SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2024
ORGANIZATION AND MANAGEMENT SERIES NO. 204

SHAPING SAFE AND HYGIENIC WORKING CONDITIONS FROM THE PERSPECTIVE OF IMPLEMENTING THE ASSUMPTIONS OF THE LEAN MANUFACTURING CONCEPT

Robert GOLEJ[1*], Anna CIERNIAK-EMERYCH[2]

[1] Wroclaw University of Economics and Business; robert.golej@ue.wroc.pl, ORCID: 0000-0003-4462-7035
[2] Wroclaw University of Economics and Business; anna.cierniak-emerych@ue.wroc.pl, ORCID: 0000-0003-4435-4954
* Correspondence author

Purpose: The aim of the article is to show the importance given to working conditions in the hierarchy of employees' interests and to attempt to verify the question whether, when implementing LM solutions in enterprises, working conditions are consciously shaped in terms of employees' health, in the physical and mental sense.
Design/methodology/approach: In order to determine the rank of safety of working conditions among employees, a survey was conducted on a representative sample of employees from Lower Silesia. (Poland). The study was conducted in several companies from the Lower Silesia region. As a result, practices used in manufacturing companies when implementing 5S principles were identified.
Findings: The deployments analyzed did not consider the context of working conditions as a conscious goal of the measures taken. The potential impact of the implementations on the mental comfort, physical and mental health of employees was also not considered. The implementations did not measure the pre- and post-implementation status of working conditions, physical and mental health of employees. Companies focus on waste reduction (MUDA) excluding MURA and MURI.
Research limitations/implications: An important issue in conducting further research is the distinction between physical and non-physical factors shaping working conditions in the light of their impact on physical and mental health. The research was conducted regionally, which may limit the results and conclusions from the research to a defined cultural area.
Practical implications: The increased awareness of the importance of the MURA and MURI principles for the proper functioning of the Lean Management philosophy.
Social implications: To improve the quality of life, the implementation of LM tools should include appropriate training, personalization of workstations and the application of the MURI and MURA principles.
Originality/value: In the cognitive layer, the research allows for a better understanding of the phenomena accompanying the implementation of 5S practices and their impact on working conditions related to physical and mental health, both in the implementation phase of this practice and its further consistent use.
Keywords: 5S, Working Conditions, mental health, physical health.
Category of the paper: Research paper.

1. Introduction

The modern realities of business operation are referred to as the world of VUCA (volatility, uncertainty, complexity, ambiguity), or the world of BANI (brittle, anxious, non-linearity, incomprehensibility). This is accompanied by changes in the sphere of technical and organizational conditions for the implementation of tasks. The development of technology and technology cause us to deal with certain changes concerning workplaces, including their equipment. Aiming at the elimination of unnecessary waste, more and more often the importance is pointed out in this regard of standing the assumptions of the Lean Manufactoring concept and related management methods and techniques, also referred to as tools of this concept (e.g. 5S, kanban, Poka-Yoke, etc.). Their implementation in certain ways (positive, but also negative) can affect both the physical and psychological comfort of the people performing the work. In a broader sense, it can affect employees' perception of the issue of providing them with safe and hygienic working conditions (occupational safety and health - OSH).

Providing employees with safe and healthy working conditions should be considered as an important interest of employees. In the literature - for a long time now - it has been stated that employees are the primary stakeholder group (Stuart, 2002). In doing so, it is pointed out that it is extremely important to be aware of the expectations (interests) of employees (Maxwell, Knox, 2009). Thus, the self-awareness of employees and the organizations representing them regarding the need for basic solutions to ensure occupational health and safety as well as personnel policies to ensure the fairness of working conditions developed often at the philosophical-ethical or economic level deserves attention. Thus, the issue of the working conditions of employees is not only a matter of the enterprise itself, which employs the employee, but an element of the socio-economic order that ensures its sustainability. The literature states that the provision of safe and hygienic working conditions is considered a key area of socially responsible activities within the CSR concept (cf. Ruiz-Frutos et al., 2019; Macassa et al., 2021). These few sentences are meant to indicate the magnitude of the scope and gravity of the importance of the issue of working conditions and their formation in the enterprise.

With the above in mind, the aim in this article has become, on the one hand, to address the issue of determining the rank given by employees - among their interests - to safe and hygienic working conditions and, at the same time, to their elements. On the other hand, the article tries to present the problem lying at the interface between the implementation of lean production methods (lean manufacturing) and working conditions. These issues, in addition to those indicated above, this one is all the more relevant in light of the set of radical changes referred to in the literature as Industry 4.0 or the fourth industrial revolution. As a direct result of Industry 4.0, the need for employees to perform work in harmful conditions (physical health) has been reduced.

On the back of the enthusiasm for Lean methodology present in the Polish literature on the subject, and even more so in business practice, the question arises as to whether such a one-sided picture is appropriate, and whether perhaps there is something we should know about that somewhat demolishes this ideal picture. Such an attitude may be the result of an axiological context, often the evaluation of the Lean concept is derived from the results to which its application leads in the perspective of the employer/owner. Other perspectives for evaluating this philosophy are extremely rare omitting the perspective of other stakeholders such as employees. Sometimes evaluation from a perspective other than the owner's is simplistic and residual, and often discredited. It is this attitude that became the source and inspiration for this article and further conducting adequate research in this light. The evaluation of the research conducted was developed from the perspective of an employee for whom physical and mental health is one of the most important values. The article attempts to answer the question: do the working conditions co-created by Lean Manafacturing tools affect the physical and mental health of employees?

From here, further questions arise:

- What place in the hierarchy of employees' interests is occupied by ensuring safe and hygienic working conditions (OSH) for employees?
- In the surveyed manufacturing companies in Lower Silesia, were working conditions taken into account when introducing lean production solutions?
- Have the effects on the physical and mental health of employees been studied before and after the introduction of lean methods?
- Are the principles of LM application carried out correctly methodologically?

The idea of the research carried out is to juxtapose with each other, the key philosophies, principles and, practices of LM with the theory of working conditions and factors affecting employee health. The paper draws on the findings of other researchers (desk research) to define the meaning and scope of the issue. Further, the collected empirical material related to the identification of the interests of employees, including those related to ensuring safe and hygienic working conditions for them and those related to the implementation of Lean Management in manufacturing companies in Lower Silesia was used. As a result of the analysis, conclusions were drawn regarding the consideration of conscious shaping of working conditions when designing and implementing LM solutions in terms of employees' health, in the physical and mental sense. In these enterprises, the LM concept was most often not functioning and methods such as SMED, 5S, layouts or even work standardisation were not used in the management process. The implementation of LM in these enterprises consisted of implementing the 5S method. Due to the social sensitivity of the issue raised, the objects of the research were kept confidential.

The paper focused primarily on the link between the safety of working conditions and the implementation of 5S practices, which is one of the tools of the Lean Management concept. In particular, it was concerned with considering the awareness of employers and employees of

the benefits and limitations in the area of shaping this safety in relation to the implementation of 5S practices.

2. Theoretical background

2.1. Safe and healthy working conditions

The term safety is difficult to define unambiguously, as it is interdisciplinary in nature. According to one definition, safety should be linked to the ability to avoid harm resulting from a risk, hazard or threat (Cambridge Dictionary,2021). Management literature - under the heading of occupational safety and health (OSH) - addresses the issue of keeping workers free from exposure to hazardous and damaging factors associated with working conditions. These factors may be of both a physical and psychological nature and may endanger the health and life of the person performing the work. The elimination or minimisation of the risks in question is, in turn, linked to a specific - and also changing - approach, preferred by the employer and the workers, to the shaping of the working conditions, i.e. their individual components. It becomes important to anticipate, recognise, control workplace hazards that may affect workers' health and safety, taking into account the impact on the surrounding communities and the environment (Alli, 2008; Cierniak-Emerych, 2023).

When defining the concept of working conditions, it is most common to point to definitions proposed by organisations concerned with conditions. For example, the European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) defines working conditions as a set of factors relating to the working environment and aspects of a worker's employment. This includes issues such as:

- work organisation and worker activity (type of work),
- training, skills and competence development, employability (neologism employability),
- health, safety and well-being,
- working time and work-life balance.

More broadly, the organisation's understanding of the concept of working conditions can be gleaned from the range of questions posed in its five-yearly surveys since 1991. The surveys were conducted in 2015 (EUROFOUND (2019) 'Working conditions', https://www.eurofound.europa.eu/pl/topic/working-conditions (Date accessed the site 4.03.2019) and the European Working Conditions Telephone Survey (EWCTS) 2021 was also conducted in 2021. In each edition, the scope of the survey has been clarified and expanded.

Referring to the Polish literature on working conditions, it is stated that working conditions form a very diverse category. Conditions are most often considered by dividing their elements into two basic groups. These are tangible and intangible elements, within which specific

components are distinguished (Cierniak-Emerych, 2005; Cierniak-Emerych, Gableta,2022). Among the former, physical, tangible, chemical, biological elements are listed, including, for example, equipment of workstations and rooms, lighting, microclimate, noise, etc. Intangible elements usually include working time, interpersonal relations, social and living activities. It can be assumed that safeguarding the health and life of employees is to a large extent linked to special attention to the proper formation of the material elements of working conditions.

Against this background, it is noteworthy that these material conditions have to be considered nowadays from a slightly different perspective than just a few years ago. This applies both to the specifics of the material elements of these conditions and to their impact on the mental health of workers. In both office and production work, there is widespread use of ICT equipment. This situation is conducive to an increase in the negative impact of these devices on the health of workers. The result of their use, as evidenced by the results of scientific studies, can be serious health problems, not only physical, but also mental. At this point, it is also worth noting the so-called technological addiction (Lin, Y.H. 2017) related to the human-technical object relationship. The issues indicated cannot therefore be ignored. They should, it seems, be highlighted within the material working conditions.

Additionally, with regard to the impact of working conditions on both physical and mental health, a special case is occupations that are characterised by high risk work. Research in this case indicates that - difficult physical conditions - cause employees to feel often or very often severe or very severe stress. It relates not only to discomfort in the performance of professional duties, but mainly to the sense of risk to life and health of those working underground. At the same time, however, it is known that this source of stress cannot be eliminated (Molek-Winiarska, 2015).

Many researchers have listed the characteristics of work that can increase mental tension, which Sperandio (1980) defined as "a term associated with the affective rather than the cognitive area and carrying with it all the negative effects and all the pollution associated with professional activity". Karasek and Theorell (1991, 1996) considered a combination of three dimensions to be special for generating stress: demands, control over work (autonomy) and psychosocial support. They developed a mental stress index that assesses psychological demands, control over work (autonomy) and social support (psychosocial). The basic idea of this indicator is that the complexity of work and social support offset the negative effects of excessive psychological demands. Karasek also showed that psychological tension resulting from the demands of work can be reduced by increasing the freedom to decide about work (autonomy). The combination of a small range of work decisions (control over working conditions) and high psychological professional requirements has been shown to be very stressful. Which, subsequently, resulted in, m.in cardiovascular diseases (Schnall, Landsbergis, Baker). This has been demonstrated in many empirical studies m.in. Stock et al. (2006), Lucifora and Cottini (2013).

Long-term exposure of an employee to stressors affects the mental health of employees, and subsequently the physical health. There are three ways of defining it in the literature (Cox et al., 2000). In the first stage, stress is understood as a set of stimuli describing the work environment, causing disorders in health and functioning. In the second approach, stress is defined as a reaction to the excessive demands of the work environment. These reactions are described in physiological, psychological, and behavioral terms. The third approach captures stress as a relationship or interaction between the environment and the employee. The OSI (Occupational Stress Indicator) questionnaire developed by Cooper, Sloan and Williams (1998) is one of the most frequently used tools in global research on occupational stress. This tool is mainly designed to measure the stress of managers. The OSI test examines the following stress factors:

- requirements overload,
- social relations,
- work-home balance,
- requirements of a managerial role,
- personal responsibility,
- everyday nuisances,
- appreciation,
- organizational climate.

Therefore, research can be carried out in the field of identifying factors shaping working conditions or, more anthropologically, their changes, to the strength of their impact on physical and mental health, well-being, productivity, creativity, etc.

Analyzing the literature, it can also be noted that the definition of working conditions has not changed drastically over the last dozen or even several dozen years. However, the authors of this article believe that security should be looked at more broadly. In their opinion, it is worth using the concept of safety of working conditions, which should be understood as the lack of an acceptable risk of a threat to health and life by the employee in certain circumstances of performing work. At the same time, it is assumed that the sources of these damages should be sought in the impact of material and non-material elements of working conditions.

Against this background, it is worth noting that a query of the literature on the issue of working conditions, from the perspective of implementing the Lean concept complexes that we are interested in in this article, gave the basis for the conclusion that there is still a lack of studies directly devoted to the issues we are interested in here. In the last few years, most publications concerned the working conditions of individual professional groups, such as: hospitality industry workers (Lugosi, Ndiuini, 2022) and women from deprived areas of South Africa (Stumbitz, Jaga, 2020), academics (Yildirim, Eslen-Ziya, 2021). Working conditions were also studied in relation to: migrants (Giordano, 2021), working mothers (Guy, Arthur, 2020), women employed in agriculture and the productive sector (Sarker, 2021).

2.2. Lean Manufacturing

In Poland, this system is called "lean production", "lean manufacturing", "lean management" or "lean organization" (Walentynowicz, 2013). The origins of LM date back to the 1950s, this method was born after the end of World War II in the Toyota factory in Japan, and was improved over the next 20 years until it became the proper system (Walentynowicz, 2013). The term "Lean Management" was first used by IMVP scientist John Krafcik. It comes down to the assumption that by producing the same or similar amounts of goods, factories using the above-mentioned system use half as much materials, raw materials, human resources, production space and need significantly smaller amounts of inventory compared to enterprises using mass production (Womack, 2008).

Operating according to the Lean concept involves the most effective use of available materials and company resources in order to obtain the best results. Mostly, it is a series of activities aimed at eliminating waste in a broad sense. Not only that occurring during the production process, but from the entire area located around it, including the network of logistic connections" (Walentynowicz, 2013).

In Japan, three causes of waste have been distinguished (Kornicki, Kubik, 2008):

MUDA (waste) – when production exceeds demand, this method identifies seven basic types of waste, they are:

- overproduction,
- unnecessary supplies,
- improper transport,
- shortcomings,
- unnecessary processing,
- unnecessary downtime,
- excessive movement, multitasking (switching between tasks), walking between rooms/departments, switching between applications, bending, reaching, twisting/rotating the torso, crouching, jumping, walking.

MURA (variability) - sometimes production exceeds demand, and sometimes it does not exceed demand, unevenness in the broad sense of the word, causing sudden loading and underloading of our resources, e.g.

- no standards, no rules,
- incomprehensible rules and standards, complicated procedures and instructions,
- freedom of action,
- individual approach,
- work 4 days, 10 hours a day,
- four-brigade system,
- shift work,
- unequal use of machines and people,

- changes to work schedule,
- lack of standards regarding the work methods and tools used,
- undefined, non-standardized industry vocabulary,
- seasonality,
- variable workflow,
- unequal division of responsibilities,
- uneven pace of work,
- information scattered in various places or systems.

MURI (irrationality) – when demand exceeds production. Overload, strain, difficulties - everything that requires extraordinary effort and work. This component mainly refers to the overload of a person at work in a given organization, increasing his comfort and work ergonomics, and thus increasing the employee's efficiency. Typical manifestations of muri include:

- overloaded shelves, containers, carts, vehicles, people,
- operation of machines and devices, as well as people with higher than average loads,
- unergonomic workstation,
- overtime,
- accumulation of tasks,
- increased work pace,
- responsibilities beyond current competences,
- urgent reports and summaries "on demand",
- monotonous work (repetitive activities, constant body position),
- failure to delegate tasks (overload of managers and leaders),

This is one of several waste classifications, called 3M or 3MU. It strives to optimize the consumption of human resources, machines, equipment and materials necessary for the production of products, as well as to deliver them on time. Improving production efficiency therefore requires their waste identification and elimination of their causes. As Kornicki (2008) writes, if the management adheres to the principles consistent with the Lean philosophy, it can be expected that waste will be significantly minimized. Walentynowicz (2013) points out that the purpose of implementing Lean Management is to continuously improve the company through the use of appropriate tools that will allow you to completely get rid of waste. However, this is not the only goal, it also strives to improve quality, reduce costs and improve logistics liquidity.

The literature on the subject indicates a whole range of LM tools from basic TPM, through SMED, JiT, 5S and a number of methods to shorten the time of work on an element at the workstation, e.g. timings, layouts. The last group of methods is to focus on improving productivity at the workplace.

2.3. Lean manufacturing as a method shaping working conditions

In Polish literature, enthusiasm and an uncritical view of the LM are revealed. By taking a critical look at the goals and objectives of LM as they are widely used in the literature, we can see without much insight that the dominant goal of LM is to improve, solely production efficiency. Humans are reduced to the role of a "bio-robot" whose goal is to bring the highest efficiency, self-limiting unnecessary downtime or excessive movement. Reducing downtime can mean increasing time pressure, increasing the speed of performed activities, reducing micro-rests. Timings and layouts are often built in the light of radicalization of efficiency, forcing an increase in the intensity of work and improper, painful and burdensome postures or an increase in the risk of injuries and accidents caused by physical fatigue or mental fatigue. Fatigue causes a lack of concentration. It would seem that the theory of inverted U is overlooked, which clearly explains that no extrema of the explanatory variable gives the optimal long-term effect of the explanatory variable. Therefore, the high efficiency obtained by excessive workload (overload) is unsustainable in the long term.

It cannot and must not be denied that many LM solutions such as 5S allow for the improvement of material conditions and safety at work. Working conditions are not only material conditions, but also non-material ones, which strongly affect the mental sphere of the employee. The impact of working conditions on mental and further psychosomatic health is now becoming an increasingly frequent subject of research. In this context, we often talk about stress or burnout. Science has not yet developed certainties and paradigms in this area.

Globalization and the Industrial Revolution 4.0 changed the labor market, leading to the growth of the service sector, while production was moved to countries with lower wages. The process of globalization has also changed the organization of work in various sectors through the implementation of the concept of lean management. Lean management is widely considered to be one of the ways of organizing work (Valeyre, 2007) that has a negative impact on the health of employees. This is an extremely important statement in the context of the considerations conducted in the article. In the United States, the deterioration of workers' health occurred earlier than in the European Union, and lasted from the mid-1980s to the mid-1990s, as the first forms of LM-based production organization were first implemented in this country (Askenazy, 2001; Brenner et al., 2001, Fairris, Brenner, 2001). Research conducted at the beginning of the 21st century reveals that this phenomenon reached Europe in the 90s of the twentieth century (Daubas-Letourneux, Thébaud-Mony, 2001, 2003; Datta Gupta, Kristensen, 2008; Bertrand et al., 2011).

The study identified a relationship between several main factors of working conditions that contributed to the deterioration of employees' health. These factors included:

- repetitive work, its intensity,
- teamwork, the pace of work depending on the work of colleagues, machines,

- rotating schedules,
- adherence to quality standards, sitting position (Askenazy, Caroli, 2003, Stock et al., 2006; Gollac, 2005).

Figures for work-related accidents and occupational diseases in the United States began to decline in the mid-1990s. This seems to m.in because the role of the Occupational Safety and Health Administration (OSHA) has been strengthened (Askenazy, 2006). At the same time, the concept of corporate social responsibility began to be introduced in the USA as a way of indirect protection of employees and the environment. It should be noted here that historically in the US, health care is an organizational responsibility, and in Europe, it is a role of the state (Matten, Moon, 2008). Analysing working conditions is not just a matter of physical working conditions. Most of the labour resources are currently outside the sphere of production. In the sphere of production, physical health risks are relatively well recognized and studied. However, the situation is quite different in the case of services, especially in the field of mental health. Stock et al. (2006) identified workplace bullying and excessive psychological demands as factors contributing to the deterioration of health among workers in Canada. According to data provided by the International Labour Organization (ILO, 2022), there are 2.9 million deaths from work-related accidents each year, and 2.32 million people die annually as a result of work-related diseases.

To sum up the theoretical considerations and the achievements of researchers in the discussed area, it should be stated that the LM concept in its basic version, which was derived from the war economy, was basically oriented towards production efficiency, and in particular the efficiency of machines; humans were not the central point of this concept. It should be emphasized that working conditions may affect both the level of stress (mental tension) and the level of concentration, fatigue and tiredness, which may lead to incidents and accidents. Let's take as an example the work of a driver who, in order to maintain concentration and reaction time, is forced by law to rest. However, many professions do not notice this problem, leading to employee overload. However, the problem of overload is a phenomenon whose assessment is difficult and subjective, especially in the case of work that does not require physical strength and does not cause strong social consequences (road accident). Another phenomenon is the developing network of services in which contact with customers is an extremely important aspect. This applies to both public services (offices, etc.) and private services (business). Contact with the client is often very difficult and is associated with psychological tension. Basińska (2005) says that mental health deficits are the first signal of insufficient coping with the demands received. Chronic fatigue syndrome and burnout develop next, especially in people who are constantly exposed to contact with other people (Basińska, 2005). In this context, the question arises how to understand the intensity of work of people providing customer service; working in a call center; working with sick, disabled and elderly people, etc. So wherever contact with a large number of people is the main content of the work.

2.4. Method 5S

Preliminary discussions with representatives of the surveyed entities showed that these companies are implementing the LM approach in the first place by introducing the 5S method. So they start with cleaning. The content of the article therefore requires a brief explanation of what this method is. A tool supporting the solution of problems related to the organization of work is the 5S system (practice), the term of which is an abbreviation of the first five letters of the Japanese words: seria – seiton – seiso – seiketsu – shitsuk (Gapp et al., 2008), which is most often translated as: selection – systematics – cleaning – standardization – self-discipline. The 5S system allows, as it is emphasized, not only to improve the organization of work, but also to improve working conditions and safety (Karaszewski, 2009).

Therefore, attempts are being made to "expand" this system with another S, i.e. safety, i.e. safety understood as safe and hygienic working conditions. As a result, the concept of 5S+1 or even 6S appears (Gajdzik, 2014; Junewick, 2002; Becker, 2001).

5S practices, as Zimon states, have a positive impact on the state of material working conditions, creating opportunities to minimize the costs of reorganization (Zimon, 2012) carried out at workplaces. Reference to 5S requires consideration (Gapp et al., 2008; Szatkowski, 2014):

- seiri as the selection and elimination of what is superfluous,
- sejton, which is an expression of systematics, segregation and sorting,
- seiso corresponding to the cleaning category,
- seiketsu who prefers standardization, and thus order,
- shitsukae referring to self-discipline.

They are related to the introduction of order, elimination of unnecessary equipment and objects of work, discipline, including self-discipline, also in the use of personal and collective protective equipment, etc. This results not only in a clean and pleasant working environment, but also – in relation to the interests of employees – in the improvement of the level of work safety (Imai, 2006; Karaszewski, 2009; Krasiński, 2014,), which is conducive to the involvement of employees in work and organization (Juchnowicz, 2010), and as a result, an improvement in the image of the company as an employer.

Safe working conditions as a consequence of the application of 5S practices result directly from the essence of the system in question. This is because this system somehow enforces respect for legal regulations in the field of occupational health and safety, but also the definition of internal guidelines regarding the desired behaviors and activities at workplaces, important from the point of view of occupational safety of interest here. Thus, the preferred "enrichment" of the system in question with another S seems unnecessary in this context. "Good management in one's own workplace and in its vicinity" (Aluchna, Płoszajski, 2008) – as the 5S system is referred to – also means management that is safe for people, taking into account the implementation of their interests in this area.

3. Research methodology

In search of answers to the first of the research questions formulated in the Introduction to this article, reference was made to the results of empirical research conducted:

- in 2018-2020[1] among employees. The information was collected using a survey. The PAPI (Paper and Pencil Interview) technique was used. Additionally, the research also used in-depth interviews in the form of informal interviews[2],
- in the years 2020-2023 using a loose interview.

The research conducted in 2018-2020 used a survey questionnaire[3] addressed to a randomly selected sample of people providing work (based on an employment relationship or, for example, a mandate contract) employed in enterprises registered in the Lower Silesian Voivodeship. Based on data from EURES (European Job Mobility Portal), it was determined that the population of employees (in the Lower Silesian Voivodeship, in the enterprise sector) in 2018 was 484,100. For the purposes of the study, a random sample of n = 274 was taken from a finite population employees employed in enterprises registered in the Lower Silesian Voivodeship. Assuming a 6% maximum estimation error, a significance level of alpha = 0.05 and an estimated size of the fraction of 0.5 for a finite population of N = 484,100, the minimum sample size is n = 267. To obtain the randomness of the sample, a sampling frame was used in the form of a database of employed employees in enterprises registered in the Lower Silesian Voivodeship coming from the employee population defined for the purposes of the study (Cierniak-Emerych, Gableta, 2022; Cierniak-Emerych, Pietroń-Pyszczek, Zareba, 2023).

Women constituted 50.4% and men - 49.6% of the survey respondents. 24.5% of respondents were under 30 years of age, and every fourth respondent was aged 31-40. The largest group covered by the study were people aged 41-50 (28.8% of respondents).

In the years 2020-2023, taking into account changes in economic realities, including the Covid-19 pandemic and the war in Ukraine, loose interviews were conducted and addressed to respondents previously covered by the study. Those who agreed to it were selected (approx. 40% of those surveyed).

In turn, looking for answers to the three remaining research questions included in the introduction, due to the qualitative nature of the discussed issue, the case study method was chosen to present it, focusing more on its in-depth understanding. The point is to discover what the results of quantitative research can only suggest (Wójcik, 2013, pp. 17-22). The analysis of

[1] The research results presented here are part of broader research into employee interests and how far they are respected by one of the co-authors of this article, and presented in a broader context in a monograph (Cierniak-Emerych, Gableta, 2022).
[2] Cooperation with the IPC Sp. z o.o. Research Institute was used at this stage of the research.
[3] The questionnaire covered a range of interests. For more information on the questionnaire, see (Cierniak-Emerych, Gableta, 2022).

available documents was used, as well as participant observation and informal interviews conducted with management representatives and employees of selected 5 enterprises from Lower Silesia involved in the implementation of the Lean concept, which was associated in particular with the use of 5S[4]. In other words, an in-depth individual interview (IDI) was used, i.e. a direct method of primary survey measurement, in which the respondent is the active object of measurement and there is direct communication between the people subjected to the measurement and those carrying (conversation) (Kaczmarczyk, 1999, p. 252). The analysis was carried out using the descriptive method. The main aim of the study is to determine whether the consequences of its implementation for the physical and mental health of employees were taken into account during the implementation of the LM concept.

4. Research results

Looking for answers to the first of the indicated research questions (what is the place of ensuring safe and healthy working conditions for employees in the hierarchy of employees' interests) during the research conducted in 2018-2020, it was revealed that occupational health and safety takes first place among the category of their interests considered by employees (96.3% of respondents' indications). The above indications for safe and healthy working conditions were also confirmed by the parametric results from the sample. The mean for the answer to the question about the degree of importance of health and safety is 4.54 with a standard deviation of 0.593.The median value is 5.0 and the dominant value is 5.0. The value of the asymmetry coefficient is -1.095. It is worth adding here that the next places in the hierarchy of employees' interests were taken by interests related to ensuring pay adequate to the duties performed (96% of responses), followed by 92% of responses, good atmosphere at work. Also in the 2020-23 survey, occupational health and safety was considered by respondents to be their most important interest. In this context, it should be added that occupational health and safety has somewhat become more important among the interests of employees, as stated by respondents, especially due to the Covid-19 pandemic and its consequences.

Subsequently, the research sought answers to the next three questions included in the Introduction, i.e. Were the broadly understood working conditions taken into account when implementing Lean Manufacturing solutions in the surveyed companies in Lower Silesia that implemented at least elements of LM? Was the impact on physical and mental health of employees studied before and after the implementation of lean methods? Are the rules for the use of LM carried out methodically correctly?

[4] Attention was focused on companies where the management declared that they had implemented the Lean concept and, at the same time, agreed to participate in the study.

The results of the research indicate that during the implementations, the concentration of implementation teams was focused in particular on the search for and elimination of waste, i.e. MUDA, while omitting the application of the MURI and MURA principles. During the research on the part of enterprises, words such as uniformity or overload were not used to describe the objectives of the implementation. The main emphasis was placed on increasing efficiency, e.g. by reducing the time needed to search for tools, and thus increasing the time for performing production tasks, an additional expected result of the implementation was the improvement of work safety, understood as material working conditions. There is no denying that the principles of 3MU are often internally contradictory and the use of one causes the violation of the other. For example, improving layouts and timings can lead to overloads and uneven workload, but it will improve efficiency at the workplace (reduce waste).

Referring to the specific tools of the Lean concept, it is worth noting that the implementation of the 5S practice did not differ significantly in the surveyed entities. The market in which they operate is stable and competitive. The organization of work in enterprises is based on the division of responsibilities, in which specific tasks are assigned to specific areas and employees.

In the light of the results of the research, answering the question: Were the broadly understood working conditions taken into account when implementing Lean Manufacturing solutions in the surveyed companies in Lower Silesia, which implemented at least elements of LM? It was found that most of the measures were aimed at improving efficiency by reducing the loss of time. On the other hand, in response to the question whether working conditions were taken into account during the implementation of Lean tools, the results of interviews and document analysis indicate that working conditions were not indicated as the purpose of implementing this method. It was also not checked whether work does not cause negative changes in the employee's mental health. At the same time, the implementation work was not supervised by an OHS expert. However, it can be said that the physical working conditions have been unintentionally improved by removing unnecessary objects and creating space for individual materials, tools and equipment. It should be noted, however, that in two cases some actions were identified to improve health and safety of working conditions. In the first case, it concerns the change, use and control of protective clothing and the use of other personal protective equipment. In the second case, it was pointed out that it was necessary to include the OHS instructions contained in the 5S rules.

The interviews show that the places for individual items were not always correctly indicated. By achieving the effect of standardization and systematization, ergonomics and optimization of processes are achieved. The implementations did not verify the effects of the implementation in terms of the impact of the changes on the health of employees, their well-being at work or the level of stress they experienced.

The survey shows that in connection with the implementation of e.g. 5S principles, employees felt: fear that they would not be able to cope with the new requirements; fear that they would not adapt to the new order, that they would have to look for something longer,

with the current state considered good; fear that the cleaning process will take more time and they will not perform basic tasks; fear that cleaning will have to be carried out after the working time agreed with the employer (without appropriate overtime); fear that the work environment will start to resemble a sterile laboratory.

The interviews show that the feeling of anxiety did not disappear, but was replaced by a habit that weakened its effects. The 5S method, considered an important element of the Lean Management approach, has been implemented in a way that raises many concerns among employees. The implementation of 5S did not take into account the mental health and well-being of employees.

To answer the question: Has the impact on the physical and mental health of employees been studied before and after the implementation of lean methods? It was found that no such studies were conducted. We can identify a certain picture by analyzing the number and place of accidents at work.

The last question concerned the correctness of using LM methods. Are the rules for the use of LM carried out methodically correctly? The observation showed that the implementation of 5S itself was carried out quite correctly. Particular attention is paid to conducting introductory training to alleviate the feeling of stress. The methodology of LM or LO itself does not take into account the specificity of individual departments. In the interviews, the fight against waste (MUDA) was emphasized, while no one even mentioned MURI and MURA. This means that the understanding of LM is limited only to improving efficiency by eliminating waste.

5. Discussion

The analysis presented in the article allowed to draw conclusions on the importance given among the interests of employees to the issue of ensuring safe and hygienic working conditions and taking into account and consciously shaping these conditions when designing and implementing LM solutions in the light of ensuring employees' physical and mental health.

As demonstrated, the issue of providing them with safe and healthy working conditions is a key interest in the opinion of the respondents surveyed in 2018-2023. This should not be surprising, in particular, that the results of research presented in the literature on the subject prove that, for example, excessive workload and extended working hours prevent the employee from regenerating adequately (Sánchez, 2017). In turn, improving working conditions has a positive effect on the health and well-being of employees (Belloni, Carrino, Meschi, 2022) (Bratberg, Holmås, Monstad, 2020). All this also affects work efficiency.

Another question that arises is the limits of improvement so that they do not lead to overload. Here another question arises, when to talk about overloading the employee. From a practical perspective, this is a challenge for building labour standards.

Comparing the main causes of deterioration of health, repetitive work, its intensity, teamwork, work pace dependent on the work of colleagues, machines, rotational schedules, compliance with quality standards, sedentary posture (Askenazy, Caroli, 2003; Stock et al., 2006; Gollac, 2005) with factors lying in the area of MURA and MURI, it can be said that the application of these two principles should mitigate the impact of MUDA reduction at the workplace. However, the research shows that the practice is different. When implementing LM, companies focus on reducing waste in its simplest form. At the same time, apart from the application of the MURA and MURI principles.

This is confirmed by the results of research conducted in the USA and Europe, where it was only the activity of trade unions that forced the actions of relevant state institutions, forcing changes in the approach of enterprises to shaping safe material conditions of work.

Another effect of standardization and systematization is the depersonalization of the workplace, which means for the employee and the employer:

- easier preparation of a new employee for the position, shortening the training time to the level of expected efficiency,
- mismatch of the workplace to the physical characteristics of individual people, in the case of people with physical parameters not adapted to the norm, it is possible to work only in a strenuous position, which may lead to deterioration of the health of the musculoskeletal system, which should also be understood as a kind of exclusion,
- exclusion of people with reduced mobility from work,
- instilling a sense of substitutability among employees, which leads to a decrease in their motivation and self-esteem,
- fear of losing your job.

The results of the study encourage the development of solutions within the implementation of Lean assumptions, especially in the 5S system, which will also ensure:

- improving production efficiency,
- occupational health and safety (physical and mental health),
- the level of workplace organization that guarantees a certain level of personalization,
- standardization of work guaranteeing minimization of overloads,
- changes in work position, the use of position variation, e.g. changing every other day or during a shift, so as to achieve the effect of changing position,
- alleviating negative emotions in the process of implementing new management methods.

This solution can be offered by tailoring the 5S principles to individual employees. It can be said that this would mean the development of the 5S+P concept. In addition, many negative emotions and behaviors can be avoided by showing all employees a broader vision of the production system and the place of individual employees. In the case of planned redundancies, indicate ways to support employees in getting a new job or improving their

competences. Detailed LM methods should be introduced only after ensuring an appropriate level of knowledge and a sense of security of employees.

6. Conclusion

An important problem in conducting further research is to distinguish between physical and non-physical factors that shape working conditions in the light of their impact on physical and mental health. There can be physical conditions that affect mental health, but there can also be non-physical conditions that affect physical health. The question is also whether health should be considered psychosomatic so that conditions can have a greater impact on physical and mental health. Today, the labour market is changing and more and more work is being done in the service sector, where working conditions and health problems are shifting the focus from physical to non-physical working conditions and from physical health to mental or at least psychosomatic health. There is also a practical problem of standardizing work based on the principle of limiting overload while maintaining adequate efficiency.

The practical usefulness of the research can be considered to increase awareness of the importance of the MURA and MURI principles for the proper functioning of the Lean Management philosophy.

References

1. Alli, B.O. (2008). *Fundamental principles of occupational health and safety*. Geneve: International Labour. Retrieved from: https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_093550.pdf, 14 July 2020.
2. Aluchna, M., Płoszajski, P. (2008). *Zarządzanie japońskie. Ciągłość i zmiana*. Warszawa: SGH.
3. Askenazy, P. (2001). Innovative workplace practices and occupational injuries and illnesses in the United States. *Economic and Industrial Democracy, 22(4),* pp. 485-516.
4. Askenazy, P. (2006). La santé et la sécurité dans les entreprises américaines [Occupational health and safety in American companies]. *Actes de la recherche en sciences sociale, 163*, pp. 72-89.
5. Askenazy, P., Caroli, E. (2003). Pratiques « innovantes », accidents du travail et charge mentale: résultats de l'enquête française « Conditions de travail 1998 » [Innovative practices, work place accidents and mental strain: the results of a French study entitled «1998 working conditions »]. *Perspectives interdisciplinaires sur le travail et la santé, 5(1)*.

6. Basińska, B. (2005). Warunki pracy a źródła stresu właścicieli małych przedsiębiorstw. In: D. Walczak-Duraj (Ed.), *Humanizacja wobec wyzwań transformacyjnych i cywilizacyjnych* (pp. 205-220). Płock: Novum.
7. Becker, J.E. (2001). Implementing 5S to Promote Safety & Housekeeping. *Professional Safety, 46*, pp. 29-31.
8. Belloni, M., Carrino, L., Meschi, E. (2022). The impact of working conditions on mental health: Novel evidence from the UK. *Labour Economics, 76*, pp. 1-22, doi.org/10.1016/j.labeco.2022.102176.
9. Bertrand, T., Stimec, A. (2011). Santé au travail [Health at work]. *Revue Française de Gestion, 214(1)*, pp. 27-144.
10. Bratberg, E., Holmås, T.H., Monstad, K. (2020). Health effects of reduced workload for older employees. *Health Economics (United Kingdom), 29(5)*, pp. 554-66, doi.org/10.1002/hec.4002.
11. Brenner, M., Fairris, D., Ruser, J. (2001). 'Flexible' work practices and occupational safety and health: exploring the relationship between cumulative trauma disorders and workplace transformation. *Social Science Research Network.* ID 333762 SSRN Scholarly Paper.
12. *Cambridge Dictionary* (2021). Cambridge University Press, https://dictionary.cambridge.org/pl/dictionary/english/interest, 6.03.2023.
13. Cierniak-Emerych, A. (2023). Work safety as an important aspect of CSR and sustainable development goals. In: S.O. Idowu, Z. Liangrong (eds.), *The Elgar Companion to Corporate Social Responsibility and the Sustainable Development Goals* (pp. 99-115). https://doi.org/10.4337/9781803927367.
14. Cierniak-Emerych, A., Gableta, M. (2022). *Gospodarowanie potencjałem pracy zorientowane na interesy pracobiorców.* Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.
15. Cierniak-Emerych, A. (2005). *Europejskie standardy praw człowieka i warunków pracy*. Wrocław: IB-iS.
16. Cierniak-Emerych, A., Pietroń-Pyszczek, A., Zaręba, I. (2023). Shaping Working Conditions in the Perspective of Employee Interests. *Zeszyty Naukowe Politechniki ŚLąskiej. Organizacja i Zarządzanie,* 95-108. https://doi.org/10.29119/1641-3466.2023.177.6
17. Cooper, C.L., Williams, S. (1998). Measuring occupational stress: development of the pressure management indicator. *Journal of Occupational Health Psychology, 3(4)*, pp. 306-321.
18. Cox, T., Griffiths, A., Rial-González, E. (2000). *Research on work-related stress*. Bilbao: European Agency for Safety and Health at Work.
19. Datta Gupta, N., Kristensen, N. (2008). Work environment satisfaction and employee health: panel evidence from Denmark, France and Spain, 1994-2001. *European Journal of Health Economy, 9*, pp. 51-61.

20. Daubas-Letourneux, V., Thébaud-Mony A. (2001) Blind spots in our knowledge of industrial accidents. *Travail et Emploi, 88,* pp. 25-42.
21. Daubas-Letourneux, V., Thébaud-Mony, A. (2003) Organisation du travail et santé dans l'Union Européenne [Work organization and health in the European Union]. *Travail et Emploi, 96,* pp. 9-35.
22. EUROFOUND (2019). 'Working conditions', https://www.eurofound.europa.eu/pl/topic/working-conditions, 4.03.2019 and the European Working Conditions Telephone Survey (EWCTS) 2021 was also conducted in 2021.
23. Fairris, D., Brenner, M. (2001). Workplace transformation and the rise in cumulative trauma disorders: is there a connection? *Journal of Labor Research, 22(1),* 15-28.
24. Gajdzik, B. (2014). Twórcze warunki pracy w przedsiębiorstwie produkcyjnym – wybrana problematyka. *Zeszyty Naukowe Wyższej Szkoły Zarządzania Ochroną Pracy w Katowicach, 1(10),* pp. 66-77.
25. Gapp, R., Fisher, R., Kobayashi, K. (2008). Implementing 5S within a Japanese Context: An Integrated Management System. *Management Decision, 46(4),* pp. 565-579.
26. Giordano, C. (2021). Freedom or money? The dilemma of migrant live-in elderly carers in times of COVID-19. *Gender, Work and Organization, 28(S1),* pp. 137-150, https://doi.org/10.1111/gwao.12509.
27. Gollac, M. (2005). L'intensité du travail [Work intensity]. *Revue économique, 56(2),* pp. 195-216.
28. Guy, B., Arthur, B. (2020). Academic motherhood during COVID-19: Navigating our dual roles as educators and mothers. *Gender, Work and Organization, 27(5),* pp. 887-899. https://doi.org/10.1111/gwao.12493
29. ILO (International Labour Organization) (2022). *Social dialogue is key to mitigate work accidents and increase productivity.* World Day for Safety and Health at Work. Retrieved from: https://www.ilo.org/jakarta/info/public/pr/WCMS_844891/lang--en/index.htm, 13.04.2023.
30. Imai, M. (2006). *Gemba Kaizen. Zdroworozsądkowe, niskokosztowe podejście do zarządzania.* Warszawa: MT Biznes.
31. Juchnowicz, M. (2010). Zarządzanie kapitałem ludzkim a poziom zaangażowania pracowników. *Zarządzanie Zasobami Ludzkimi, 3-4,* pp. 57-66.
32. Junewick, M.A. (2002). *LeanSpeak. The Productivity Business Improvement Dictionary.* New York: Productivity Press.
33. Kaczmarczyk, S. (1999), *Badania marketingowe. Metody i techniki.* Warszawa: PWE.
34. Karasek, R., Theorell, T. (1991). *Healthy work: stress, productivity, and the reconstruction of working life.* New York: Basic Books.
35. Karaszewski, R. (2009). *Nowoczesne koncepcje zarządzania jakością*. Towarzystwo Naukowe Organizacji i Kierownictwa" Dom Organizatora".

36. Kornicki, L., Kubik, Sz. (2008). *Identyfikacja marnotrawstwa na hali produkcyjnej*. Wrocław: ProdPress.com.
37. Krafcik, J. (1988). Triumph of the Lean Production System. *Sloan Management Review, 30(1).*
38. Krasiński, M. (2014). *Kulturowe uwarunkowania wykorzystania japońskich koncepcji, metod i technik zarządzania.* Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.
39. Lin, Y.H., Lin, Y.C., Lin, S.H., Lee, Y.H., Lin, P.H., Chiang, C.L., Chang, L.R., Yang, C.C., Kuo, T.B. (2017). To use or not to use? Compulsive Behavior and Its role in Smartphone Addiction. *Translational Psychiatry, 7(2),* pp. 1-6, https://doi.org/10.1038/tp.2017.1.
40. Cottini, E., Lucifora, C. (2013). Mental Health and Working Conditions in Europe. *ILR Review, 66(4),* pp. 958-988. https://doi.org/10.1177/001979391306600409
41. Lugosi, P., Ndiuini, A. (2022). Migrant mobility and value creation in hospitality labour. *Annals of Tourism Research, 95,* pp. 1-12, https://doi.org/10.1016/j.annals.2022.103429.
42. Macassa, G., McGrath, C., Tomaselli, G., Buttigieg, S.C. (2021). Corporate social responsibility and internal stakeholders' health and well-being in Europe: a systematic descriptive review. *Health Promotion International, 36(3),* pp. 866-883, https://doi.org/10.1093/heapro/daaa071
43. Matten, D., Moon, J. (2008). 'Implicit' and 'explicit' CSR: a conceptual framework for a comparative understanding of corporate social responsibility. *Academy of Management Review, 33(2),* pp. 404-424. Available at SSRN: http://ssrn.com/abstract=978942
44. Maxwell, R., Knox, S. (2009). Motivating employees to "live the brand": a comparative case study of employer brand attractiveness within the firm. *Journal of Marketing Management, 25(9-10),* pp. 893-907, https://doi.org/10.1362/026725709X479282
45. Molek-Winiarska, D. (2015). Sources of occupational stress among employees in the mining sector. *Management Science, University of Economics Publishing House, 2(23),* pp. 74-92, DOI:10.15611/noz.2015.2.06
46. Ruiz-Frutos, C., Pinos-Mora, P., Ortega-Moreno, M., Gómez-Salgado, J. (2019). Do companies that claim to be socially responsible adequately manage occupational safety and health? *Safety Science, 114,* pp. 114-121, https://doi.org/10.1016/j.ssci.2019.01.010.
47. Sánchez, R. (2017). Does a mandatory reduction of standard working hours improve employees' health status? *Industrial Relations, 56(1),* pp. 3-39, https://doi.org/10.1111/irel.12163.
48. Sarker, M.R. (2021). Labor market and unpaid works implications of COVID-19 for Bangladeshi women. *Gender, Work and Organization, 28(S2),* pp. 597-604, https://doi.org/10.1111/gwao.12587.
49. Schnall, P.L., Landsbergis, P.A., Baker, D. (1994). Job Strain and Cardiovascular Disease. *Annual Review of Public Health, 15(1),* pp. 381-411.

50. Stock, S., Messing, K., Tissot, F., Seifert, A.M., Vézina, N. (2006). Les troubles musculo-squelettiques, la détresse psychologique et les conditions de travail au Québec: relations complexes dans un monde du travail en mutation [Musculoskelettical disorders, mental distress and working conditions in Quebec: complex relationships in a changing world of work]. *Santé, Société et Solidarité, 5(2),* pp. 45-58.
51. Stuart, H. (2002). Employee Identification with the Corporate Identity - Issues and Implications. *International Studies of Management & Organization, 32(3),* pp. 28-44, https://doi.org/10.1080/00208825.2002.11043663.
52. Stumbitz, B., Jaga, A. (2020). A Southern encounter: Maternal body work and low-income mothers in South Africa. *Gender, Work and Organization, 27(6),* pp. 1485-1500, https://doi.org/10.1111/gwao.12527
53. Szatkowski, K. (2014). *Nowoczesne zarządzanie produkcją*. Warszawa: PWN.
54. Theorell, T., Karasek, R.A. (1996). Current issues relating to psychosocial job strain and cardiovascular disease research. *Journal of Occupational Health Psychology, 1(1),* pp. 9-26. https://doi.org/10.1037/1076-8998.1.1.9
55. Valeyre, A. (2007). Les conditions de travail des salariés dans l'Union européenne à quinze selon les formes d'organisation. *Travail et Emploi, 112,* pp. 35-47: http://journals.openedition.org/ travailemploi/2185; DOI: 10.4000/travailemploi.2185
56. Walentynowicz, P. (2013). *Uwarunkowania skuteczności wdrażania Lean Management w przedsiębiorstwach produkcyjnych w Polsce.* Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
57. Wójcik, P. (2013). Znaczenie studium przypadku jako metody badawczej w naukach o zarządzaniu. *e-Mentor, 48(1),* 17-22.
58. Womack, J.P., Jones, D.T. (2008). *Maszyna, która zmieniła świat.* Wrocław: ProdPress.com.
59. Yildirim, T.M., Eslen-Ziya, H. (2021). The differential impact of COVID-19 on the work conditions of women and men academics during the lockdown. *Gender, Work and Organization, Vol. 28, Iss. S1,* pp. 243-249, https://doi.org/10.1111/gwao.12529
60. Zimon, D. (2012). Znaczenie jakości w zrównoważonej logistyce. *Logistyka, 2,* pp. 22-24.