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The Progress of Digitalization of Logistics Management in the Enterprise Caused by the COVID-19 Pandemic

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Abstract:

Purpose: *The purpose of the research is to analyse the progress of logistics management digitization as a result of the COVID-19 pandemic in enterprises (based on survey research).*
Design/Methodology/Approach: *As part of the research, the following research methods were used in this paper, desk research, elements of descriptive statistics and a survey research.*
Findings: *When analysing the results of the study, it is possible to indicate an increase in the level of logistics management digitization as a result of the COVID-19 pandemic. It was most often pointed out that the top management of organizations is currently performing coordinated duties in terms of setting goals, developing strategic visions and plans for the digitization of all logistics processes.*
Practical Implications: *The results of the research may constitute a recommendation for entrepreneurs in the matter of the approach to logistics management digitization, as well as creating a strategy and a plan for digitization - in the context of benchmarking the progress in this area against other organizations.*
Originality/Value: *Digitization is nowadays an indispensable feature of the functioning of a company's logistics. Today, digitization is perceived as a key driver in the transformation of logistics management, and the main benefit of digitization is the reduction of logistics costs.*

Keywords: *Logistics management, digital transformation, logistics management digitization, logistics, COVID-19 pandemic.*

JEL codes: *O32, P33, L23.*

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1. Introduction

The unprecedented dynamics of civilization development covering all areas of social and economic life, as well as the intensively progressing globalization, digitization and computerization processes, affect the functioning of the socio-economic system.

Technical, process and IT solutions have been revolutionizing the models and shape of business processes of enterprises for years. The ability to effectively use the potential of innovative technologies and competences has become a source of competitive advantage for entire industries and economies (Concoran, 2016). Similar tendencies can be observed with respect to logistics processes and logistics management in an enterprise. In addition to the core activities related to, for example, the manufacturing of goods or the provision of services, it is logistics that becomes the foundation of an efficient and effective business.

It is necessary to adapt the standard of functioning of business entities to the dynamically changing reality, trends and unpredictable situations. One can indicate here, among others, the use of artificial intelligence, automation, robotics and machine learning. The COVID-19 pandemic is not without significance in dynamising the above-mentioned phenomena as it accelerated the implementation of advanced technical and process solutions, as well as digitization in logistics management within the organization (Krasuski, 2021).

The progress of digitization means a process of targeted changes aimed at a better use of digital technology and the introduction of electronic infrastructure on a large scale (i.e. achieving the next, higher stage of use of these solutions). At the time of limiting economic activity, "freezing the economy", maintaining the continuity of flows within the entire supply chain has become a significant challenge for logistics systems. Focusing on increasing the level of broadly understood digitization has contributed to the survival of many companies on the market.

The aim of the paper is to analyse the progress of logistics management digitization in enterprises as a result of the COVID-19 pandemic (based on survey research) using an author's scale for assessing the level of digitization.

2. The Impact of the COVID-19 Pandemic on the Digitalization of Enterprise and Logistics Processes

Pursuant to the data from the World Health Organisation (WHO), the global emergence of SARS-CoV2 coronavirus may be connected with the identification of the virus in Wuhan, China (Hubei province) in December 2019 (WHO, 2020). The global situation has been significantly affected by the pandemic. Firstly, it impacted economy sectors closely related to human traffic, namely tourism and communication, and secondly trade, which is the movement of goods.

In view of the above, in the face of the spread of the SARS-CoV-2 virus, it is reasonable to ask about the effects of this phenomenon on the functioning of economic entities. Based on research conducted jointly by PwC, SpotData and CBM Indicator[3], it can be pointed out that almost 90% of enterprises in Poland from the sector of small and medium-sized enterprises (SME) experienced business disruptions resulting from social isolation and changes in customer behaviour. (PwC, 2020). The Pekao S.A. Bank and the International Trade Centre conducted a comparative analysis of Poland and other countries, which shows that 37% of entrepreneurs in Poland admit that their economic activity has been strongly affected by the crisis (Pekao, 2021).

Based on the results of the study 'Economic climate and business environment'[4], carried out by the Polish Agency for Enterprise Development, it was shown that in 2021 the economic situation in the Polish economy was assessed much lower than in previous years (2016-2019). Only 10% of respondents considered that the economic situation in the Polish economy was better than in 2020, a much lower result than in 2019 (27%). Moreover, 35% of respondents felt that the economic situation was much worse than in the previous year, and another 48% - that it was slightly worse. Never in the history of this study has the assessment of the economic situation been so low (ARP, 2021).

Such a significant impact on the functioning of enterprises in the economic environment forced decision-makers to take actions accelerated the digitization and virtualization of business processes in an unprecedented manner.

According to research by Capgemini[5], more than half of the enterprises (in global terms - industry leaders) offering financial services conduct almost 40% of interactions with clients with the support of artificial intelligence algorithms. On the other hand, as many as 54% of buyers interact with artificial intelligence algorithms every day, including through virtual agents, biometric scanners,

[3]*The aim of the research was to analyse the first effects on companies of the fight against COVID-19. The survey research was conducted from March 24 to April 02, 2021, with the use of phone interviews (the so-called CATI surveys) and on-line surveys, on a sample of over 750 micro, small and medium-sized enterprises.*

[4]*The survey was carried out by the Polish Agency for Enterprise Development as part of the Polish Enterprise Panel research program, from March 22 to April 09, 2021. 397 interviews were conducted with a representative group of owners and managers of companies operating in Poland. The research was carried out using the CAWI (Computer-Assisted Web Interview) technique.*

[5]*The study was conducted in April-May 2020. It consisted of two stages. The first one concerned a survey research of 5,300 clients of insurance and financial companies from 12 countries: Australia, United States, France, Germany, United Kingdom, India, Brazil, Sweden, China, Italy, Spain and the Netherlands. The second part of the research was based on a sample of 318 companies - business leaders in the insurance and finance industries (with annual revenues of at least $ 1 billion in 2019).*

interactive fitting rooms or hyper-personalized offers. It can be therefore indicated that the time is coming when automation and artificial intelligence will merge into one phenomenon - hyperautomation (Capgemini, 2021).

The socio-economic impact of the COVID-19 pandemic will be felt in the long term. Survival and further functioning on the market is related to the acceleration of the digital transformation of the organization (both enterprises and public institutions as well as others). This is confirmed, among else, by a survey carried out among tenants of office buildings managed by Cushman and Wakefield[6], results of which show that 45% of companies declare that they will implement a hybrid work model (combination of remote and stationary work). A similar tendency is indicated by A. Kicińska, noting that observing social trends and employee expectations, the hybrid work model will be implemented for a long time (Mózgowiec, 2021).

Therefore, it can be assumed that the use of digital tools and the level of digitization in organizations will be increasing. Similar tendencies will appear in logistic management, which has become the main function performed by enterprises and thanks to which it is possible for them to stay on the market or to act effectively in order to build a competitive advantage.

3. Logistics Management Digitalization Tools

Logistics management is an activity that creates a comprehensive concept of logistic projects (processes), taking into account their course both within the enterprise as well as at the partners, and coordination of implementation (in a broad sense) by appropriate organizational units, using appropriate management and control instruments (Krawczyk, 2001).

For many businesses, digital transformation means an evolutionary transition from traditional business models to new models of functioning in a digitized world[7]. In this approach, logistic management is based on using new technologies in order to increase efficiency, improve customer service and methods of communication and cooperation within the organization, while the level of use of innovation,

[6]*The CAWI survey conducted in June 2021 on a sample of 132 decision-makers in the field of office space management in buildings managed by Cushman and Wakefield.*

[7]*Continuous to discrete or analog-to-digital conversion is the basis of the digitization process. It takes place through the so-called sampling, i.e. dividing some area (domain) into discrete components, and saving the signal value in each component For sound, sampling consists of recording the intensity of the sound signal in time intervals. For a two-dimensional image, the area is divided into rectangles (most often squares) and the signal value - in this case the colour - for a given square (pixel) is recorded. The division of the area into components is discrete itself, as well as the values that the signal record can take after sampling.*

technologies and processes is highly varied depending on the specificity of the organization and its logistics processes (Płaczek, 2015).

Businesses are exploiting the potential of digital technologies as a source of value and transform logistics processes to a varied extent and in a variety of ways. At the same time, it is indicated that the implementation of digital technologies requires strategic changes in both the business model and the operational model of enterprises (Boyes, 2015l Sherman and Chauhan, 2016; Bock, Iansiti and Lakhani, 2017). Logistics management at the organization level includes, among others, procurement, manufacturing, storage, distribution, transport, green logistics, and recovery logistics.

There are many different technological solutions that are nowadays a key element of digitization, Cloud data storage, IoT (Internet of Things), robotisation, Artificial intelligence, simulation with the use of digital twins, Big Data Analytics, mobile technologies and social media (Ocicka, 2017; Adamczewski, 2018). The majority of the indicated technological solutions are related to the concept of Industry 4.0, which is a complex process of organizational and technical changes aimed at creating a smart factory.

There is already a vision for Industry 5.0 - an era of intelligent social factories that will be able to develop communication with people via corporate social networks. In fact, people will be asked to collaborate and complement virtual and robotic components of automated production systems with breakthrough technologies supporting faster and intuitive workflows (Nahavanki, 2019; Salimova, Guskova, Krakovskaya, and Sirota, 2019; Aslam, Aimin, and Rehman, 2020; Longo, Padovano, and Umbrello, 2020; Frederico, 2021; Vogt, 2021).

It should be noted that the digitization of logistics management in an organization is based on many technological solutions that already exist. The COVID-19 pandemic has stimulated the digitization of organizational processes and the transformation of business models in enterprises. In the near future, there will be a focus on the wider use of artificial intelligence, robotisation, automation, which will partially or completely replace human work.

4. Research Methodology

The research purpose of the paper is the analysis of the progress in the logistics management digitization in enterprises as a result of the COVID-19 pandemic (based on survey research).

The following research problems were formulated:

1. To what extent has the use of digital tools in enterprise logistics management increased as a result of the COVID-19 pandemic?

2. What are the benefits of digitizing the enterprise's logistics management?
3. What are the risks of the logistics management digitization in enterprises?

The following research methods were used, desk research, elements of descriptive statistics and survey research.

The desk research method consists in compiling, analysing and processing data and information from existing sources, and then formulating conclusions on the problem under investigation (Makowska, 2013; Bednarowska, 2015).

Descriptive statistics elements refer to the description of statistical data related to a given population. The techniques used in this report include, tabular description, graphical presentation of results and determination of distribution measures (Zimny, 2010).

A survey method, which consists in obtaining data by asking questions on the basis of a specially prepared questionnaire - obtaining answers by the interviewer from respondents selected on the basis of appropriately selected research samples. The CAWI (Computer Assisted Web Interviewing) online survey, in which the respondent is asked to complete an electronic questionnaire (Malinowski, 2012).

The survey was conducted in October 2021. The research sample consisted of 39 entrepreneurs from Poland (the questionnaire was sent to 65 organizations). The criterion for selecting an organization for the study was to have an organizational unit in the structure that dealt with the implementation and control over the course of logistics processes. The surveys were aimed at people dealing with logistics in enterprises.
The survey questionnaire consisted of a total of five questions, including a record concerning: the number of employees and the sector of activity, and three basic questions on progress in the logistics management digitization in enterprises as a result of the COVID-19 pandemic (based on the proprietary digital maturity scale), the benefits of logistics management digitization, the threats to the logistics management digitization. The results of own research are included in the next part of the study.

5. Resaerch Results

The vast majority of entities (94.89%) participating in the survey can be classified as small and medium-sized enterprises (SMEs). Almost a half (48.72%) were "small" entities, i.e., those employing from 10 to 49 people (Table 1). Majority (53.58%) of the companies participating in the study were involved in manufacturing, followed by 35.90% in transport and forwarding, while the remaining 10.26% operated in the construction industry (Table 2).

Table 1. *Employment level in enterprises participating in the survey*

Description	N	[%]
Up to 9 employees (micro)	7	17.95%
10-49 employees (small)	19	48.72%
50-249 employees (medium)	11	28.21%
Over 250 employees (large)	2	5.13%
Total	39	100.00%

Source: *Own creation.*

Table 2. *The scope of activities (industries) of the companies participating in the survey*

Description	N	[%]
Manufacturing	21	53.58%
Construction industry	4	10.26%
Transport and forwarding	14	35.90%
Total	39	100.00%

Source: *Own creation.*

An original scale covering five levels was used to assess the progress of logistics management digitization. It was developed based on the analysis of secondary research (Jahn and Pfeiffer 2014; Piccini, Hanelt, and Gregory, 2015; Denecken, 2015; Little, 2015; Berghaus and Back, 2016; Forrester, 2016; Uhl and Gollenia, 2016; Adamczewski, 2018) - Table 3.

Table 3. *Logistics management digitization levels*

Level	Description
1	The management of the organization is not aware of the needs of digitization of logistics processes, there is no digital vision of development, strategies, plans or measures.
2	Selected logistics processes become digital as a part of a process-oriented approach, however, their scope is often limited. ICT solutions for selected activities and activities are emerging. There are budget limitations for digitization. Lack of coordination of digitization activities at the level of the entire logistics system. Selected applications of innovative technological solutions appear.
3	The top management of the organization is engaged in coordinated responsibilities in the field of setting goals, developing strategic visions and plans for the digitization of all logistics processes. Digitization is seen as a key driver in the transformation of logistics management. A strategy for the digital transformation of logistics processes has been developed.
4	The top management of organizations has made visible progress in communicating the vision, plans for digitization and implementing new solutions in this area by redefining logistics processes to digital by default. Advanced ICT is becoming the standard.
5	Digitization is the essence of the organization's logistics operation and development strategy. The implemented logistic processes are digital by default and based on advanced ICT technologies. An organization is developing a user-oriented, innovative and flexible digital culture.

Source: *Own creation based on, Jahn and Pfeiffer 2014; Piccini, Hanelt, and Gregory, 2015; Denecken, 2015; Little, 2015; Berghaus and Back, 2016; Forrester, 2016; Uhl and Gollenia, 2016; Adamczewski, 2018.*

It should be emphasized that the scale of digitization of logistics management was developed based on domestic and foreign sources. It translates the organization's digitization maturity models and levels of digitization into the area of logistics management. It is consistent with the accepted standards for assessing the levels of digitization appearing in the literature on the subject.

It should be noted that the respondents were asked about the logistics management digitization before and after the outbreak of the COVID-19 pandemic, in accordance with the presented (Table 3) scale containing the definition of five levels. With regard to the state before the COVID-19 pandemic, the entrepreneurial majority pointed at the second level - 56.41% of the answers, then the first level - 20.51%, the third level - 12.82%, the fourth level - 7.69% and the last level - the fifth level - the remaining 2.56%. However, as a result of adaptation to the new reality caused by the COVID-19 pandemic, the level of logistics management digitization has increased. The most frequently indicated level was the third level - 43.59%, followed by the second level - 23.08% and the fourth level – 17.95%.

The surveyed entrepreneurs indicated the benefits of logistics management digitization (open question, it was possible to indicate more than one answer). The most important advantages include: reduction of logistics costs (16.77% of the total indications), reduction of logistics costs (13.66%) and improvement of the level of customer service (13.66%) (Table 4).

Table 4. *Benefits of logistics management digitization in the enterprise (main answers)*

Description	**N**	**[%]**
Improvement of the order flexibility	3	1.86%
Improvement of the customer service level	22	13.66%
Improvement of the customer satisfaction	15	9.32%
Logistics costs reduction	27	16.77%
Optimization of shipping routes	10	6.21%
Shortened time of delivery and transport	11	6.83%
Reduction of negative effects and unforeseen phenomena	9	5.59%
Reduction of storage costs	12	7.45%
Total	161	100.00%

Source: *Own creation.*

It can be concluded that the logistics management digitization generates a number of benefits for the organization. On the one hand, it shows the legitimacy of stimulating progress in this area in the organization, and on the other hand, it is an element of competitive advantage. In this approach, it is important to improve the level of customer service, as it creates a positive image of the company's functioning among stakeholders.

The last question concerned the threats to logistics management digitization - open question, it was possible to indicate more than one answer). The critical threats include: significant costs of implementing innovation (digitization) - 28.79% and the complexity of the technology being implemented (staff resistance to changes)– 21.21% (Table 5).

Table 5. *Threats to logistics management digitization*

Description	**N**	**[%]**
Significant costs of implementing innovations (digitization)	19	28.79%
Complexity of the technology being implemented (staff resistance to changes)	14	21.21%
Risk of project failure	9	13.64%
Security threats as a result of digitization	6	9.09%
No need to improve logistics processes	7	10.61%
Shortage of time resources to implement improvements (digitization)	11	16.67%
Total	66	100.00%

Source: *Own creation.*

While the focus on the digitization of logistics management may contribute to the improvement of the functioning of the organisation, such projects are also associated with certain risks. Entering the next level of digitization is often associated with significant financial outlays and additionally with the reorganisation of the work system. Therefore, it is important to involve employees in order to minimise fears and resistance to change. A significant risk is also associated with the failure of the digitization process, as well as the lack of time to undertake such initiatives.

6. Conclusions

Today, digitization is one of the drivers of building a competitive advantage for enterprises. It contributes to the optimization of the processes of entering new markets and extending the existing ones, implementing new and innovative products. Consequently, digitization has now become the most effective tool for managing logistics processes.

Based on the survey research conducted on a sample of 39 companies, it should be noted that an increased level of digitization of logistics management has been observed. According to the presented author's model - as a result of the COVID-19 pandemic, the largest percentage of organizations reached the third level of digitization, according to which the top management of the organization is engaged in coordinated responsibilities in terms of setting goals, developing strategic visions and plans to digitize all logistics processes. In this perspective, digitization is seen as a key driver in the transformation of logistics management.

The benefits mentioned primarily include the reduction of logistics costs. At the same time, on the side of barriers and potential threats, significant capital expenditures on improvement were indicated.

Referring to the results of studies by other authors relating to the progress of digitization of logistics management, it can be indicated that the progress or increasing the level of digitization of logistics processes was a response and an attempt to minimize the risk of negative effects of the COVID-19 pandemic (Parfenov *et al.*, 2021).

In turn, Webfleet Solutions conducted a survey (on a sample of 1,050 people managing delivery fleets in European companies) to assess the impact of the COVID-19 pandemic on the digitization of fleet-related activities. Based on the research results, it can be concluded that since the outbreak of the pandemic, 74% of fleets have implemented new digital solutions, of which in Poland this percentage was 69%. In turn, almost all respondents - 97% - indicated that this investment helped them conduct their business during the pandemic (Terlecki, 2021).

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