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RISK MANAGEMENT IN THE SUPPLY CHAIN IN THE LIGHT OF THE ENTERPRISES' EXPERIENCES DURING THE COVID-19 PANDEMIC

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Purpose: The purpose of the study was to identify key reasons for intensifying risk management activities in supply chains. To achieve the objective, the following research hypotheses were adopted: H1 - the extent of business activity is not correlated with problems related to demand constraints and timeliness of payments, H2 - disruptions in supply chain continuity during a COVID-19 pandemic are independent of the type of chain.
Design/methodology/approach: These paper highlights the importance of risk management in the supply chain management in addressing the pandemic induced disruptions and supply chain risk management activities. Achieving the stated goal requires answering two questions: (1) What problems are companies facing due to the coronavirus pandemic, and (2) What actions are companies taking to ensure supply chain continuity, especially in Poland conditions. 137 enterprises participated in the research, including 118 with foreign capital. The survey was conducted online. The research sample included entities from the manufacturing, trading, and service sectors located throughout Poland. Companies were selected using a snowball method, starting with supply chain managers from friendly entities and asking them to identify other entities that could take part in the study.
Findings: The research showed that the continuity of supply chains in Poland was not maintained, and companies were able to keep inventories only at a minimum level. The research also analysed the impact of remote work on the effects of the functioning of enterprises and assessed the effects of support under anti-crisis shields.
Originality/value: The research has been carried out in order to identify the factors that have the greatest influence on the efficiency of the supply chains of Polish enterprises. The research showed that the continuity of supply chains in Poland was not maintained, and companies were able to keep inventories only at a minimum level.
Keywords: risk, risk management, supply chain, COVID-19, pandemic, enterprise, Poland.
Category of the paper: research paper.

Introduction

Supply chains that form a network of organizations involved, through links with suppliers and customers in various processes and activities that create value in the form of delivered consumers are extremely complex systems of interconnected vessels. In managing such a complex structure, there are always events and phenomena that are difficult to predict, and the probability of violating any of the links is usually high. Therefore, skilful risk management in supply chains becomes a key competence (Bevilacqua et al., 2020). This became particularly apparent after the shock of the SARS-CoV-2 pandemic, at which time all players, regardless of industry, had to take a series of countermeasures to ensure their continued operation and viability.

For almost two years, the world has been overwhelmed by problems resulting from the SARS-CoV-2 pandemic. The pandemic has redefined the way companies look at the world. The prevalence of health problems has changed the balance between productivity, profitability, job security, occupational health, and the environment. It has restricted access to labour and imposed social distance (Ashokka, 2020). COVID-19 has caused massive disruption to global supply chains. The pandemic is an example of the so-called black swan, i.e. an unpredictable event with a huge impact on the reality a high diversity of risks (Taleb, 2007). The factor that makes the SARS-CoV-2 pandemic different from other threats that have taken place in recent decades is its global scope and duration. As a high-risk event, the pandemic has triggered an unprecedented crisis and exposed the flaws in the existing supply chain management system and the vulnerability of companies working with a limited number of trading partners, often located in remote parts of the world. Due to the supply chain disruptions, companies dependent on global sourcing had to make difficult decisions regarding crisis management strategies. The decisions made can be affected by both the lack of labour to physically move goods and government restrictions on the operation of seaports and airports, causing difficulties in loading and unloading goods (Schoenfeld, 2020).

In such a complex structure like supply chains there is always a threat of random events and phenomena that cannot be fully predicted due to unknown causes, as in the case of the COVID-19 pandemic. COVID-19 not only caused a global tragedy (human deaths - from the beginning pandemic 5.01.2020 to 25.02.2024, there have been 774 771 178 confirmed cases of COVID-19, reported to WHO (https://covid19.who.int, 10.03.2024) but also affected supply chains. Therefore, the importance of risk management in the supply chain, understood as a decision-making process supporting the achievement of the planned goal at optimal cost with the help of procedures that enable the complete elimination or reduction to an acceptable level of any risks that threaten its achievement, increased. The pandemic has disrupted supply chains, forced businesses to remodel their structures and make concerted efforts to reduce potential risks in a post-pandemic world (Jabbour et al., 2020; Paul et al., 2021; Yang et al., 2020).

With this in mind, the goal of the article is to identify pandemic-induced disruptions and supply chain risk management activities. Achieving the stated goal requires answering two questions: (1) What problems are companies facing due to the coronavirus pandemic, and (2) What actions are companies taking to ensure supply chain continuity. The following hypothesis was adopted: the COVID-19 pandemic has disrupted supply chains, regardless of the nature of the business. In addition, it was assumed that the extent of business activity is not correlated with problems related to demand constraints and timeliness of payments. The study used methods of descriptive statistics and basic methods of statistical inference to test the relationship between variables (chi-square independence test).

Our research is relevant to both theory and practice. We point to a model-based approach to risk management, highlighting the need to take into account factors caused by the pandemic, and thus develop complex scenarios. The assumption that the pandemic disrupted all supply chains, regardless of industry, has been positively validated. The practical dimension of our research is reflected in the discussion of the results obtained.

This research logic determined the structure of the article. The first step of the research was a literature review, where the main focus was on presenting the nature of risk and its management in the supply chain in the era of the pandemic. The methodology describes the data collection and analysis process that was used to understand the impact of the pandemic on risk management in supply chains. We identify the determinants of supply chain risk management during a pandemic based on empirical research. The problems faced by companies after the pandemic outbreak are identified, as well as the steps that players had to take to stay in business. The research design is presented in Section 2. This section presents the rationale for undertaking research, methodology of the research. The paper ends with conclusions summing up the achievements of the undertaken problem – Section 3. Conclusions are presented in Section 4. It concludes by highlighting the consequences of a lack of risk management for all links in globalized supply chains and the need for a strategic approach to the issue.

Literature review

The management of supply chains relies on the active and systematic flow of goods and services, which includes all processes that transform raw materials into final products (Best, Williams, 2021; Tang, 2005). Risk is an inherent feature of supply chain management resulting from its complex structure. We can define it as a danger or threat that may prevent the achievement of the company's set goals.

Over the last 20 years, supply chain management has become a more sophisticated discipline. To cope with such turbulences and the changes inherent in today's supply chains, great attention, both in practice and research, has been given to strategies that minimize supply chain risks (Bakshi, Kleindorfer, 2009; Hendricks et al., 2009; Kern et al., 2012; Wieland, Wallenburg, 2012; Pisz, Kauf, 2022). The fundamental vision has been to create an integrated approach to a company's end-to-end supply chain, from the furthest upstream suppliers to its end customers, with participants working in concert toward common goals. Through practices such as lean manufacturing, outsourcing, and supplier consolidation, companies have made tremendous progress in achieving that vision. For many companies and their customers these efforts have led to lower costs, higher quality, shorter time to market, and increased business agility (Marchese, Paramasivam, 2013).

On one hand risk in business is becoming an increasingly important issue, mainly as a result of constantly increasing consumer awareness and intensifying globalisation processes. Globalisation processes started just after World War II. Companies looked for opportunities to save costs and began to enter into strategic alliances (through outsourcing and foreign direct investment) with entities located even in the most remote parts of the world. Production facilities moved from countries with high labour costs to Asia and Africa, where labour costs were low. This resulted not only in cost efficiencies but also in market expansion (Caniato et al., 2015; Caniato, Größler, 2015). Expanding the territorial coverage entails an increase in the dynamics of market processes, forcing a fast and flexible response to changing demand. Each time, this is accompanied by uncertainty and unpredictability. As a result, global supply chains are exposed to a number of risks, such as long execution times, delays, and over- or understocking. On top of this, there are risks typical of countries in which partners in the chain are based, which leads to a snowballing effect for local high-risk events.

On the other hand The Global Risks Report (2024) year warned of potential knock-on economic risks that are now clear and present dangers in many area of life and economics. Supply chain disruptions, inflation, debt, labor market gaps, protectionism and educational disparities are moving the world economy into choppy waters that both rapidly and slowly recovering countries alike will need to navigate to restore social cohesion, boost employment and thrive. These difficulties are impeding the visibility of emerging challenges, which include climate transition disorder, increased cyber vulnerabilities, greater barriers to international mobility, and crowding and competition in space (Figure 1). The Global Risk Report 2024 19th edition identifies tensions that will result from diverging trajectories and approaches within and between countries and then examines the risks that could arise from such tensions. This year's report also highlights the implications of these risks for individuals, governments and businesses (GRIR, 2024).

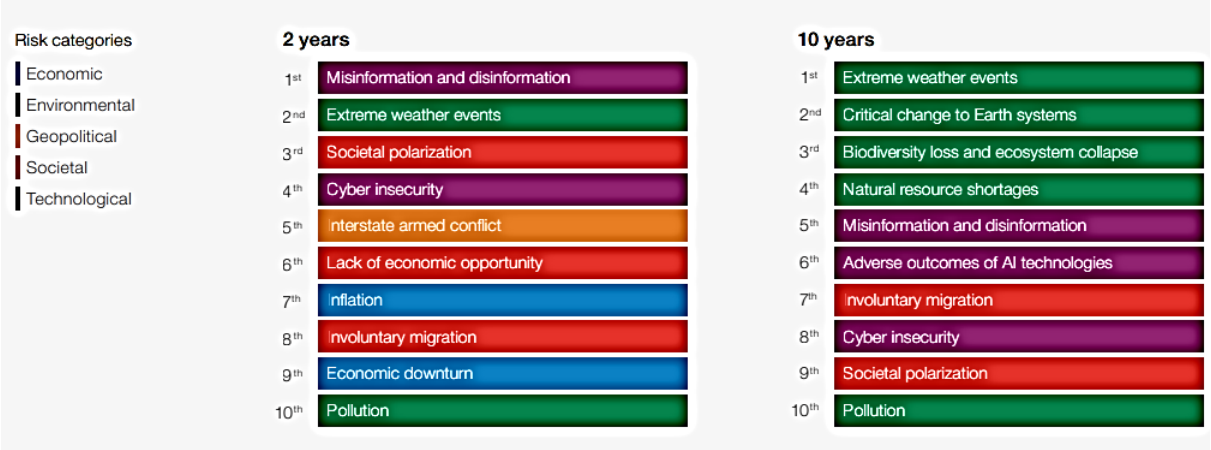

Figure 1. Identify the most severe risks on a global scale over the next 10 years.

Source: The Global Risks Report 2024, 19th Edition, World Economic Forum, 2024.

Risk management in the supply chain is a critical and increasingly complex issue. As economic practice shows, supply and sales markets are becoming gradually more distant from each other, while supply chains are becoming longer, more complex, and involve more partners. Moreover, given the constant economic changes (as a result of the global economic crisis and the uncertainty of the economic situation), political changes (growing threat of terrorism, wars, other military operations, and ship hijacking by pirates), technological changes (new technologies and shorter product life cycles), social changes (growing consumer awareness and demands, development of the information society, and faster spread of epidemics due to greater mobility of people), and climatic changes (increasingly frequent natural disasters, such as hurricanes and earthquakes) as well as the outbreak of the COVID-19 pandemic, the risk of the supply chain disruptions significantly increases.

Knowledge of supply chain risks is a critical success factor for the efficiency of the supply chain. The ability to anticipate risks and develop a scenario for use in an emergency is a key process for risk management in supply chains (Bakshi, Kleindorfer, 2009; Hendricks et al., 2009; Kern et al., 2012; Sodhi et al., 2012; Sharma et al., 2021).

Risk management at every node of a supply chain can help to prevent cascade failure of the supply chain (Wieland, Wallenburg, 2012). We should add that each node within a supply chain should play a value-adding role, additionally some nodes are typically more critical than others, for example production node or distribution node (Jüttner, Maklan, 2010; Lin, Wang, 2011). With respect to the field of risk management in the area of supply chain, this has been brought into full view because of COVID-19 pandemic. To cope with such turbulences as COVID-19 pandemic in today's supply chains, great attention, both in practice and research, has been given to strategies that minimize supply chain risks. The pandemic showed the increased role of risk management in the global chains, where the most of nodes gathered in the supply chains are located in the China (Dmitry et al., 2019; Dmitry, Das, 2020).

Rangel et al. (2015) identifies a lack of consensus among authors regarding the types of risks that affect supply chains and proposes a supply chain risk classification to address this gap. Paulsson (2003) characterizes the existing scientific knowledge in supply chain risk management and finds that the research area is fairly new and limited in terms of the number of articles available. Jüttner et al. (2003) emphasizes that the concepts of supply chain vulnerability and risk management are still in their infancy and calls for future research in this area. Singhal et al. (2011) discusses the need to consider risk issues as prime concerns in supply chains and provides a multi-layered taxonomy to classify and codify the literature, suggesting future research directions. Taschner & Charifzadeh (2020) emphasize that risk management is crucial in supply chains and suggests potential risk responses such as adapting the supply chain design and adopting a collaborative approach with supply chain partners. Vilko et al., (2011) focuses on the need for information exchange and cooperation among supply chain actors to effectively manage risks. Wiengarten 2016 explores the role of risk and risk management practices in the success of supply chain integration, suggesting that supplier integration and supply chain risk management practices can be effective even in high-risk environments. Ouabouch & Paché (2014) focuses on the impact of risks on the logistical performance of supply chains, emphasizing the need to anticipate and manage risks for maintaining a competitive advantage. Overall, these papers underscore the critical role of risk management in ensuring the resilience and performance of supply chains.

Jafarnejad et al. (2014) identifies financial risks, demand risks, and supply risks as the most important risks in the context of small and medium-sized enterprises (SMEs). Narasimhan et al. (2009) emphasizes the significance of risk management in supply chains due to industry trends such as strategic outsourcing, globalization, and reliance on suppliers and supply networks. Ouabouch 2014 examines the impact of risks in the upstream and downstream supply chain on logistical performance, based on a survey of Moroccan manufacturers. Bahroun (2015) focuses on the modern retail supply chain and emphasizes the need for decision support tools to manage supply chain risks, proposing a framework for categorizing risks and assessing their impact on performance. In summary, these papers collectively emphasize the importance of risk management in supply chains and provide insights into identifying, assessing, and managing various risks in different contexts.

Additionally, these papers collectively highlight the importance of risk management in the supply chain and identify areas for further research. Bahroun (2015) emphasizes the need for decision support tools to manage supply chain risks in the modern retail industry. Singhal (2011) discusses the impact of outsourcing and global partnerships on supply chain vulnerabilities and proposes a taxonomy for classifying and codifying risk issues. Pfohl et al. (2010) provides an overview of the state of the art in supply chain risk management research and offers a roadmap for its implementation in practice. Narasimhan (2009) acknowledges the significance of risk management in supply chains and highlights the need for further research

in this area. Overall, these papers underscore the need for effective risk management strategies in the supply chain and suggest avenues for future investigation.

Mańkowski et al. (2022) identifies three research gaps in managing supply chains during the pandemic, including concepts, methods, and tools for supply chain management. Fares & Lloret (2023) identify barriers to supply chain performance measurement during disruptions like the pandemic, such as uncertainty of investment and disrupted cash flows. Van Hoek (2021) explores the progress of supply chain risk management during the first year of the pandemic, finding that risks have increased in severity and that multifaceted approaches are needed for risk mitigation. Queiroz et al. (2020) highlights the impacts of epidemic outbreaks on supply chains, emphasizing the need for adaptation, digitalization, and sustainability in supply chain management during the pandemic. Ma'ady 2022 focuses on the importance of supply chain resilience during the pandemic for enterprise risk management. These papers collectively provide insights into the challenges and strategies for managing supply chain risks during the COVID-19 pandemic.

Additionally, these papers provide insights into risk management in supply chains during the COVID-19 pandemic. Trautrims et al., (2020) highlights that the pandemic has increased the vulnerability of workers to modern slavery in supply chains. Woong & Goh (2021) identify various risk management strategies employed by companies, with partnerships being the most frequently used strategy. El Baz & Ruel (2020) emphasize the role of supply chain risk management practices in enhancing supply chain resilience and robustness during disruptions. Szuster & Lotko (2022) discuss the need for a change in attitude towards risk management due to the impact of the pandemic. Overall, these papers emphasize the importance of proactive risk management approaches and the need for collaboration and adaptability in supply chains during times of crisis.

Capgemini's study "Rethinking chain resilience for an after-COVID-19 world" (Capgemini, 2021) found that more than 80% of companies have experienced pandemic-related disruption to their supply chains. Sherman (2020) reports that as many as 94% of Fortune 1000 companies have experienced disruptions resulting from COVID-19. Ernst&Young (2020) indicates that only 20% out of the 500 managers of the largest global corporations were confident in their ability to react quickly to such a big risk. The main causes of disruption included supply delays and international trade restrictions (Capgemini, 2021). Faced with disruptions on the demand and supply side, global supply chains have proven to be inflexible. The pandemic has disrupted many lean supply chain operations that rely on Just in Time and zero inventory management strategies, making them excessively susceptible to epidemic disruption. This forced executives and supply chain managers to almost immediately modify their supply chains and move towards agile and resilient approach to effectively manage black swan events (Belhadi et al., 2021). While it is possible to identify the short- and medium-term effects of COVID-19 given the persistent epidemic state, the long-term ones still remain

undetermined. Therefore, in supply chain risk management, on-going measures should not overshadow strategic considerations as short-term changes have a long-term impact.

The SARS-CoV-2 epidemic in Wuhan, China, has stopped imports of many key components to countries in Europe and beyond. As a result, the existing supply chains have been disrupted and relationships with suppliers and customers had to be re-examined with respect to the following risks:

- input risks involving delivery of goods from suppliers and their capabilities to provide goods (delays in delivery due to pandemic restrictions, the need to renegotiate payment terms, delays in the transport of goods due to local restrictions, such as closure of airports and seaports or border difficulties, and shortage of staff to receive shipments);
- output risks involving delivery of goods to customers (shortage of goods in the warehouse, the need to adapt packaging to new sanitary requirements, changed means of transport, and shortage of transport staff).

The crisis triggered by COVID-19 has made companies realise that relying on suppliers from just one region is too risky. The same is true for multi-tiered, geographically dispersed networks of subcontractors as a single disruption can lead to a knock-on effect. Therefore, in the short term, it seems necessary to identify products that are particularly dependent on a single supplier and consider diversification of supply sources and allocation of stocks. It is likely that managers will consider regions that they have not taken into account so far. Costs will certainly play a major role although not necessarily as a decisive factor. Companies will particularly focus on procedures to handle a crisis, such as a positive COVID-19 test, and how they are prepared to work remotely, implement new technologies, and find new ways to serve customers. The number and location of subcontractors will also be important. To mitigate the knock-on effects in the medium term, the following measures may be useful: (1) safety stock buffers for critical components and (2) time buffers (delay in the production of goods for which demand is unpredictable) (McMaster et al., 2020). In this respect, current and forecast demand should be continuously analysed based on information from key customers and the related risks should be assessed (Teodoro, Rodrigez, 2020). Identification of products available from stock also plays a significant role. Classifying the products by priority can be a starting point in determining production priorities and assessing the stockout risk. To classify the components required for production in a simple way, the classical ABC analysis can be used (Kauf, Tłuczak, 2015). Due to the risk of large fluctuations in supply, some companies may seek to hold more stock, relying too heavily on capital.

In the long term, based on the analysis of the potential risks and benefits and being aware of the excessive interdependence of economies resulting from globalisation, companies may decide to regionalise their supply chain. Regionalisation can not only mitigate the effects of disruption but also reduce transport-related delivery costs and the cost of renting warehouse space as a result of shorter delivery times.

Risks of global chains arise from many internal and external factors. Some are related to macro trends - with the increasing globalization of supply chains and the increasing importance of the links between them, chains become more and more susceptible to disruptions. Other risks arise from the continued drive to improve efficiency and reduce operating costs. It is typical for supply chains be faced with the pressure of maintaining short lead times and low costs. Relying on a small number of suppliers can heighten risk of supply chains disruption in unexpected circumstances, as seen with the global COVID-19 pandemic.

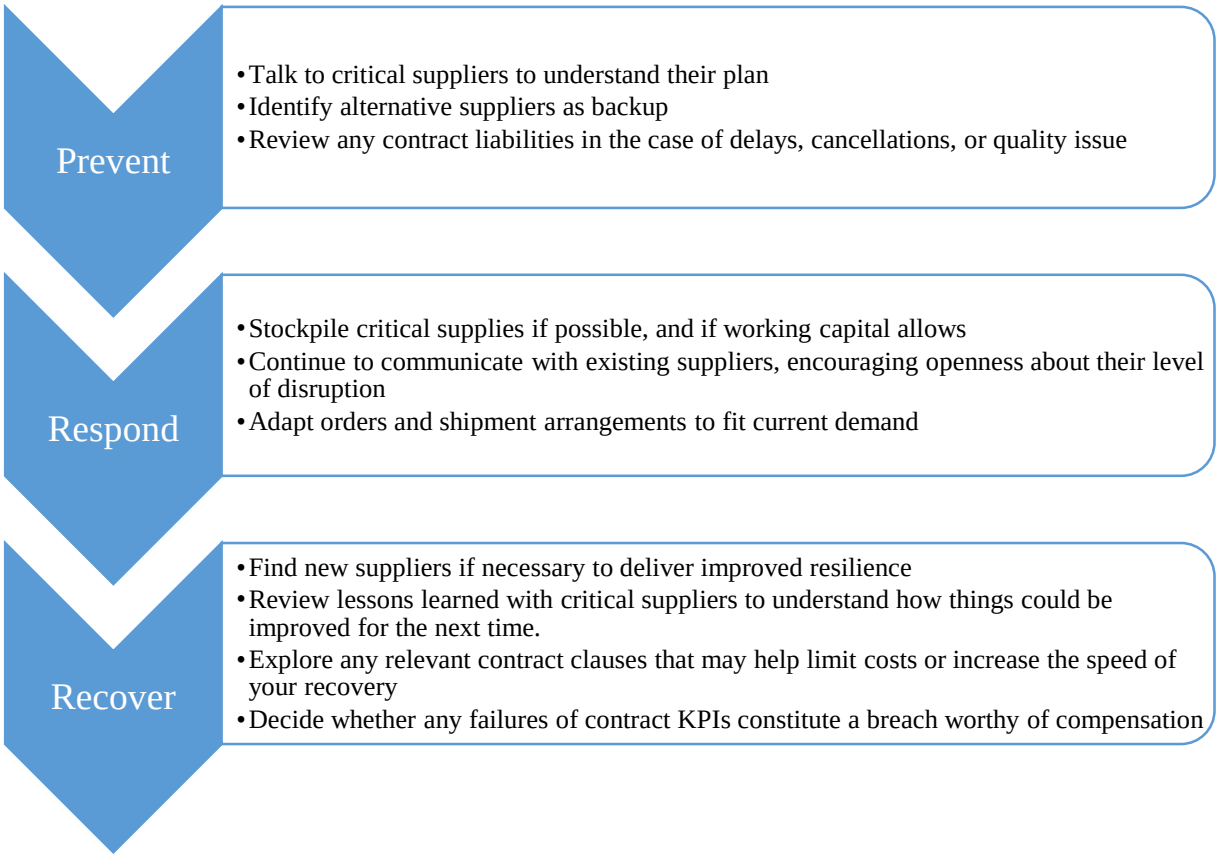

Figure 2. A three-step risk management plan Complex systems of polygamous holes made from one cluster to several coal deposits.

Source: own elaboration.

In the age of pandemics, in evaluating the effectiveness of the existing supply chain or planning its reorganisation, companies should (1) identify key suppliers; (2) consider diversification and regionalisation of the supply chain; (3) identify alternative sources of supply for suppliers in high-risk regions; and (4) build relationships with suppliers without a multi-stage, geographically dispersed network of subcontractors. By creating a simple three-step action plan, they can manage the impact of the COVID-19 pandemic (Figure 2).

Developing a comprehensive action plan will make the supply chain more flexible making it easy to quickly change a supplier. Those companies that manage to build strong relationships with key suppliers as well as develop and implement systems to ensure transparency across the

supply network will become more resilient to disruption and more quickly return to operation and a state prior to the black-swan disruption (Dolitte, 2021).

As previously indicated, the SARS-CoV-2 pandemic is a unique set of circumstances, different from events that have appropriate risk mitigation mechanisms and strategies in place. Over a period of almost two years of the pandemic, there have been different experiences and thus different ways of mitigating risks are required. It is not surprising that there is a lot of research (Ketchen, Craighead, 2020; Van Hoek, 2021) intended to provide ideas and solutions that can be applied to reduce supply chain risk.

There is a timely motivation to investigate supply chains in this uncertain situations. Disruptions in the functioning of global supply chains have become an impulse to conduct research among entities, especially located in Poland. The purpose of the research is to identify the key reasons for intensifying activities around risk management in the supply chains. Therefore, this paper attempts to identify the risk supply chains under COVID-19 pandemic in the context of already existing research in literature and on the own research in the Polish chosen companies. The research showed that the continuity of supply chains in Poland was not maintained, and companies were able to keep inventories only at a minimum level. As a result of the disruptions, many entities decided to revaluate their activities, moving some of them to the network, in particular in terms of sales and customer service. The research also analysed the impact of remote work on the effects of the functioning of enterprises and assessed the effects of support under anti-crisis shields.

Research methods

Disruptions in the operation of global supply chains have triggered research among entities located in Poland. To explore companies' experiences during the pandemic and mitigation techniques, a survey questionnaire was used to ask respondents about the key issues they faced during the pandemic, particularly those related to maintaining the continuity of supply chains. Respondents were asked about changes in procurement during the pandemic and the automation tools that helped mitigate disruptions and improve pandemic supply chain management. The focus was on the measures taken by the companies to ensure the continuity of their supply chains. To identify the influence of various factors on the entities, closed single-choice, semi-open multiple-choice, and Likert scale questions were used in the questionnaire.

- H1 - the extent of business activity is not correlated with problems related to demand constraints and timeliness of payments,
- H2 - disruptions in supply chain continuity during a pandemic are independent of the type of chain.

Taking into account the adopted research objective and hypotheses, the survey questionnaire was developed taking into account the multidimensional and multifaceted impact of the pandemic on the operation of supply chains. Key variables such as availability of supplies, decrease in demand, reduction in employment, need to keep inventories at a lower level, lack of supplies, delays in deliveries for assessing risks were identified on the basis of a review of the literature on the subject, newspaper articles, reports from national and international institutions and consultations with experts in the field of supply chain management. The questionnaire items and response scales were constructed in accordance with the accepted principles of question formulation and scaling. The results obtained from the survey were subjected to a validation process, i.e. checked for completeness, reliability and distribution of variables.

The survey was conducted online. The research sample included entities from the manufacturing, trading, and service sectors located throughout Poland. Companies were selected using a snowball method, starting with supply chain managers from friendly entities and asking them to identify other entities that could take part in the study. Although the sampling was determined by the availability of respondents, it was possible to gather a relatively large base of entities (845 companies) involved in various supply chains. At the turn of May and June 2021, the entities received e-mails with a link to the survey attached asking them to complete the questionnaire. As much as 137 companies responded, including 118 with foreign capital. The response rate was 16.2%, which is a satisfactory result.

The largest share was accounted for by companies that carried out manufacturing activities (52%), followed by trading companies (31%) and service companies (17%) (Figure 3).

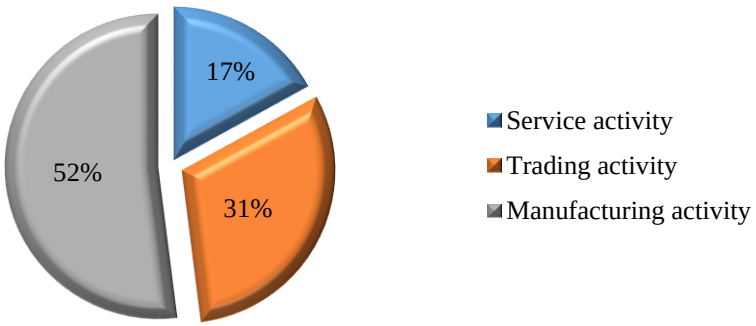

Figure 3. Structure of companies by activity.

Source: own elaboration.

The companies varied in terms of the number of employees. The companies employing up to 50 people prevailed and companies employing over 250 people were represented by the fewest respondents (11%).

Although this sampling is not representative, thanks to the great diversity of businesses and the range of influence of the entities, it is possible to conduct an extensive analysis, not limited to a particular industry or position in the supply chain.

The data were analysed using descriptive statistics methods showing changes in responses to individual questions and basic statistical inference methods for examining relationships between variables (chi-square test).

Discussion of the results

Risks to supply chains during the pandemic arise from both internal and external factors. The factors most frequently reported by respondents include (1) staff shortages due to some staff being in quarantine and on care leave, (2) insolvency of contractors, (3) delays in payment, and (4) reduction in demand for the goods offered (Figure 4).

The data in the figure shows the reduction in demand for the services/products offered and timeliness of paying for orders (about 37% of respondents) were the key factors. Based on the results of the chi-square test, it can be concluded that there is no relationship between the occurrence of problems and the type of activity carried out by the respondents ($\chi 2 = 2.38517$, p-value = 0.495702 for the reduction in demand and $\chi 2 = 3.2538$, p-value = 0.187727 for timeliness of payment).

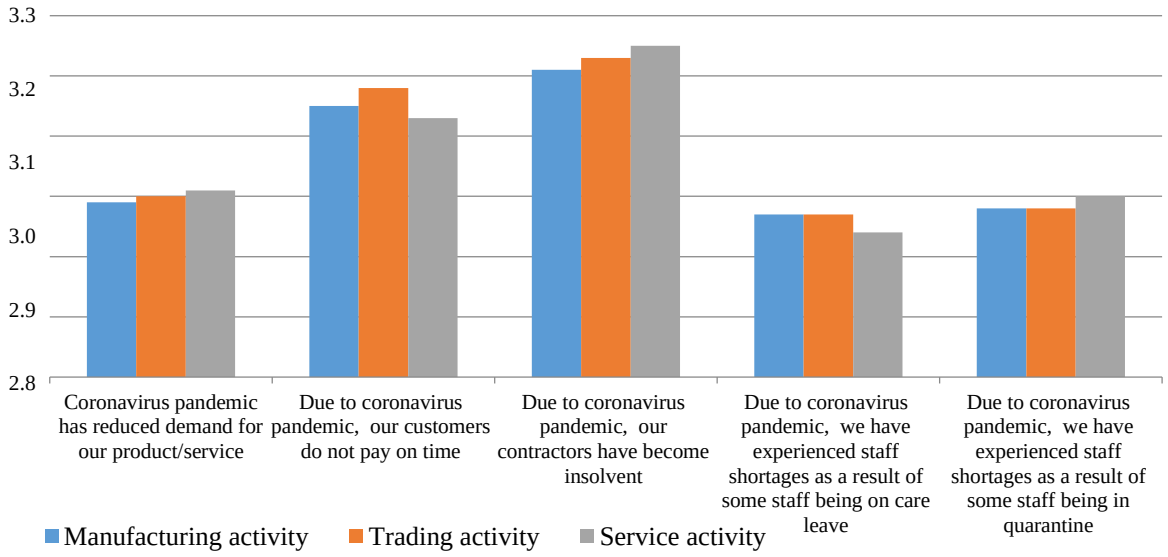

Figure 4. Most frequent problems by type of business.

Source: own elaboration.

The problems experienced during the pandemic did not have an impact on staff reductions; 110 respondents indicated that they were not forced to dismiss some staff. Staff shortages due to some staff being in quarantine or isolation and on care leave due to the closure of kindergartens and schools were more onerous. The problems depended on the number of employees employed, being far less frequent in companies with more than 250 employees (8% of respondents) than in companies with up to 10 employees (38% of respondents).

The difficult period of the pandemic affected the continuity of the supply chain. In this area, respondents highlighted the following factors: (1) problems with supplies from abroad; (2) the need to keep stocks at the lowest level; (3) broken supply chains due to the lack of supplies; (4) delays in supplies; (5) broken supply chains due to the supplier bankruptcy.

Most problems were diagnosed in the area of timeliness of deliveries (30% of respondents), twice as often there were shortages of deliveries (15% of respondents). There were correlations for timely deliveries and shortages with the type of business, each time the p-value was 0.0000. Supply issues have translated into inventory levels, with 30% of businesses resulting in keeping inventory at a minimum for an extended period of time. Here, however, was no relationship with the type of activity ($\chi 2 = 4.68862$, $p = 0.570571$).

Supply-related changes during the pandemic resulted in an increase in foreign suppliers (37% of indications), which was associated with the occurrence of a foreign ownership relationship ($\chi 2 = 4.15873$, $p = 0.164283$). The decision to increase the number of foreign suppliers was made mainly in enterprises where the owners represented foreign capital.

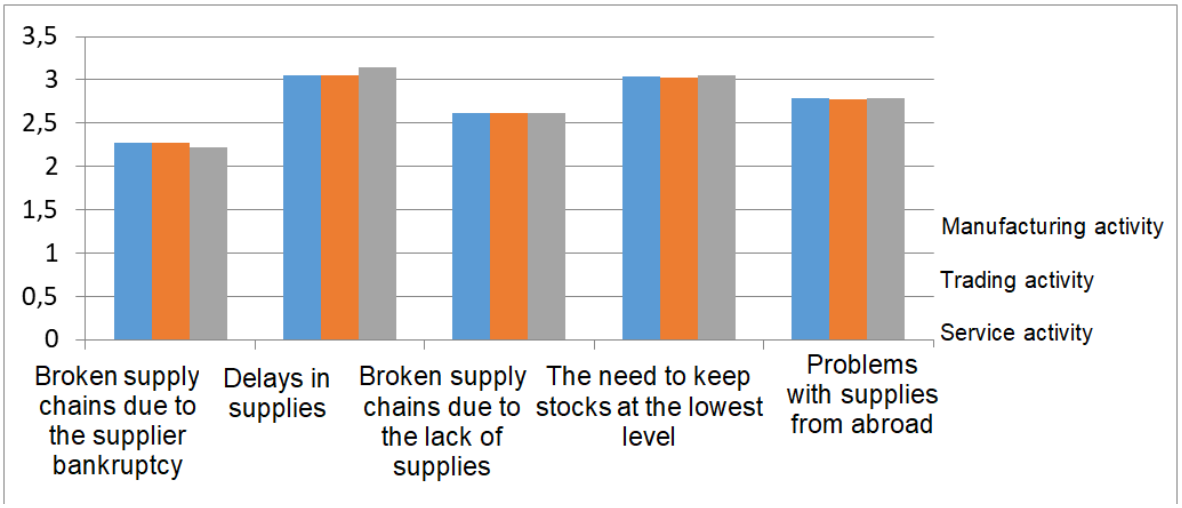

Figure 5. Problems affecting supply chain continuity by type of business.

Source: own elaboration.

The pandemic has forced entrepreneurs to move their business from the real world to the virtual reality. The departments that were most often moved to the virtual reality were sales (32%) and customer service (33%). However, as many as 58% of the respondents chose not to move their business online and this was not related to the type of business ($\chi 2 = 2.99900$, $p = 0.223242$). The restrictions put in place during the pandemic caused some employees to take advantage of the remote work opportunity. Employees from the following departments used this opportunity most often: accounting and human resources (43%), sales (44%), and customer service (37%). Based on the significance test of differences and at the 5% significance level, it was determined that there were no differences between the listed occupational groups. The remote form of work is associated with difficulties in interpersonal contact, while it does not affect the efficiency of employees and does not delay the implementation of tasks (Table 1).

Table 1.
Occurrence of problems during remote work

Answers	Remote work has made it harder to connect with people	Remote work has slowed down tasks	Remote work has reduced the effectiveness of our workforce
I disagree	1	63	59
I don't have an opinion	27	39	46
I agree	83	9	5

Source: own study.

The time of the pandemic necessitated other improvements besides remote working to maintain supply chain continuity. They include (1) intensifying the use of e-mail and telephone communication; (2) placing orders in advance; (3) intensifying cooperation with the local market; (4) increasing the level of inventory held; (5) strengthening cooperation with existing partners; and (6) monitoring the financial condition of regular contractors.

It was also important to comply with the requirements of the restrictions, including maintaining a social distance and a sanitary regime. In companies with continuous and shift work (mainly manufacturing), it has become critical to separate workers and maintain breaks between shifts.

In order to mitigate the effects of the COVID-19 pandemic on many businesses, the government has drafted what is known as an "anti-crisis shield." Among the surveyed companies, a little more than a half (54%) received aid under the Government Anti-Crisis Shield (Figure 6), but it should be noted that this aid was much more often obtained by companies that were involved in production or trade. The report „Tarcza kryzysowa. Koło ratunkowe dla firm i gospodarki? [Anti-Crisis Shield. A safety net for companies and the economy?]" (Dębkowska et al., 2021) shows that 86% of the surveyed companies were beneficiaries of the solutions available in the anti-crisis shield. Most of them (92%) used more than one aid instrument (Figure 7).

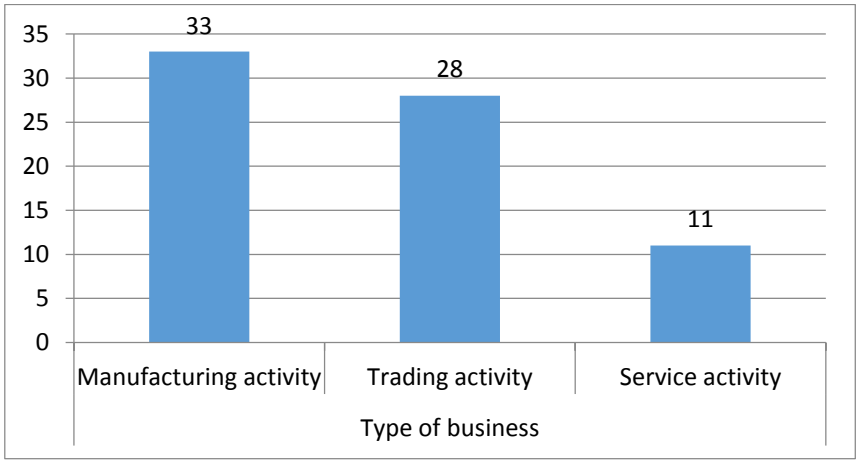

Figure 6. Aid under the Government Anti-Crisis Shield by type of business.

Source: own study.

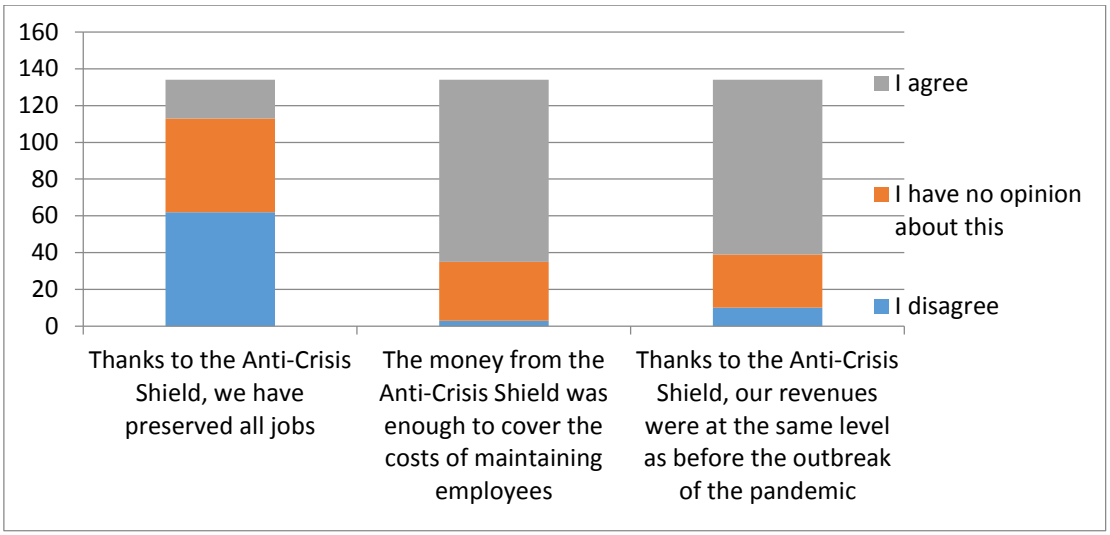

Figure 7. Aid under the Government Anti-Crisis Shield by type of business.

Source: own study.

It cannot be unequivocally stated that the actions taken under the Government Anti-Crisis Shield were positively evaluated by the respondents. According to the report (Dębkowska et al. 2021), the state aid was assessed at 3.5 (on a scale from 1 to 5).

Certainly, these actions helped preserve jobs, but not enough to cover all the costs of maintaining employees. Many times, employees have been deprived of additional benefits as part of their compensation. However, the long-term effectiveness of the aid instruments is yet to be seen, and the process of saving the economy and emerging from recession is still underway. Similarly, many business areas are still vulnerable to operating under the uncertainty of a pandemic.

Conclusions

The results of the study clearly show that the COVID-19 pandemic has significantly affected the functioning of supply chains, and this is true regardless of the industry or type of company. Virtually every company felt the effects of the pandemic. The crisis has brought many problems, which Polish (and not only) companies faced and still have to deal with. From the results of the study, a pattern emerges in which the main problems are late payments (the so-called payment backlog), which threaten the functioning of companies, and the progressive economic recession and galloping inflation. Even before the crisis emerged, payment backlogs were among the problems faced by almost 70% of Polish companies (Intrum, 2021). The European Payment Report[1] shows that the largest payment backlog is in the public

[1] The report is based on a survey that was conducted simultaneously in 29 European countries between 26 January and 16 April 2021. A total of 11,187 companies from 11 industries across Europe participated in the survey. In Poland, 540 companies took part in the survey.

sector at 20 days and in the B2B sector at 17 days. The problem, however, is not only the number of days the payment backlog spans, but also the payment period itself. It extended to 54 days in the public sector and 36 days in the B2B sector.

Delayed payments negatively impact financial liquidity and threaten the continued operation of businesses. The report also shows that 46% of Polish companies consider themselves lucky to have survived the pandemic crisis. Moreover, 57% of Polish respondents admit that the pandemic has reduced their companies' profits. The infamous list of sectors that suffered the most were business services (60%), industrial and chemical products (58%), hospitality industry (58%), and real estate and construction (57%) (Intrum, 2021).

The cited results from our own research and from the ERP highlight the effects of the pandemic felt by all entities along the supply chain, from suppliers of raw materials and supplies, through manufacturers and public sector entities to end users. This fact will certainly force many companies to rethink and transform. The events of the last virtually years have shown that globalisation and increasingly interlinked supply chains are increasingly vulnerable to disruption.

Instability and unpredictability become an everyday reality in pandemic conditions, forcing economic actors to take a number of measures to prevent the negative effects of the crisis. Given the impact of the pandemic, actors along supply chains should become increasingly conscious of managing risk by: (1) developing strategies to secure business continuity by geographic diversification of suppliers, (2) using key raw materials or products from different sources to reduce reliance on a single supplier, (3) developing inventory strategies to safeguard operations against supply disruptions in the supply chain, (4) building (sustainable) relationships with key suppliers, (5) implementing systems to ensure good transparency of the supply chain, (6) seeking to increase agility in processes, manufacturing and distribution networks so they can be quickly reconfigured and maintain supply to meet demand.

Bearing in mind the above problems, several recommendations and suggestions can be made for risk management in the supply chain based on the pandemic situation: (1) the further deepening of practical knowledge in the field of risk management and the implementation of appropriate risk strategies; (2) integrating a digital transformation based on the concept of Industry 4.0, not only with a company's operational departments but also with a supply chain' global strategy. The crucial role in the supply chain is played by small and medium enterprises as their level of digitalization impacts on ability to compete by smart supply chain idea. This approach will minimize the risk of incorrect current decisions and facilitate contact and communication with the employees; (3) guaranteeing data security, not only on the scale of an individual enterprise but throughout the entire value-creation chain; (4) integrating early with partners, which will allow for the establishment of appropriate technical standards; (5) stimulating a culture of cooperation characterized by flexibility and openness; (6) implementing a training system (including e-learning) that raises the competences and qualifications of the employees; (7) establishing interdisciplinary project teams consisting of

engineers, programmers, marketing, logistics specialists, etc.; (8) developing new models of working times and methods of remunerating employees that will stimulate creative thinking and co-create value (for clients and the enterprise); and (9) introducing such information systems and data exchanges between participants of the nodes within supply chain that will be based on openness with and trust in all partners.

From the supply chain management perspective, the best way to minimise risk is to increase trust and ensure integration, cooperation, and joint risk management. However, when managing supply chain risk, they should start with employees and ensure their safety.

One of the most noticeable impacts of the COVID-19 pandemic is the uncertainty surrounding the continuity of supply chains. Emerging disruptions resulting in discontinuity of supply chains (interrupted supply chains) are the result of, among other things, the occurrence of individual COVID-19 outbreaks, which result in downtime in production enterprises or the closure of entire factories (as we observed particularly at the beginning of the pandemic in China and individual European countries). Economic practice shows that Europe will not be able to function independently of Asian producers and suppliers for a long time to come so disturbances in that part of the world have an impact on the health of the global market. Disruptions in supply chains have a negative impact on the operation of their businesses.

From the supply chain management point of view, it is important to recognise opportunities and threats facing the entities comprising a given supply chain, as well as to make the right decisions in order to implement an appropriate risk management strategy. Globalisation, competition, and uncertainty in the management of resources generate the need to develop logistics and take an appropriate approach to managing risks in the supply chain. Changes in the focus of logistics and changes in the nature of logistic managers' activities in an individual company as well as in the entire supply chain result in the need to develop and implement an appropriate risk management approach. The effects of the lack of risk management or inadequate risk management in the supply chain can be very negative for companies, as evidenced by the COVID-19 pandemic outbreak.

Failure to effectively manage supply chain risk can have a significant negative impact on organisations not only through direct financial loss and bankruptcy due to inability to fulfil orders. It can also lead to reduced product quality, damage to property and equipment, loss of reputation in the eyes of customers and other business partners, or even a sharp drop in an organisation's stock price and shareholder conflicts. Additionally, it can result in the loss of health and life of employees and customers.

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