level thereof.

As a result of the bibliometric analysis and literature review, a knowledge deficit was outlined, indicating the need as well as the manner of identifying the project excellence manifestations in organizations characterized by low levels of project maturity.

The theoretical study has revealed three cognitive gaps intersecting at two planes:

- the theoretical, stemming from the paucity of publications describing the relationship between the levels of organizational project maturity and project excellence,
- the empirical, consisting in the paucity of publications presenting the results of project excellence levels, particularly in organizations which had carried out project maturity assessments.

The cognitive gaps presented have led the Authors to outline the following research problem: Which of the areas listed in the H. Kerzner's model of project excellence exert positive impact on increasing project maturity in project-immature organizations (organizations at stages 1-4 of the PMMM model)? The following research questions were posed with regard to the research problem formulated:

- PB1: At which stage of project maturity are large organizations operating in Poland?
- PB2: At which level of project excellence are large organizations operating in Poland?
- PB3: How to identify the project excellence manifestations, in order to achieve higher levels of project maturity using the assumptions of the project management method?

To answer the research questions posed, a wide range of research methods, including bibliometric analysis, literature review, an opinion survey, and statistical methods, were used.

The main objective of the research undertaken is to identify the manifestations of project excellence in organizations classified as entities at the first, second, third and fourth stages of project maturity, in accordance with the PMMM model developed by H. Kerzner (2001, 2003), and to delineate the areas of excellence positively affecting organizational project maturity.

The main research objective was assigned sub-objectives within the empirical dimension (CCE).

- CCE1: To assess the level of project maturity in a non-probabilistically selected group of large organizations operating in Poland.
- CCE2: To assess the level of project excellence in a non-probabilistically selected group of large organizations operating in Poland.
- CCE3: To delineate the areas of excellence positively affecting project maturity in organizations at low stages of project maturity (stages 1-4).

As a result of the empirical study, only 3 organizations, out of the 48 surveyed, were qualified as project-mature organizations. Ultimately, a set of areas of excellence positively affecting the organizational project maturity was identified in the sample of 45 organizations.

2. Research Background – project maturity and project excellence

2.1. Bibliometric analysis – identification of publications simultaneously addressing the issues of project maturity and project excellence

The theoretical study began with the implementation of a bibliometric analysis based on the Web of Science Core Collection (WoS) resources. The bibliometric analysis was aimed at identification of publications simultaneously addressing the issues of project maturity and project excellence. Table 1 presents a summary of selected bibliometric indicators for the search terms identified in the WoS database. It should be emphasized here that, for comparative purposes, the indicators were compiled in a thematic distribution by the ‘project maturity’ and ‘project excellence’ fields, using the keywords presented in Table 1. The search results apply to the topic search area within all the WoS categories, as well as English-language publications, due to the subsequent detailed analysis thereof.

Table 1.

Summary of selected bibliometric indicators for the set of keywords explored

Entry	Years of publication	Number of publications	h-index	Number of citations per publication	Total number of citations
Project maturity	1969-2022	4040	97	14.27	57650/55639*
Project management maturity	1990-2022	1692	60	12.22	20670/19405*
Project excellence	1961-2022	3070	79	11.79	36197/35806*
Project management excellence	1985-2022	867	50	11.84	10268/10201*
Project maturity and Project excellence	1997-2022	46	10	17.04	784/783*

* without self-citations

Source: compiled on the basis on Web of Science databases (access: 12.11.2022).

Table 2 compares the keywords searched with the Web of Science disciplinary categories in which they appear most frequently.

Table 2.

Summary of the main Web of Science categories for the set of keywords explored

Web of Science Categories	Project maturity	Project management maturity	Project excellence	Project management excellence	Project maturity and Project excellence
Management	12.82%	23.29%	9.12%	23.18%	31.48%
Computer Science Information Systems	10.82%	13.89%	3.55%	3.92%	5.56%
Computer Science Software Engineering	10.64%	10.17%		2.31%	3.70%
Computer Science Theory Methods	8.71%	9.16%	3.42%	3.92%	1.85%
Engineering Electrical Electronic	7.55%	8.22%	4.66%	3.92%	3.70%
Engineering Industrial	6.81%	11.17%	3.19%	7.15%	5.56%
Business	6.21%	10.23%	3.39%	8.42%	12.96%
Economics	3.07%	3.72%	2.05%	3.11%	5.56%
Education Educational Research			17.82%	13.26%	5.56%
Engineering Multidisciplinary					9.26%

Source: compiled on the basis on Web of Science databases (access: 12.11.2022).

As a result of the bibliometric analysis, 3 generalizing conclusions were formulated.

Number of publications

The issues of project maturity are much more frequently addressed on the theoretical, methodological and empirical planes, compared to project excellence. Against that background, publications combining both areas are scarce.

Topicality of the subject matter

All search terms reached the highest citation rate in 2021, while 2022 is not yet closed. This demonstrates the timeliness of the topics and the growing interest in the matter. The relevance of the organizational project maturity and excellence issues can also be evidenced by the number of conferences, as a result of which the share of post-conference materials devoted to these topics accounts for almost 50% in the set of the publications examined.

With regard to the topics combining the concepts of project maturity and project excellence, the interest in the issue is quite high, although relatively few studies have been produced over nearly 25 years. This is evidenced by the continued high citation rate, as of 2019, and the same the highest citation rate per publication, compared to the other keyword search entries.

Disciplinary categories

Both the issues of project maturity and project excellence are interdisciplinary in nature, with a dominance of the 'Management' category. Publications combining the two areas are mainly located within the 'Management' and 'Business' categories. This possibly indicates a large rendition of such a combination of issues in the business aspects, much greater than in the case of a disjoint approach to each area.

This part of the theoretical study resulted in an outline of cognitive gaps, consisting in the paucity of publications addressing the relationship between project maturity and excellence, and consequently the lack of research data describing and exemplifying the two organizational states.

After examining 46 publications, 12 articles were qualified for further detailed analysis, in the context of the research objective (i.e., to identify the relationship between project maturity and project excellence). The English-language publications identified within the WoS database, which attempt to explain (partially at the very least) these relationships on a theoretical-cognitive plane include Dolata (2019a, 2019b), Fajsi (2022), Bersam (2017). Other studies dealing with similar subject areas address slightly different sets of relationships.

The results of the studies presented in these publications can, nevertheless, indirectly explain certain aspects of the dependence between project excellence and maturity. The analysis of these publications enabled delineation of the following frames of reference, in association with the approaches to project maturity and project excellence:

- project management effectiveness, assessed via a combination of the Balanced Scorecard and the EFQM Excellence Model (Scheiblich, 2017),
- a project maturity model developed for Spanish organizations based on the most common business practices thereof (Amendola, 2016),
- project maturity models used as a tool for determining the level of company competitiveness within a given industry (Chovanova, 2017),
- a maturity model for construction projects, which combines the ICMM model with the EFQM excellence model (Guangbin, 2020),
- the impact of project maturity on the increase of operational excellence in the construction industry (Xing, 2011),
- the impact of project management centers of excellence (CoEs) on project management maturity (Walker, 2005),
- software-development project excellence vs. quality-culture maturity (Karout, 2017),
- organizational maturity (including project maturity) versus high reliability of hospital units (Chassin, 2013).

Publications the research content of which did not overlap with the research topics assumed were excluded, i.e., articles addressing the following issues were not considered:

- BIM maturity measurement at the levels of project, organization and industry,
- assessment of the technological maturity of micro and nano manufacturing processes,
- the impact of process excellence elements on the digital transformation of companies,
- the impact of business and process analytics on business excellence,
- achievement of organizational excellence through digital-maturity enhancement projects,
- Maturity Model for Innovation in SMEs,
- technological maturity and excellence vs. organizational development strategy.

A study (Dolata, 2019a) based on a research carried out in public sector organizations (basic local-government units in Poland) has outlined a set of variables most and least determining project management success and formulated the key success factors, which include the following: commitment and support of the superiors representing basic local-government units in Poland; appropriate schedules of project activities (including appropriate distribution of tasks and responsibilities); appropriate selection of project team members (taking the competence, experience, attitudes and commitment thereof into account); identification and regular monitoring of risks, for all projects implemented; as well as risk management ability. The group of the factors least correlated with organizational project maturity included: project management orientation on people (provision of knowledge enhancement and skill improvement, development of an appropriate incentive system, and assurance of a proper flow of information), organization of project team working meetings, and the development of communication rules (Dolata, 2019a, p. 213).

Another study (Dolata, 2019b) presents selected aspects of project management serving as a possible source of competitive advantage, on the example of basic local-government units in Poland. It should be emphasized here that, as per the author of the publication, competitive advantage, in the context of the public sector units analyzed, is based on the satisfaction of the stakeholder needs. The study shows that a relationship exists between the importance assigned by municipalities to individual project tasks and the level of project maturity. The findings show that, according to the respondents, achievement of competitive advantage in project management is determined by both soft and hard project management factors. Based on the research results obtained, M. Dolata pinpointed that achievement of competitive advantage in project management is primarily dependent on the synchronization and coordination of the activities carried out in projects. This requires a structured, homogeneous approach to project management, which is primarily facilitated through implementation of various standards encompassing project management methodologies and techniques (Dolata, 2019b).

A study (Fajsi, 2022), in which an attempt was made to determine the impact of different levels of project management maturity (PMMM) on business excellence, in the context of Industry 4.0, contrasted project maturity with business excellence. The study covered 124 organizations awarded business excellence awards by the European Foundation for Quality Management (EFQM) and proved that higher levels of organizational project management maturity have positive impact on business excellence. Statistically significant differences were also noted between the individual dimensions of project maturity and the impact thereof on business excellence, except for one – the cultural factors. The study indicated that organizations with high levels of excellence define quite clearly and support a ‘corporate culture’ of project management.

Another article (Bersam, 2017) attempted to assess the project maturity of IT companies, using the H. Kerzner's model of organizational project excellence. While the theoretical considerations presented in the work did address the PMMM model, the study itself only

attempted to identify the dependencies between the components that are based on the characteristics of IT companies and the areas of project excellence. Foreign or multinational companies (characterized by greater ability to manage time, scope and quality within all phases of the project life cycle) as well as companies which have been operating in the sector longer (characterized by higher scores of integrated processes) showed better maturity assessment results. Contrarily, no significant relationship exists between the number of patents in a company and the level of project maturity - project maturity does not imply company innovation.

2.2. H. Kerzner's model of project management maturity (PMMM) and project excellence

Most of the existing project maturity models only deal with the maturity of project management processes. Kerzner's PMMM model, in addition to assessing the maturity of project management processes, also takes the relationships from the EFQM excellence model into account, providing a more complete picture of an organization's assessment, in terms of its project management capabilities. The PMMM model therefore finds broad application in empirical studies (Karlsen, 2011; Simangunsong, 2013; Rezaeean, 2012; Andersen 2003).

According to H. Kerzner, project maturity is identified as *development of systems and processes that are repetitive in nature and provide a high probability that each project will be a success. Repetitive processes and systems do not guarantee success. They simply increase the probability of success* (Kerzner, 2004, p. 34). The PMMM model identifies 5 stages of project maturity: embryonic, board support, line management support, development, maturity. The statements contained therein allow organizations to assess their levels of project maturity, indicating, at the same time, the steps necessary to achieve full project management maturity and improve organizational performance. As such, both the levels of project management maturity as well as the points of possible improvement are determined when applying the model (PMI, 2001).

Project excellence, on the other hand, occurs when *the growth and maturity phases of the project management life cycle are implemented* (Kerzner, 2004, p. 16). Kerzner's excellence model defines the level of project management excellence in terms of six areas: integrated processes, organizational culture, management support, training and education, informal project management and behavioral excellence (Kerzner, 2001). The six main segments of the model are understood as follows:

- Integrated processes: Integrated processes consist of all the areas of project management implemented in an integrated manner. An integrated use of processes affects the efficiency and success of project implementation.
- Organizational culture: This segment facilitates the organization's perception of its organizational culture in terms of its impact on project management, supporting the assessment of which elements of the culture positively affect project execution and which do not foster the effectiveness of project management processes.

- Management support: The role and support of senior management directly affects project excellence. Supportive management skills and appropriate communication with project managers increase the effectiveness of project management.
- Training and education: This segment indicates the ability to view the investment in training and education through the lens of a return in terms of a better contribution to project management. Performance of an educational assessment of a company, including indication of the contribution resulting from training and education, allows accurate determination of its project excellence.
- Informal project management: Such assessment draws attention to the team's ability to cooperate smoothly, without unnecessary formal protocols. This, of course, involves the ability to communicate effectively and the trust between project team members and managers.
- Behavioral excellence: Behavioral excellence focuses on the project manager's role in the organization, his/her positive and reliable behaviors. It also draws attention to the aspects of motivation in project management as well as the project team effectiveness.

In the article, project management excellence, in the context of the study carried out with the use of H. Kerzner's model, is equated with an organization's conscious discounting of the benefits resulting from the use of project management methods to ensure project implementation, from the perspective of the so-called iron triangle of project management, i.e., the project scope, cost and time (see Meredith, Mantel Jr., Shafer, 2017, p. 3).

3. Research Design

3.1. Research procedure

The study was carried out on the basis of the research steps formalized at the stage of outlining the concept of the proceedings presenting a plan of action in both the theoretical and empirical research stages.

- Step 1. Identification, using bibliometric analysis, of the publications simultaneously addressing the issues of project maturity and project excellence.
- Step 2. Systematic literature review. Analysis of secondary research on project maturity and excellence.
- Step 3. Outlining the cognitive gaps as well as the research problem and objectives.
- Step 4. Selection of the organizational project maturity and excellence models.
- Step 5. Selection of the survey method and sampling technique, including definition of the selection criteria and compilation of the organization register.

- Step 6. Implementation of the proper survey, using an opinion polling with the CAWI technique.
- Step 7. Analysis of the empirical data collected.
- Step 8. Assessment of the project maturity and excellence levels, based on the model developed by H. Kerzner.
- Step 9. Statistical analysis of the results, followed by LOGIT modeling.
- Step 10. Compilation and discussion of the results, including suggestions and recommendations for achievement of a higher level of project maturity.

3.2. Structure of the organizations under study

The empirical investigation was carried out in 2021. The study involved a research method of an opinion survey, carried out using the CAWI (Computer Assisted Web Interview) technique. The research sample was selected using a non-probabilistic technique with purposive selection. Only large organizations operating in Poland (the organization's headquarters are located on the territory of the Republic of Poland) were included in the survey. The classification criterion was company size, where the number of employees for large organizations exceeded 250 persons. At the stage of inviting the organizations selected to participate in the survey, a preliminary identification was additionally attempted, based on a declarative assessment of the degree of project management. Out of the 80 organizations invited, 74 organizations participated in the survey. After analyzing the data contained in the survey questionnaires, 48 organizations were ultimately qualified for the study. This means that, at the stage of the questionnaire verification, 26 organizations indicated no project implementation.

Out of the 48 correctly filled in questionnaires, the vast majority of the organizations were headquartered in the Pomeranian (16), Mazovian (7) and Lower Silesian (5) provinces. In the group of the entities surveyed, based on the PKD (Polish Classification of Business Activity), Finance and Insurance (12) as well as Manufacturing (11) were the most dominant business activity areas, as indicated by the largest number of the surveyed organizations. As a result, the organizations surveyed were divided according to the dominant type of activity: manufacturing (12), services (30) and trade (6). The last entity division criterion was the scope of the business activity conducted. Based on the respondents' declarations and the documentation analysis, the largest share of the organizations surveyed were entities operating internationally (25) and nationally (16). Detailed numerical share of the organizations included in the empirical investigation is shown in Appendix 1.

The survey questionnaire was completed by respondents representing different hierarchical levels, depending on the genotype (core) business activity. The respondent structure is shown in Figure 1.

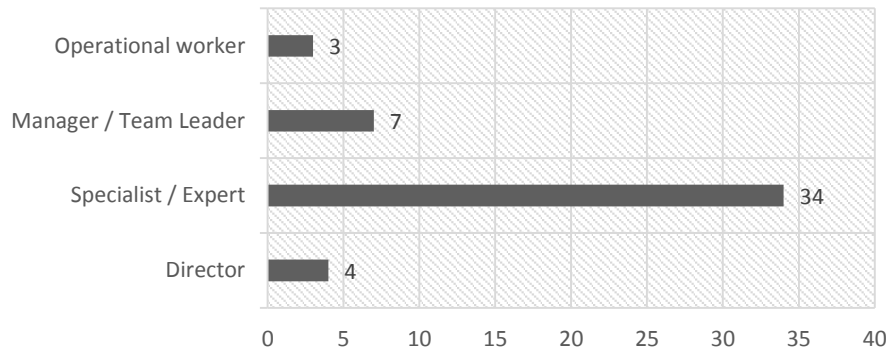


Figure 1. Survey respondent structure, N = 48.

Source: compiled on the basis of a study carried out in 2021.

The Authors aimed to address the survey tool to senior (e.g., director, manager) or middle-level (manager) executives. It should be noted here that specialists and experts constituted the largest share in the total number of the survey respondents. This group was dominated by such positions as, inter alia, process expert (3), quality management system specialist (7), process improvement specialist (4), project management specialist (12), investment project specialist (4).

4. Assessment of organizational project maturity and excellence – results of the empirical study

4.1. Assessment of project maturity in the surveyed group of organizations

Based on the research-questionnaire data generated in the empirical investigation, an attempt was first made to assess the degree of project maturity in the surveyed group of organizations, using the Project Management Maturity Model (PMMM) and a research tool (survey questionnaire) developed by H. Kerzner (2001, 2003).

Figure 2 shows the classification of organizations into PMMM-model maturity levels, based on the survey results obtained.

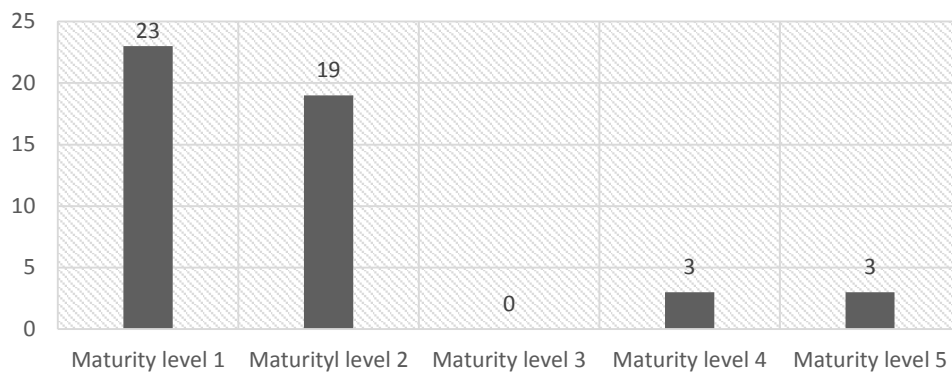


Figure 2. Summary of project maturity stages in the surveyed group of organizations, N = 48.

Source: compiled on the basis of a study carried out in 2021.

As Figure 2 shows, the vast majority of the organizations surveyed were classified as stage 1 (23) and stage 2 (19) entities. In the surveyed group of 48 entities, only 6 were qualified as organizations at maturity stages 4 (3) and 5 (3). The results obtained are in line with the results of the empirical investigations carried out in Poland, indicating a low level of organizational project maturity (e.g., Juchniewicz, 2009a; Spałek, 2013). It should be emphasized here that, due to the varied model of maturity, as well as the research methods (CAWI, CATI, observation) and the sampling techniques (non-probabilistic and probabilistic techniques) used, the study compiling possibilities are limited. Table 3 presents descriptive statistics for the maturity stages under examination.

Table 3.

Descriptive statistics for the PMMM-model maturity levels examined

Maturity levels	Median	MIN	MAX	Q1	Q3	SD
Level 1_PMMM	2	4	5	4	-4	8
Level 2_PMMM	0.75	2	4	2	-4	7
Level 3_PMMM	0	2	4	4	-4	7
Level 4_PMMM	1.75	4	5	4	-5	8
Level 5_PMMM	0	2	3	2	-5	8

* MIN – minimum value, MAX – maximum value, Q1 – quartile I, Q3 – quartile 3, SD – standard deviation.

Source: compiled on the basis of a study carried out in 2021.

As Table 3 shows, no entities meeting most of the criteria, approaching the maximum response value for the sum = 8, were observed in the surveyed group of organizations. The maximum results = 5, in the surveyed group of entities, were obtained for stages 1 and 4. The low median values for stages 3 and 5 of maturity are worth noting as well.

Figure 3, in turn, shows a summary of the organizations' stages, in distribution by the range of operation. Based on the results obtained, a conclusion was drawn that the organizations characterized by an international scope of operation were mostly classified at stages 1 and 2 of project maturity, with one organization classified at stage 4.

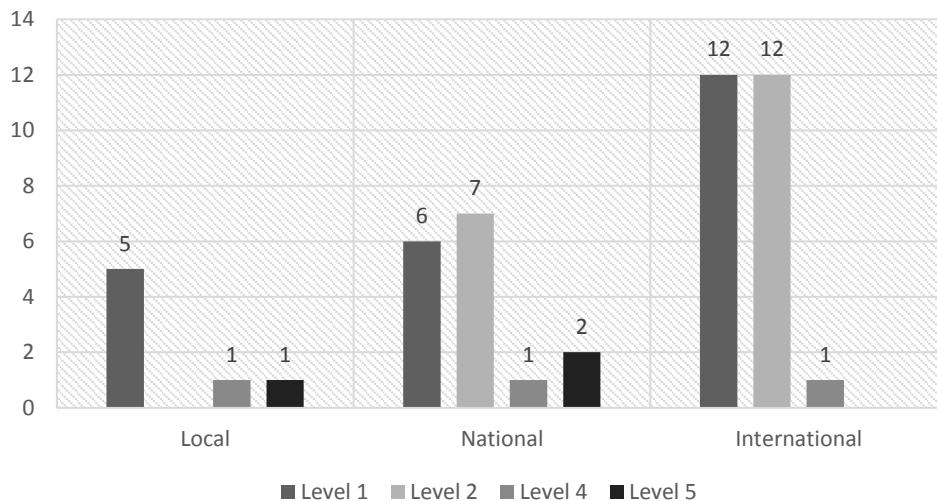


Figure 3. Summary of project-maturity stages in distribution by the surveyed organizations’ scope of operation.

Source: compiled on the basis of a study carried out in 2021.

Figure 4 shows the distribution of the organization classification, into one of the five stages (levels) of maturity, by the dominant activity of the entities surveyed. The results obtained for the group of the 48 organizations participating in the empirical investigation show that stages 4 and 5 were primarily achieved by the service sector organizations.

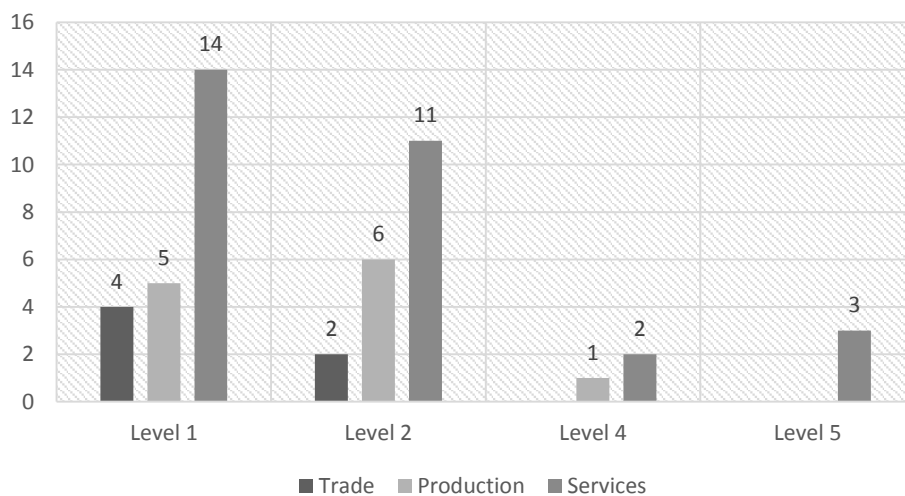


Figure 4. Summary of project-maturity stages by the surveyed group of organizations’ dominant activity.

Source: compiled on the basis of a study carried out in 2021.

In order to assess the scale homogeneity of the survey tool used, and thus the reliability of the questionnaire domain responses, the Cronbach's alpha test was used. The resulting index value for the project maturity assessment was 0.90. All the values obtained are above 0.70, which shows the compatibility thereof with the tool’s limit of acceptability, as described in the literature (see Hair et al., 2010).

4.2. Assessment of project excellence in the surveyed group of organizations

The second part of the empirical investigation entailed the assessment of project excellence in the surveyed group of 45 organizations (organizations at stage 5 of project maturity were excluded). The attempt to assess project maturity in the surveyed group of organizations was carried out using the excellence model and research tool developed by H. Kerzner (2001, 2003).

Just as in the case of the project maturity assessment, the Cronbach's alpha test was used to assess the scale homogeneity of the survey questionnaire used and the reliability of the responses received. The resulting index value for the project excellence assessment was 0.89. All the values obtained, as in the case of project maturity investigation, fall above 0.70, which is fully acceptable.

4.3. Identification of excellence manifestations in project-immature organizations

Based on the partial data obtained, Table 4 shows the descriptive statistics for the surveyed areas of project excellence assessment in the organizations under examination.

Table 4.

Summary of H. Kerzner's areas of project excellence assessment, N = 45

Assesment area	Model Max*	Median	MIN	MAX	Q1	Q3	SD
Process integration	35	24.5	2	34	20.75	27.5	7.625
Culture	35	23	8	31	18.75	26.25	5.632
Management support	35	15	8	25	13	20	4.530
Training and education	40	19.5	8	34	15.75	25.25	6.604
Informal management	30	14.5	7	24	12	18	3.987
Behavioral excellence	35	20	13	27	18	23.25	3.656

* According to the model, the MAX value indicates the maximum number of points to be scored in the area under examination.

Source: compiled on the basis of a study carried out in 2021.

According to the assumptions of the H. Kerzner's model, the partial results obtained enabled classification of the organizations surveyed into 1 of the 4 levels of excellence (2001, p. 729). This means that each of the areas investigated constitutes a component of the project excellence hexagon. Only one organization scored enough to qualify as an organization meeting the project excellence criteria, in accordance with the adopted assessment model of H. Kerzner (2001). The remaining organizations scored an average of 116 points, out of the possible 210.

It should be noted here that, despite the fact that the organizations surveyed were not classified as entities at the 5th stage of project maturity (as per the PMMM), they do show signs of excellence. The research proceedings assumed that the project excellence criteria are met, within a selected area of assessment, when the number of the points obtained exceeds 70% of the maximum value. The value adopted was developed based on the criterion of summative project excellence assessment in the H. Kerzner's model (2001, p. 729). As a result, out of the 45 project-immature organizations surveyed, 24 entities were identified as meeting the excellence criterion in the area of process integration, 14 in the area of culture, 2 in the area of

management support, 6 in the area of training and education, 2 in the area of informal management, and 4 in the area of improvement/excellence.

Using statistical methods (LOGIT modeling), an attempt was then made to identify the areas of project excellence assessment supporting the achievement of higher levels of project maturity in an organization. Dichotomous variables were used for this purpose (Table 5).

Table 5.

Classification of organizations by the criterion of project maturity and excellence

Project excellence\ Project maturity	Immature Organization	Mature Organization	Total
The organization does not meet the project excellence criteria	44	3	47
The organization does not meet the project excellence criteria. The organization meets the project excellence criteria (summation of the points scored in the 6 evaluation areas of the H. Kerzner's model)	-	-	1
Total	45	3	48

Source: compiled on the basis of a study carried out in 2021.

A catalog of dependent and explanatory variables was formulated, which are characterized in Table 6.

Table 6.

Dependent and explanatory variables in the logit models – characteristics

Variable type	Symbol	Variable	Description of variable
Dependent variable	ED1	Level1_PMMM_LOGIT	1 = a state, in which the organization can be described as meeting the criteria for stage 1 of project maturity 0 = a state, in which the organization does not meet the criteria for being classified at stage 1 of project maturity
	ED2	Level2_PMMM_LOGIT	1 = a state, in which the organization can be described as meeting the criteria for stage 2 of project maturity 0 = a state, in which the organization does not meet the criteria for being classified at stage 2 of project maturity
	ED3	Level3_PMMM_LOGIT	1 = a state, in which the organization can be described as meeting the criteria for stage 3 of project maturity 0 = a state, in which the organization does not meet the criteria for being classified at stage 3 of project maturity
	ED4	Level4_PMMM_LOGIT	1 = a state, in which the organization can be described as meeting the criteria for stage 4 of project maturity 0 = a state, in which the organization does not meet the criteria for being classified at stage 4 of project maturity

Cont. table 6.

	EDex1	process_integration_LOGIT	1 = a state, in which the organization meets the integration area criteria of the project excellence model, 0 = a state, in which the organization does not meet the integration area criteria of the project excellence model
	EDex2	culture_LOGIT	1 = a state, in which the organization meets the culture area criteria of the project excellence model, 0 = a state, in which the organization does not meet the culture area criteria of the project excellence model
	EDex3	management_support_LOGIT	1 = a state, in which the organization meets the management support area criteria of the project excellence model, 0 = a state, in which the organization does not meet the management support area criteria of the project excellence model
	EDex4	training_and_education_LOGIT	1 = a state, in which the organization meets the training and education area criteria of the project excellence model, 0 = a state, in which the organization does not meet the training and education area criteria of the project excellence model
	EDex5	informal_management_LOGIT	1 = a state, in which the organization meets the informal management area criteria of the project excellence model, 0 = a state, in which the organization does not meet the informal management area criteria of the project excellence model
	EDex6	behavioral_excellence_LOGIT	1 = a state, in which the organization meets the behavioral excellence area criteria of the project excellence model, 0 = a state, in which the organization does not meet the behavioral excellence area criteria of the project excellence model
Explanatory variable	DsP_O1	process_integration	Total points scored in the area under study - process integration in the H. Kerzner's project excellence model
	DsP_O2	culture	Total points scored in the area under study – culture in the H. Kerzner's project excellence model
	DsP_O3	management_support	Total points scored in the area under study – management support in the H. Kerzner's project excellence model
	DsP_O4	training_and_education	Total points scored in the area under study – training and education in the H. Kerzner's project excellence model
	DsP_O5	informal_management	Total points scored in the area under study – informal management in the H. Kerzner's project excellence model
	DsP_O6	behavioral_excellence	Total points scored in the area under study – behavioral excellence in the H. Kerzner's project excellence model
	PMMM_1	Level 1_PMMM	Suma punktów uzyskana w obszarze badania dla etapu 1 (poziomu 1), według modelu dojrzałości projektowej H. Kerznera

Cont. table 6.

	PMMM_2	Level 2_PMMM	Total points scored in the area under study for stage 2 (level 2) in the H. Kerzner's project excellence model
	PMMM_3	Level 3_PMMM	Total points scored in the area under study for stage 3 (level 3) in the H. Kerzner's project excellence model
	PMMM_4	Level 4_PMMM	Total points scored in the area under study for stage 4 (level 4) in the H. Kerzner's project excellence model
	PMMM_5	Level 5_PMMM	Total points scored in the area under study for stage 5 (level 5) in the H. Kerzner's project excellence model

* The classification of organizations into project maturity stages was developed based on the PMMM model assumptions (Kerzner, 2001).

Source: own compilation.

The impact of project-excellence areas on project maturity

An attempt was further made to identify and statistically assess the impact of the project-excellence assessment areas on the various stages of project maturity.

Table 7 (Model 1) shows the results of the LOGIT estimation for the dependent variable *EDI* (stage 1 of PMMM-model maturity).

Table 7.

Model 1 – LOGIT estimation for dependent variable EDI

Variable	Factor	Standard error	z	p value
const	-8.40178	3.56026	-2.360	0.0183**
process integration	0.0765907	0.0771873	0.9923	0.3211
culture	0.179481	0.111341	1.612	0.1070
management support	-0.147065	0.106696	-1.378	0.1681
training and education	0.105774	0.0783826	1.349	0.1772
informal management	0.238603	0.127202	1.876	0.0607*
behavioral excellence	-0.0310212	0.119029	-0.2606	0.7944

* $p < 0.1$. ** $p < 0.05$.

Source: own compilation using the GRETTL package. based on the data obtained via a study carried out in 2021.

In the presented Model 1. a statistically significant relationship between the explanatory variable *informal_management* and the dependent variable *EDI* was identified. indicating a statistical impact of the activities aimed at increasing informal project management on the satisfaction of the criteria for the first level of project maturity (*EDI*).

Table 8 (Model 2) in turn shows the results of the LOGIT estimation for the dependent variable *ED2* (stage 2 of PMMM-model maturity).

Table 8.

Model 2 - LOGIT estimation for dependent variable ED2

Variable	Factor	Standard error	z	p value
const	-12.5740	4.65308	-2.702	0.0069***
process integration	0.166348	0.0966110	1.722	0.0851*
culture	0.00227206	0.105838	0.02147	0.9829
management support	-0.0880701	0.0909013	-0.9689	0.3326
training and education	0.0177747	0.0709770	0.2504	0.8023
informal management	0.174158	0.117572	1.481	0.1385
behavioral excellence	0.289165	0.143493	2.015	0.0439**

* $p < 0.1$. ** $p < 0.05$. *** $p < 0.001$

Source: own compilation using the GRETTL package. based on the data obtained via a study carried out in 2021.

Based on Table 8. it can be noted that the factor supporting the achievement of the second stage of project maturity encompasses the activities within the excellence-related area. identified in the model as *behavioral_excellence*. The following have been qualified as such activities: project team building as well as the project managers' roles, skills and training.

Table 9 (Model 3) shows the LOGIT estimation results for the dependent variable *ED3* (stage 3 of PMMM-model maturity).

Table 9.
Model 3 - LOGIT estimation for dependent variable ED3

Variable	Factor	Standard error	z	p value
const	-13.0480	4.71059	-2.770	0.0056***
process_integration	0.103091	0.0943322	1.093	0.2745
culture	0.0949973	0.125692	0.7558	0.4498
management_support	-0.0757431	0.0928785	-0.8155	0.4148
training_and_education	0.0152105	0.0710570	0.2141	0.8305
informal_management	0.215273	0.126960	1.696	0.0900*
behavioral_excellence	0.247795	0.139195	1.780	0.0750*

* p < 0.1. ** p < 0.05. *** p < 0.001.

Source: own compilation using the GRETLL package. based on the data obtained via a study carried out in 2021.

Based on Model 3. a statistical relationship between the variables *informal_management* and *behavioral_excellence* as well as the dependent variable *ED3* was identified.

Table 10 (Model 4) shows the LOGIT estimation results for the dependent variable *ED4* (stage 4 of maturity).

Table 10.
Model 4 - LOGIT estimation for dependent variable ED4

Variable	Factor	Standard error	z	p value
const	-11.8009	4.20300	-2.808	0.0050***
process_integration	0.0701438	0.0806508	0.8697	0.3845
culture	0.231312	0.135190	1.711	0.0871*
management_support	-0.219779	0.117339	-1.873	0.0611*
training_and_education	0.0694560	0.0797787	0.8706	0.3840
informal_management	0.381712	0.148944	2.563	0.0104**
behavioral_excellence	0.0764272	0.126001	0.6066	0.5441

* p < 0.1. ** p < 0.05. *** p < 0.001.

Source: own compilation using the GRETLL package. based on the data obtained via a study carried out in 2021.

As Table 10 shows. statistically significant impact of such explanatory variables as *culture*, *management_support* and *informal_management* on the fourth stage of PMMM-model project maturity (variable *ED4*) was identified. The organizational-culture aspect fits in with the opinion of K. Piwowa-Sulej (2015). according to whom *the success factor of project implementation in organizations employing a project approach is unquestionably the project culture [...]. The concept of organizational culture thus approximates the issue of project maturity* (Piwowa-Sulej, 2015, p. 256).

Summing up, 4 factors associated with the level of informal management in H. Kerzner's (2001) excellence model were classified within the set of the excellence areas identified as the potentials supporting the achievement of higher stages of project maturity.

The first factor pertains to employee promotion to line (functional) managerial positions, based on the managerial skills possessed. This approach indicates the need to reconfigure the desired, from the perspective of an organization's objectives and strategies, role of the functional manager, from a specialist (expert) in the implemented part of the process, towards a manager overseeing the knowledge potential of employees, whose role, in the context of project management, should entail provision of the resources necessary for project implementation (matrix structure).

The second factor pertains to the organizational culture within the trust-, communication, and cooperation-based spheres of project management. This area of excellence is in line with J. Skalik's opinion, according to whom *achievement of excellence in organizational project management is also characterized by its cultural determinants. The organizational culture prevailing in a changing institution should support the four core values in project management: cooperation, teamwork, trust and effective communication* (Skalik, 2014, p. 33). The driving force behind a collaborative culture entails improvement of communication, trust and teamwork. Such-outlined factors facilitate project management, resulting in reduced project costs and implementation time as well as in lesser reliance on rigid rules and procedures (Magano et al., 2021, as cited in Spalek, 2014; Kerzner, 2019). Moreover, in an empirical investigation of biotechnology companies, carried out by J. Magano et al. (2021) the majority of the respondents indicated that an organization's culture is characterized by informal project management.

The third factor concerns organization design based on a low level of formalization. In the context of the issue under study, this pertains to the time devoted to report generation, which can have positive impact on the reduction of the associated costs.

The fourth factor pertains to the process of project planning in an organization. Checklists and guidelines are in demand in this regard. The importance of project planning, in terms of successful project completion, has been also pinpointed in the work (Iqbal et al., 2018) on the example of IT software development.

The analysis of the partial results of the organizational maturity assessment carried out has led to the identification of a relationship between the organizational structure and the level of maturity in the organizations surveyed (Figure 5).

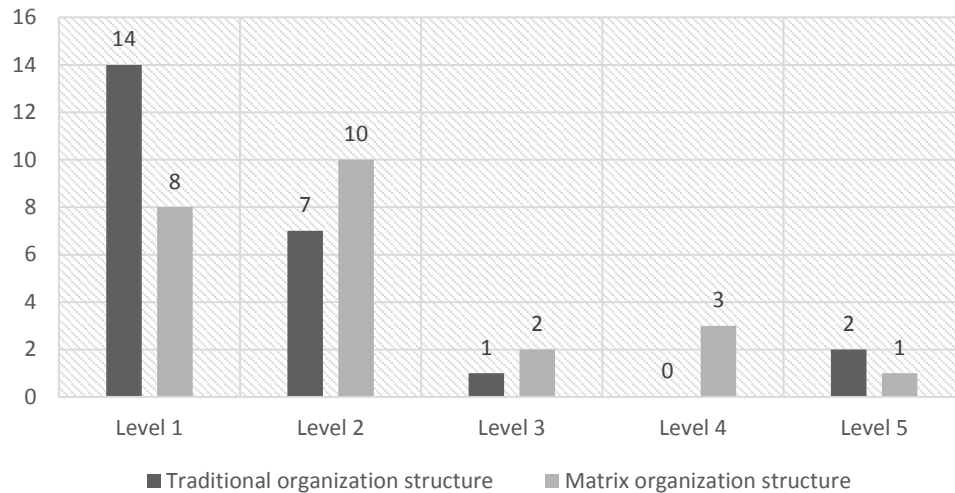


Figure 5. Project-maturity level classification of the surveyed group of organizations by declared organizational structure. for N = 48.

Source: own compilation based on a study carried out in 2021.

Based on Figure 5. it can be noted that higher levels of maturity are achieved by organizations in which the traditional structure, identified as functional in the study, is replaced by matrix solutions.

5. Conclusions

The theoretical and empirical research carried out has led to the formulation of 4 conclusions of a generalizing nature.

First, the theoretical study has highlighted the cognitive gaps, consisting in the paucity of publications describing the relationship between project maturity and excellence, the essence of which has been undeline*d*, *inter alia*, in the work (Martusewicz, Szumowski, 2018). The study has filled (to some extent) the research gaps described in the introduction, indicating that management activities focused on the project excellence areas identified in the work can positively affect the level of maturity. This is particularly true in informal process management. It should be emphasized here that the results obtained constitute a mere starting point for much broader empirical investigations.

Second, based on the assumptions of the project maturity and excellence models developed by H. Kerzner (2001, 2003), it has been determined that the vast majority of the surveyed large organizations operating in Poland is characterized by low levels of project maturity and project excellence.

Third. 45 project-immature organizations were identified as meeting the excellence criterion in such assessment areas as process integration (24). culture (14). management support (2) training and education (6). informal management (2) and behavioral excellence (4).

Four. the LOGIT modeling carried out indicated that statistically. the area of excellence supporting organizational project maturity is informal project management. This fits in with the conclusions of a similar study conducted in the public sector (Dolata, 2014). According to M. Dolata: *the observations made indicate that. according to the respondents. the achievement of successive levels of project maturity is largely influenced by the soft factors of project management* (2014, p. 81).

Like any such survey. this study too is not free of research burdens and limitations. These burdens can result from the CAWI technique used. i.e. the lack of contact with the respondent and the unfeasibility in terms of leveling the errors resulting from incorrect understanding of the questions and answers. It should be also underlined that. due to the non-probabilistic sampling technique used. the conclusions formulated are limited to the surveyed group of 48 large organizations operating in Poland. Research reliability. nevertheless. entails one of the typical problems in this area. namely the determination of a sufficient sample size. In order to assess the questionnaire response reliability. the Cronbach's alpha test was used. The issues of Cronbach's alpha test application and sufficient sample size have been widely discussed in the literature (Bland, Altman, 1997; Yurdugül, 2008; Samuels, 2015). The literature on the subject suggests that the sample size should be at least 30. and this condition was met in this study.

The research results presented in this work serve as an inducement of extended empirical investigations. The Authors intend to carry out further research. focused on the search for factors supporting and hindering the achievement of higher levels of project maturity. taking both the classical (cascade) and iterative/incremental methodologies into account. It is worth pinpointing here that identification of the factors supporting and hindering the achievement of project maturity can enable formulation of strategy assumptions for organization transition to higher levels of project maturity.

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