
The Impact of the Covid-19 Pandemic on the Application of Management Methods by Industrial Goods Processing Enterprises

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Abstract:

Purpose: The aim of this publication is to present the results of the study concerning the scope of application of the selected management methods in industrial goods processing enterprises and changes in the degree of their application during the pandemic.

Design/Methodology/Approach: The data was obtained through online survey questionnaires including questions about the symptoms of the occurrence of the selected management methods. We asked the representatives of small and medium enterprises in the industrial processing sector to fill them in.

Findings: The obtained findings not only indicate the scope of the use of methods in 2019 and 2021, but they also show changes in their application, pointing at the causes of differences.

Practical Implications: Corporate managers can compare the solutions their companies have implemented in the area of management method application to those used by other entities and can observe the ongoing changes. This information may help them to make decisions regarding potential changes.

Originality/Value: Numerous publications related to the influence of the pandemic on the functioning of economy rarely concern the issue of changes on the application of management methods.

Keywords: Management methods, enterprises, the Covid 19 pandemic.

JEL codes: L2, L21.

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1. Introduction

The year 2020 brought about revolutionary and far-reaching changes, both in the private life of us all and in the mode of operation of many enterprises. They were a consequence of governments' decisions to close borders and introduce limitations on the movement of people. This concerned not only private persons, but also company representatives. The existing body of literature (Nicola *et al.*, 2020; Grima *et al.*, 2020; Khan *et al.*, 2020; Baryshnikova *et al.*, 2021; Guth, 2021; Martínez-Azúa *et al.*, 2021; Saja, 2021; Zhuravleva and Chechenova, 2021) identifies different aspects of the influence of the pandemic on the functioning of companies depending on the industry they are in.

As far as the manufacturing industry is concerned, the main fears are related to declining liquidity or severed distribution chains, as well as problems in performing work, resulting from the fact that it cannot be done online and from restrictions due to quarantine and illness.

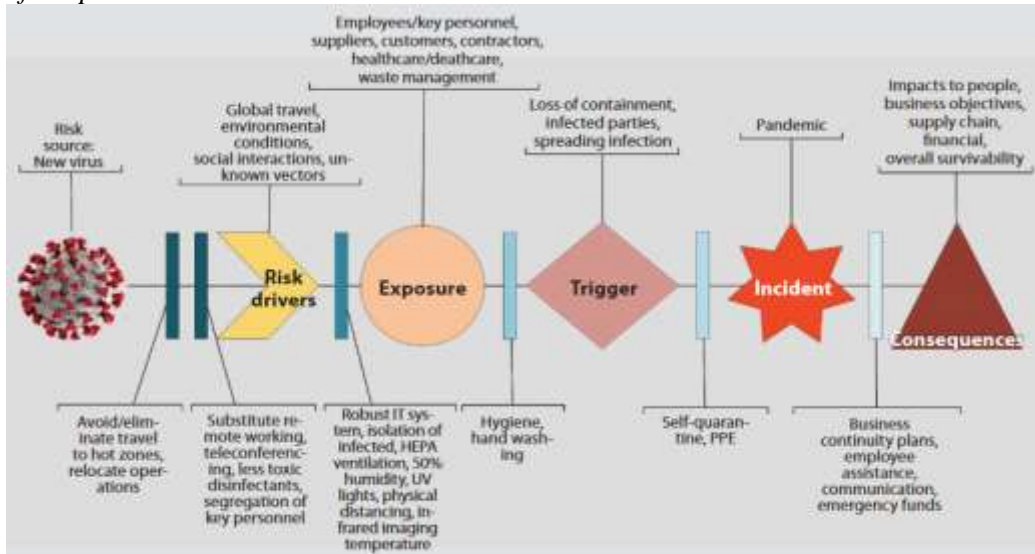
Difficulties in maintaining supply chains are also indicated by other authors (Singh *et al.*, 2021; Remko, 2020), who stress their importance for all sectors of the economy, at the same time pointing out that it has become harder to operate them under the pandemic. Because of the economic crisis and its expected implications, they propose that the supply chain should be rebuilt through seeking innovative concepts for managing disturbances.

Due to the global character of exchange in almost all economic sectors, the introduction of new solutions concerning cooperation in the supply chain will require the same global approach to implementing changes. This may be a chance to develop a new value in international exchange, but there is also a risk of not being able to adapt or adapt too slowly to the selected areas. In this case, the current level and direction of exchange will not be maintained, much less perfected.

The influence of the pandemic is also evident in the analysis of risks that business entities have to face. What is the principal problem is uncertainty and inability to predict the direction and speed of changes concerning enterprises (Bukanová, 2021). So far companies' development was a sort of continuum, based on the evolution of factors determining businesses. Under a threat from Covid-19, there is no model which could serve as a reliable basis for reasoning. Changes are of a revolutionary nature, being difficult or impossible to anticipate.

Thus, companies cannot get ready for them, although the ideas for reducing the impact of the pandemic on the stability of the economy are constantly sought (Lyon and Popov, 2020b). Figure 1 shows the pandemic-related risks and potential ways of preventing its negative consequences.

Figure 1. The impact of pandemic-related risks and the containment of the consequences of the pandemic



Source: Lyon and Popov 2020a.

As a result of the occurrence of Covid-19 and all the resulting restrictions, it was small and medium enterprises that were the most severely hit (Pedauga *et al.*, 2021). This was first due to internal problems with maintaining the stability of operations. SMEs were particularly affected by a decrease in labour supply, which was caused by employees' self-isolation, quarantines and illness and led to the reduction of production capacity, also limited by supply chain interruptions. What is more, a decrease in consumers' income and the suspension of investment spending significantly cut companies' revenue (Coibion *et al.*, 2020). These factors contributed to changes in the activity of businesses. SMEs account for 43% of this drop and for 66% of the growth of unemployment (Pedauga *et al.*, 2021) caused by pandemic-related restrictions.

Studies conducted by Zhang, Ding and Li (2021) brought some interesting findings. The aim of their research was to identify changes in the level of trust in the particular sectors of the economy in the times of the pandemic. While the overall economic sentiment tends to be rather negative, which is not surprising, what is striking is the growth of consumers' trust in general and the increasing trust in service industry. In turn, the level of trust in the manufacturing industry has fallen. The authors (Zhang *et al.*, 2021) do not provide any argument why that is so, only pointing out that managers should focus on the adaptation of those sectors which are particularly low rated to the new business circumstances and consumers' demands. Changes in corporate operations also mean the implementation or change of the scope of the application of management methods.

2. The Subject and Form of the Research

The study the result of which we present in this publication was conducted in two stages. The first of them took place at the turn of November and December 2019 and the other

one in January 2021. This means that the first phase of the study was carried out in the conditions that may be deemed relatively stable. Enterprises developed within the boundaries of their individual capacities without any sudden global external disturbances. The second stage of the research was conducted after the second wave of COVID – 19, followed by another lockdown imposed by the governments of most countries of the world. As a result, in January 2021, companies were after two processes (in spring and autumn) of adapting their operations to the entirely new circumstances.

Initially, we planned to learn about the scope of management methods used by enterprises. To this end, we devised an online questionnaire, including questions about the use of these methods by companies. Managers from 70 enterprises agreed to fill in the questionnaire. They were asked about the use of 14 management methods which all supported companies in being agile (Trzecieliński, 2011).

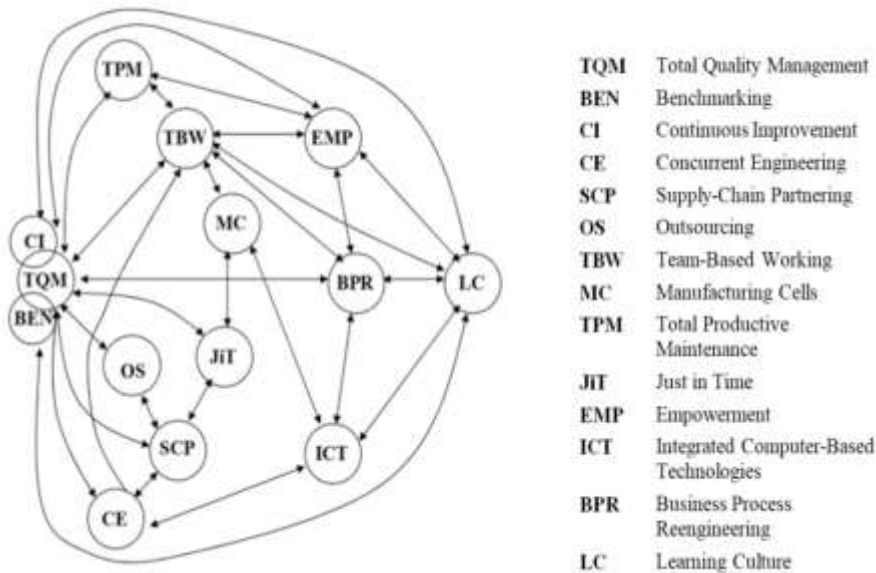
To make sure that there are no distortions in the information obtained from the respondents, we did not ask them about a specific method, but about its separate symptoms. It allowed us to avoid mistakes arising from the insufficient knowledge of all the aspects of a given method and to prevent deliberate efforts to show one's company in a better light as the one applying a wide range of diverse management methods and tools.

The companies covered by the study are all small and medium enterprises from the processing industry. They differ in the period they have operated in the market: the oldest entity was established in 1875, while the youngest one was founded in 2018. They are also based in different locations as the online survey made it possible to reach companies from all parts of Poland. The field of operation was generally recognized as industrial processing. It could be to a certain extent justified to analyse the results according to market experience or location, but, because of the different size of groups which would then be examined, we decided to perform a general qualitative analysis of all entities. This makes it possible for us to identify such an overall trend of changes in managing companies, but to draw detailed conclusions, we would need the analyses of individual entities, which may become the subject of further research.

3. The Definition and Description of the Management Methods Covered by the Study

As early as in the pre-pandemic period, when the economy developed in its own proper rhythm, it was emphasized that there was a need for enterprises to adapt to the volatile external circumstances. An agile enterprise was indicated as the business model which makes it possible to grab market opportunities (Trzecieliński, 2011). Because of the nature and speed of market changes resulting from the imposition of the pandemic-related restrictions, there was a sudden necessity of adjusting business operations to stay afloat in entirely new conditions. A company's agility is seen as a chance for remaining in the market. The spectre of management methods and tools used in an agile enterprise was the basis for the selection of methods in the research area (Figure 2).

Figure 2. Methods and tools supporting a company's agility



Source: Trzeciński, 2011.

To reach the development level to be called an agile company, an enterprise has to focus on quality. This is ensured by the application of Total Quality Management (TQM) method (Chen *et al.*, 2005). Not only the products, but also all aspects of a company's operations need to be improved: work, technological solutions, manufacturing processes and systems used, marketing, communication, i.e., all elements which help to satisfy the needs of customers, employees, and business partners. Quality in a company may also be supported using Benchmarking (BEN), which allows recognizing and applying effective solutions used in other enterprises (Rendon, 2015). Companies pursue different ways of continuous development to improve quality. Continuous Improvement (CI) method is one of them. It seeks small improvements, which are systematically introduced in everyday operations (Piersiala and Trzeciński, 2006).

High quality also requires developing and broadening knowledge by employees and a system of knowledge-sharing, which helps to gain new experience and build unique know-how Learning Culture (LC) is thus a method which is worth using in a company, although it needs proper corporate culture, in which employees feel appreciated and safe at the same time (Valadao *et al.*, 2013).

Other methods supporting a company's agility include Business Process Reengineering (BPR) (Novak, Janes, 2019) or Concurrent Engineering (CE). In the former, the aim is to optimise the flow of work and efficiency of an organization. The vertical, hierarchical structure is replaced by emphasis on maintaining the continuity of processes linking company departments through the involvement of employees from different fields.

In place of functional cells, process teams are established. A single team rather than a few functional units is responsible for the product. Therefore, Team Based Working (TBW) and Empowerment (EMP) are applied here.

Concurrent Engineering (CE) (Mas *et al.*, 2013) is a relatively parallel implementation of stages of the product development and manufacturing cycle, putting emphasis on three fundamental elements: the improvement of product development and launch, teamwork, and the application of advanced information technologies in designing. This means the use of Team Based Working (TBW) and Integrated Computer Technology (ICT).

In team-based working (TBW) (Cantzler and Leijon, 2005), tasks are performed jointly, and the lack of any member makes them impossible to accomplish. Work teams are monitored to a limited extent. They are given a lot of freedom in performing their tasks and have formal power and make their own decisions. Empowerment (EMP) method (Kim and Beehr, 2020) is also largely used. It provides employees with a lot of autonomy when it comes to the way tasks are carried out and decisions made.

Integrated Computer Technology (ICT) (Marion and Fixson, 2020; Behmer and Jochem, 2020) is defined as a module-based system encompassing many or all aspects of a company's operations. The support of corporate management processes is combined with complex information systems. Such a solution makes it possible to improve information exchange, and the speed of data processing facilitates efficient process management in an organization.

Depending on the level of IT development and process approach in an enterprise, the degree of connections among modules may be varied. If a company has implemented and applies Concurrent Engineering, it is safe to say that the scope of computer support will be significant. This stems from the necessity of making numerous and precise calculations and changes in the process of simultaneous implementation of a number of product launch stages (Pacholski *et al.*, 2009).

IT support, which often leads to highly advanced automation, is used in the organization of the manufacturing process. This process requires preparing an appropriate structure, which encompasses a set of manufacturing cells (units) and a form of their mutual links. The whole of such a structure in a company should be devised according to the principles of Manufacturing Cells (MC) adopted. A structure properly adapted to production requirements allows a company to increase efficiency through accelerating manufacturing process and reducing the frequency and volume of transport, particularly internal (Rampasso *et al.*, 2019).

The flow of the manufacturing process is supported using Total Productive Maintenance (TPM). It links all employees of a company by setting them a goal of maintaining the continuity of production by jointly eliminating various losses (Pawłowski *et al.*, 2006). Activities related to maintenance, such as: the maintenance of machinery and equipment, perfecting them, repairs, and preparation for use, are all viewed as tasks aimed at keeping fixed assets in the condition of full efficiency (Piersiala and Trzecieliński, 2005).

The effective application of MC and TPM often depends both on the proper internal organization of a company and on the establishment of external relations helping to reduce broadly defined waste.

Thus, it is commonly agreed that to achieve agility, not only does an enterprise have to be well shaped internally, but it also needs to establish relations with suppliers and customers based on cooperation within supply chains. A supply chain is a system of broad networks, sometimes beginning from companies which extract raw materials and ending with recycling organizations. To start cooperation as a part of such a network, an enterprise must manage a system of supply efficiently, going beyond the activity of companies, and to ensure the appropriate quality of raw materials and intermediate products. Just in Time (JiT) (Oguz and Dincer, 1991) is a method related to Supply Chain Partnership (SCP) (Moyano-Fuentes et al., 2020). Its characteristic feature is the delivery of materials exactly in the time and amount they are needed in the manufacturing process, which ensures there is neither shortage nor surplus. It reduces costs related to storage and waste in logistics.

An enterprise's agility is also influenced using Outsourcing (OUT) (Soderberg *et al.*, 2017). In this case, the company abandons activities which could be more efficiently performed by subcontractors. Not only is it more economical, but it also makes the organization more flexible as it is more focused on its key activities.

4. The Scope of Application of Management Methods before and during the Pandemic

The study was conducted in two stages in 2019, when there were no pandemic-related restrictions imposed on businesses, and at the beginning of 2021, when entrepreneurs had already been affected by two economic lockdowns. Our initial aim of examining the scope of application of methods was extended to check how it had changed in the period under analysis. The obtained results were presented in Table 1.

Table 1. Management methods used before and during the pandemic

Method		Number of enterprises using the method	
		2019	2021
Total Quality Management	TQM	37%	39%
Benchmarking	BEN	42%	43%
Continuous Improvement	CI	44%	38%
Concurrent Engineering	CE	52%	56%
Supply-Chain Partnering	SCP	39%	39%
Just In Time	JiT	40%	20%
Outsourcing	OS	34%	38%
Team-Based Working	TBW	41%	19%
Manufacturing Cells	MC	34%	46%
Total Productive Maintenance	TPM	52%	39%

Empowerment	EMP	44%	31%
Integrated Computer Technologies	ICT	44%	52%
Business Process Reengineering	BPR	29%	26%
Learning Culture	LC	48%	42%

Source: Author's own work.

In 2019, in the enterprises under study, CE and TPM were the most often used methods. The frequent use of CE may be explained by the need for responding quickly to consumers' changing needs, not only with regard to the number of products offered, but, first of off, with reference to their improved versions. The introduction of product innovation is often a race against time and competitors. The application of CE allows companies to simultaneously implement several necessary phases in the process of meeting customers' expectations. In such a situation, any shortcomings in the sphere of preparation of machinery and equipment for efficient and failure-free operation are unacceptable. This justifies the scope of use of TPM in the entities under study.

LC is another quite frequently used method (by almost 48% of enterprises). This signifies a certain change in the culture of the examined companies because this method involves not only employees' development in broadening and specializing their knowledge and skills, but also the introduction of the system of know-how exchange among staff. Thus, to a certain degree, company managers no longer stimulate competition, but try to promote efficiency in performing tasks. Such self-perfection may be reflected both in the improvement of employees' qualifications, also formal ones, and in the continuous development of processes and work outcomes.

Such an improvement is the basis for the application of CI (used by 44% of enterprises). It should be aimed not only at perfecting products, but also at ways of performing tasks by employees. In CI, such activities should be more formalized – they could be proposals submitted to superiors, which are then analysed and may be implemented. Sometimes, however, subordinates receive a wider range of decision-making powers and can introduce some changes on their own, on the condition that their possible failure does not have too much influence on other tasks.

Such employees' autonomy is implemented through EMP (44% of enterprises). Its relatively common use by the companies under study coincides with the degree of application of LC. Both methods require employees to take care of their self-growth, competence development and gaining new skills.

ICT is another method applied to a similar extent (44% of the companies under study). It relates to CE and, to a smaller degree, with TPM. The simultaneous implementation of phases in CE would not be possible if all stages were not supported by computer technologies. They enable a quick calculation of introduced changes and show any possible implications they might entail. They also make it possible to simultaneously design a product, plan production, distribution and estimate costs in real time.

At the same time, advanced IT technologies are applied when monitoring the work of machinery and equipment, which is one of the elements of TPM. They can indicate or even eliminate any mistakes that occur.

What is the most rarely used method among the examined ones is BPR (applied by 29% of entities). This is probably because of the reluctance to introduce comprehensive changes of a revolutionary nature in an enterprise. They involve high investment costs and the implemented modifications do not remain up to date for long, which necessitates the company's further adaptations to changes in the business environment. It seems that enterprises are more prone to introduce changes based on CI rather than BPR because it is safer financially and organizationally.

The findings of the study conducted in 2021 also indicate the relatively frequent use of CE by companies (56% of entities). The fact that this method had already been implemented earlier was conducive to its further development, so the degree of application was high. At the same time, it is worth noting that ICT is also quite often applied (by 52% of enterprises). It is the element that strongly supports or is even indispensable for CE. Thus, this relationship has once again been confirmed. What is more, the pandemic period favoured the growth of information technologies as it was them that often made it possible to perform work.

Most employees not directly involved in production performed their tasks remotely. They needed not only good internet connection, but also top-quality software. Enterprises had to make sure that several employees could log in to their systems at the same time and use IT tools which used to be available only from internal company networks.

MC was also quite frequently used (46% of entities), which could stem from the precise planning of work performed by employees directly involved in production. During the pandemic, very strict work conditions were imposed to minimise contact among people and, thus, prevent the spread of the disease. Hence, the need arose for reducing interaction, i.e., the organization of work in a way that helps to maintain the sanitary regime.

Among the relatively seldom used methods in 2021 are JiT (20% of entities) and TBW (19% of enterprises). JiT, related to supply, was used a lot less often because of numerous problems in maintaining the flow of the supply chain. Global restrictions connected with trade and the flow of goods also played a role. The rare application of TBW, in turn, was caused by the lack of possibility of doing work in teams (because of remote work) and numerous lay-offs and quarantines. All these factors make it difficult to implement the assumptions of TBW method.

5. The Causes of Differences in the Application of Methods

The second stage of reasoning based on our research involved comparing the scope of application of all methods in the two periods in which information was obtained from the respondents. This comparison was presented in the form of a diagram (Figure 3), which

shows all the examined methods and the levels of their application in 2019 and 2021 were indicated. In the case of some methods, they were used to a similar degree (TQM, BEN, SCP, BPR), while for others, the difference in application over the period of 1.5 years was quite significant (JiT, TBW, MC, TPM, EMP, ICT). In the latter case we observed both an increase and a decrease in the level of application of methods.

Small differences in the application of TQM can be understood in the context of the need for maintaining high quality both with reference to products and processes implemented in enterprises. Goods offered in the market more difficult than before, which was caused by consumers' uncertainty regarding the stability of their income and, consequently, their reluctance to spend money, had to be marked by quality high enough to attract customers. As regards the conditions of work and manufacturing processes, TQM also maintained the previous level, although the approach to them slightly changed, shifting towards ensuring safety.

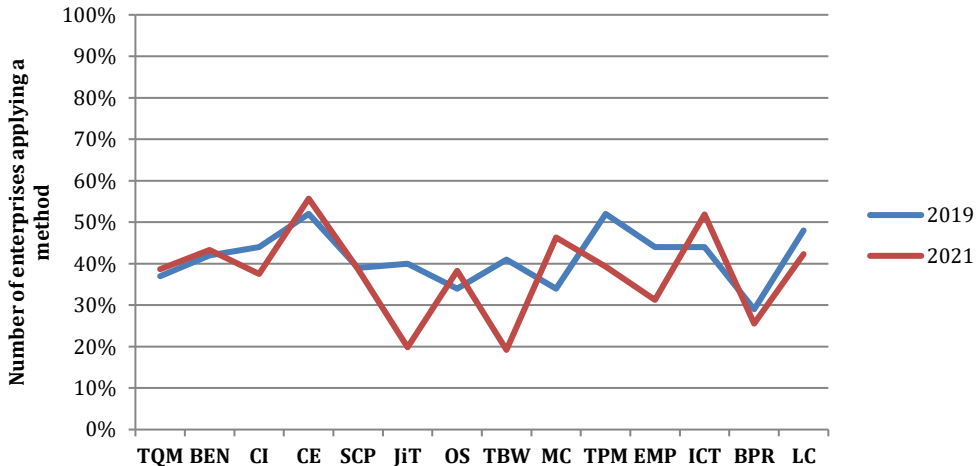
In pursuit of solutions allowing companies to stay afloat in the dynamically changing business reality, their managers monitored modes of operation in other entities. Uncertainty caused by the pandemic was the reason that the application of BEN, even though it was on the same level, involved seeking activities enabling further existence rather than improving organization and management.

The previous principles of supply chains turned out to be useless in the new circumstances, either. The implemented partnerships remained in force only owing to the broadly defined mutual loyalty of companies, not because of performed contracts, which is reflected by the significant drop in the use of JiT. SCP was seen as a guarantee of quick return to the normal levels and conditions of operation after the pandemic, as it ensured access to raw materials and semi-finished goods.

BPR was relatively little used in both examined periods. Generally, it seems that the comprehensive introduction of big changes in enterprises is not a common practice among industrial enterprises. The pandemic times have not changed a lot in this respect. CI is still more frequently used. Some companies decided to significantly modify their mode of operation, probably because they did not believe economic restrictions to end soon. Still, the frequency of the BPR application, already low in 2019, dropped by another 3% in 2021.

Figure 3 presents the levels of application of different methods by the examined entities and their changes. The biggest drop was observed regarding TBW (by 22% of the enterprises under study). It turned out difficult to perform work according to TBW-based principles remotely. This was due to a variety of factors. Apart from the inability to satisfy the need for human interactions because of online work, there was also a problem of absenteeism and non-standard working hours. This, in turn, could be a consequence of illness and convalescence or of having to take care of children, who could not attend educational institutions as they were shut down. As a result, the backlog of work accumulated.

Figure 3. The level of application of selected management methods in 2019 (before the pandemic) and 2021 (during the lockdown)



TQM	BEN	CI	CE	SCP	JiT	OS	TBW	MC	TPM	EMP	ICT	BPR	LC
+2%	+1%	-7%	+4%	0%	-20%	+4%	-22%	+12%	-13%	-13%	+8%	-3%	-6%

Source: Author's own work.

There was also a considerable decrease in the degree of application of JiT (20% of entities). In its most narrow definition, this method means the delivery of materials exactly in the time and amount they are needed. As the borders were closed and employees were unwilling to provide transportation services in fear of being infected, it was very difficult to carry out. A speculative motive also played a role here since managers, predicting price increases or further delivery problems, ordered more than was necessary in each moment.

Research and publication mainly cover the scope of application of various selected management methods. However, the causes and consequences of changes in their use were sought primarily in the way people functioned during this period. Restrictions on the freedom of movement and interpersonal contacts significantly influenced the possibility of the current manner of using management methods. The ways of sharing and transferring knowledge were also limited. The conclusions emphasized the key importance of employees' influence on the application of the indicated management methods, even though the research was not focused on human resource management.

The comparison of changes in the application of methods which are commonly viewed as co-occurrent brings interesting results. The study findings showed that as the use of MC increases (by 12% of entities), while the application of TPM decreases (by 13% of enterprises). This can be explained by staff problems, which force the management to put emphasis on such organization of work that would allow to maintain the expected level of production. To a large degree, machinery and equipment are normally maintained by the employees who use them.

However, if they are absent, which was often the case in the period of the growth in infections, keeping the proper level of production is deemed more important than the increased use of machines. At the same time, companies pay more attention to plan the manufacturing process in such way that the logic of stages of this process is maintained, with a simultaneous focus on ensuring employees' safety.

We also observed a drop in the use of LC (by 6% of the enterprises). This could be explained both by difficulties in finding adequate ways of developing knowledge and skills and by reducing the possibility of passing them to other employees. Consequently, the degree of application of CI and EMP fell (respectively, by 7% and 13% of the entities) since they are methods which require highly qualified staff. In CI, care for development and quality improvement must be preceded by good knowledge of the manufacturing process and the product itself. Otherwise, what should bring benefits may injure the company. What may be another problem is the search of new solutions in the context of the functioning of enterprises if attention paid to the creation of work conditions begins to be the fundamental issue. And it was such atypical circumstances that employees had to adapt to.

It is more the case with EMP that employees have to be prepared in terms of qualifications and know-how so that they could make decisions which will be beneficial for their company. It is those decisions that constitute the core aspect of the application of EMP. In the system of remote work, managers tended to focus on ensuring the continuity of work for their subordinates and monitoring the execution of tasks. The issue of empowerment had to be set aside with superiors paying more attention to precise supervision and showing the right ways of performing tasks instead of giving a large degree of freedom as before.

Tight scrutiny was also the possible reason for the more frequent use of ICT (by 8% of the entities). Remote work cannot be supervised in a traditional manner, so it is necessary to implement IT solutions. ICT also supported the organization and execution of tasks online on an unprecedented scale. It seems that the increased application of ICT can be attributed to the necessity of introducing solutions applicable in the remote form of work rather than IT innovations supporting systems used in enterprises.

However, some companies still tried to intensify the application of information technologies to improve their operations, which is reflected by the increased use of ICT-supported CE method (by 4% of the entities). Remote work had a limited influence on the execution of tasks in product design and planning production because such activities can be done from any place, especially since they are always carried out with the application of computer technologies. It is only the manufacturing stage that requires the actual participation of employees in a company. Thus, the increased use of CE signifies the improvement of design work connected with the introduction of product innovations or new product development.

Some jobs were sub-contracted, and this is where we also observed a slight increase (by 4% of the enterprises) in the examined periods. The use of OS is justified by transferring

jobs to entities better specialized in a given field. It makes it easier to adapt to the market requirements as the spectrum of work subject to potential modification is reduced. At the same time, the increased use of OS allows companies to move employees to the areas that are the most important from the perspective of the functioning of the company.

6. The Scope of Application of Selected Management Methods in the Context of Avoiding Pandemic-Related Risks

During the pandemic, the implementation and application of selected management methods must be first aimed at minimizing its negative consequences. In order to identify the methods that should be taken into consideration by company managers, we focused on the ways of reducing the influence of the pandemic presented in Figure 1. At the subsequent stages of the impact of pandemic-related risks, we indicated proper preventive steps and remedies. Even if the quoted study does not directly concern the functioning of enterprises, it is possible to show ways and methods of management which correspond to the preventive activities listed here.

The first stage involves avoiding the areas of the high virus incidence and moving the sites where tasks are carried out. In the case of small and medium industrial enterprises, this obviously does not mean changing the company's location, but the modification of the ways work is performed. It is the second recommendation in risk avoidance, saying about remote work, maintaining contacts via internet connection, and shift or hybrid form of work. All these recommendations are implemented by the examined companies. It is reflected in the use of MC, in which the places where jobs are performed had to be adapted to the requirements of the work process and health and safety requirement.

Changes in the organization of work entailed modifications in teamwork. Company managers paid more attention to evaluating individual employees' work, not leaving them large space for making autonomous decisions. The unusual situation and the introduced restrictions also contributed to a decrease in the use of EMP and TBW. At the same time, some jobs were a bit more frequently subcontracted in the form of OS.

Another recommendation for avoiding risk refers to ensuring a solid information system and social distance. Keeping distance at work is often dependent on the adequate computer support. Here, companies also used ICT as a method helping them to stay in the market during the pandemic. Computer systems were selected in the way which would enable employees to use them remotely and which would ensure the security and monitoring of the performed tasks. What is of key importance is, firstly, the protection of data against any leaks and, secondly, linking with the integrated systems operated in the company.

The next two phases concern maintaining proper hygiene, which involves washing hands and protecting oneself against infection using personal protective equipment and self-isolation if the disease is suspected. Also in this case, proper work organization helps, which is reflected in MC, enabling the performance of work that is harmless for health.

The last stage of counteracting the effects of pandemic-related risks relates to preparing business plans for future, concerning the enterprise as a whole and activities undertaken by individual employees. Their support is needed here to return to the traditional, stationary form of work. The scope of application of TBW and EMP should be restored to at least previous level. The best thing, however, would be to create additional teams in which workers would not only execute tasks together, but they could also depend on each other's help in the process of rebuilding human interactions. It is consistent with the recommendation for the development of communication among employees and among companies.

7. Conclusion

The scope of application of the methods under study in the analysed periods, i.e., 2019 and 2021, was varied. Some of them were quite similar (TQM, BEN, SCP, BPR), but we mostly observed changing values in time. They either increased or decreased. The most significant differences in the degree of application over the period of 1.5 years were evident in the case of JiT, TBW, MC, TPM, EMP and ICT.

When analysing changes in the application of the selected management methods, we indicate that companies must cope with staff problems. These problems include the lack of employees, who are ill, being on long-term sick leaves, or must take care of their children, which is also connected with long absences at work. What is also important is the lack of involvement in work, resulting from exhaustion or reluctance to remote work. They often show much less interest in self-improvement and become less willing to make decisions on their own than it is the case when they work on-site and can use other employees' advice.

Another common problem refers to supply chain disturbances. As a result, the demand for storing raw materials and semi-finished goods grows, because deliveries are irregular, and it is difficult to predict production downtimes caused by the lack of them. JiT method becomes applicable only regarding very local deliveries, which often involve small quantities.

Further functioning in the conditions of the next waves of the Covid 19 pandemic, which we will probably not avoid for some time, requires modification in terms of the work organization of employees. This applies not only to the physical aspect of the location of workers or the way they move around in buildings. First, emphasis should be put on improving the methods of free communication, the possibility of employee development and sharing knowledge with others. In further works on improving the functioning of the organization and the use of management methods, strong emphasis should be placed on the most problematic and, at the same time, perspective resource, which is human capital.

References:

- Baryshnikova, N., Kiriliuk, O., Klimecka-Tatar, D. 2021. Enterprises' strategies transformation in the real sector of the economy in the context of the COVID-19 pandemic. *Production Engineering Archives*, 27(1), 18-15.
- Behmer, F.J., Jochem, R. 2020. Organizational planning for quality management in the digital age. *Business Process Management Journal*, 26, 679-693.
- Buganová, K., Šimíčková, J., Brutovský, M. 2021. Impact of global changes in the business environment in relation to risk management. *SHS Web of Conferences*, 92, 03004.
- Cantzler, I., Leijon, S. 2005. Team building in small businesses owned by women. *Team Performance Management*, 11, 12-26.
- Chen, S.H., Chen, H.G., Yen, D.C. 2005. An empirical study of software process maturity, TQM practices and organizational characteristics in Taiwanese companies. *Total Quality Management & Business Excellence*, 16, 1091-1102.
- Coibion, O., Gorodnichenko, Y., Weber, M. 2020. The cost of the COVID-19 crisis: Lockdowns, macroeconomic expectations, and consumer spending. Cambridge: National Bureau of Economic Research. <https://doi.org/10.2139/ssrn.3593848>.
- Grima, S., Dalli Gonzi, R., Thalassinos, I.E. 2020. The Impact of COVID-19 on Malta and its Economy and Sustainable Strategies. Available at SSRN: <https://ssrn.com/abstract=3644833>.
- Guth, D.J. 2021. Going Global: Companies manage the pandemic's impact on international business goals. *Crain's Cleveland Business*, 42(25), 10.
- Khan, S., Rabbani, R.M., Thalassinos, I.E., Atif, M. 2020. Corona Virus Pandemic Paving Ways to Next Generation of Learning and Teaching: Futuristic Cloud Based Educational Model. Available at SSRN: <https://ssrn.com/abstract=3669832>.
- Kim, M., Beehr, T.A. 2020. Empowering leadership: leading people to be present through affective organizational commitment? *International Journal of Human Resource Management*, 31, 2017-2044.
- Lyon, B.K., Popov, G. 2020a. COVID-19: The role of the risk management process and its impact on pandemics (Webinar). www.assp.org/resources/covid-19/webinars/covid-19-the-role-of-the-risk-management-process-and-its-impact-on-pandemics.
- Lyon, B.K., Popov, G. 2020b. The role of risk management: With COVID-19 & Its Impact on Pandemics. *PSJ Professional Safety*, 65(12), 32-40.
- Marion, T., Fixson, S. 2020. The Transformation of the Innovation Process: How Digital Tools are Changing Work, Collaboration, and Organizations in New Product Development. *Journal of Product Innovation Management*, 38, 192-215.
- Martínez-Azúa, B.C., López-Salazar, P.E., Sama-Berrocal, C. 2021. Impact of the covid-19 pandemic on agri-food companies in the region of Extremadura, Spain, *Agronomy*, 11(5).
- Mas, F., Menendez, J.L., Oliva, M., Rios, J. 2013. Collaborative Engineering: An Airbus case study. *Manufacturing Engineering Society International Conference*, 63, 336-345.
- Moyano-Fuentes, J., Maqueira-Marin, J.M., Martinez-Jurado, P.J., Sacristan-Diaz, M. 2020. Extending Lean management along the supply chain: impact on efficiency. *Journal of Manufacturing Technology Management*, 32, 63-84.
- Novak, R., Janes, A. 2019. Business process orientation in the Slovenian power supply. *Business Process Management Journal*, 25, 780-798.
- Oguz, C., Dincer, C. 1991. Incorporating Just in Time into a decision support system environment. *European Journal of Operational Research*, 55, 344-356.
- Pacholski, L., Cempel, W., Pawlewski, P. 2009. Reengineering. Reformowanie procesów biznesowych i produkcyjnych w przedsiębiorstwie (Reengineering. Reforming business and production processes in the enterprise). Wydawnictwo Politechniki Poznańskiej (Publishing House of the Poznań University of Technology).

- Pawłowski, E., Pawłowski, K., Wachowski, M. 2006. Wdrażanie systemu TPM w warunkach przedsiębiorstwa międzynarodowego (Implementation of the TPM system in the conditions of an international enterprise). In: Zarządzanie we współczesnym przedsiębiorstwie (Management in a modern enterprise) ed., S. Trzcieliński, Wydawnictwo Politechniki Poznańskiej (Publishing House of the Poznań University of Technology).
- Pedauga, L., Sáez, F., Delgado-Márquez, B.L. 2021, Macroeconomic lockdown and SMEs: the impact of the COVID-19 pandemic in Spain, *Small business economics*. <https://doi.org/10.1007/s11187-021-00476-7>.
- Piersiala, S., Trzcieliński, S. 2005. Systemy utrzymania ruchu (Maintenance systems) w Fertsch M., Trzcieliński S., *Koncepcje zarządzania systemami wytwórczymi (Manufacturing systems management concepts)*. Wydawnictwo Politechniki Poznańskiej (Publishing House of the Poznań University of Technology).
- Piersiala, S., Trzcieliński, S. 2006. Istota ciągłego doskonalenia (The essence of continuous improvement), w *Zarządzanie produkcją i logistyka – koncepcje, metody i rozwiązania praktyczne (Production management and logistics – concepts, methods and practical solutions)*, eds. M. Fertsch, K. Grzybowska and A. Stachowiak, Wydawnictwo Politechniki Poznańskiej (Publishing House of the Poznań University of Technology).
- Rampasso, I.S., Anholon, R., da Silva, D., Ordóñez, R.E.C., Quelhas, O.L.G. 2019. Maturity analysis of manufacturing cells. *Production planning & control*, 30(15), 1250-1264.
- Remko Van, H. 2020. Research Opportunities for a More Resilient Post-COVID-19 Supply Chain – Closing the Gap between Research Findings and Industry Practice. *International Journal of Operations & Production Management* 4.0, (4), 341-355.
- Rendon, R.G. 2015. Benchmarking contract management process maturity: a case study of the US Navy. *Benchmarking International Journal*, 22, 1481-1508.
- Saja, P., Woźny, A., Bednarova, L. 2021. Risk management in the context of COVID-19 pandemic in an enterprise – Ishikawa cause-and-effect diagram, *System Safety: Human – Technical Facility – Environment*, 3(1), 253-259.
- Singh, S., Kumar, R., Panchal, R., Tiwari, M.K. 2021. Impact of COVID-19 on logistics systems and disruptions in food supply chain. *International Journal of Production Research*, 59(7), 1993-2008.
- Trzcieliński, S. 2011. *Przedsiębiorstwo zwinne (Agile enterprise)*, Wydawnictwo Politechniki Poznańskiej (Publishing House of the Poznań University of Technology).
- Valadao, A.F., da Silva Campos, P.H., Turrioni, J.B. 2013. Relationship between the maturity of Continuous Improvement and the certification of quality management system in automotive sector in Brazil. *Independent Journal of Management & Production*, 4, 96-110.
- Zhang, H., Ding, Y., Li, J. 2021. Impact of the COVID-19 Pandemic on Economic Sentiment: A Cross-Country Study. *Emerging Markets Finance and Trade*, 57(6), 1603-1612.
- Zhanga, J. 2020. Five Basic Insights into the Economic Impact of the COVID-19 Outbreak, *Frontiers of economics in China*, 15(2), 167-178.
- Zhuravleva, N., Chechenova, L. 2021. Impact of Global Changes of the Pandemic Crisis on Business Models of Transport Companies. *SHS Web of Conferences*, 92, 01058.