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LOGISTICS INNOVATIONS AND SHAPING COMPETITIVE ADVANTAGE DURING A GLOBAL CRISIS ON THE EXAMPLE OF SELECTED ENTERPRISES

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Purpose: The aim of the article is to analyse and assess the influence of logistics innovations on shaping competitive advantage in the context of a global crisis on the example of selected Polish enterprises.
Design/methodology/approach: The article is based on the study of literature and own empirical research. The results of own empirical research presented in the study are the effects of more extensive research on the analysis of logistics systems and logistics processes management in Polish manufacturing and trading enterprises in years 2020-2022 in the context of building the competitiveness of an enterprise. The research was being conducted from January 2023 to April 2024 among 459 randomly selected small, medium and large Polish manufacturing and trading enterprises.
Findings: Enterprises achieving the best economic and market results implemented the supply chain management strategy. Enterprises competing by the supply chain had the greatest innovative potential. The best enterprises used partnership relations with entities being links in the supply chain, based on the exchange of strategic and operational information, in order to jointly implement logistics innovations that ensured the delivery of greater value to a customer than their competitors, the greatest possible increase in operational efficiency, reduction of the negative influence of the COVID-19 pandemic and the war in Ukraine on economic and market results, improvement of the flow of information, reduction of the risk associated with the implementation of logistics processes, faster and better response to the dynamically changing conditions – agility, building resilience and shaping competitive advantage respecting, at the same time, the principles of sustainable development. Enterprises achieving the best economic and market results used digital technologies in the area of logistics thanks to which they improved the flow of information, reduced the risk associated with the implementation of logistics processes and increased innovativeness. The conducted studies have confirmed that the rapid implementation of adequate logistics innovations in the conditions of a global crisis is extremely important as it enables the rapid reduction of the negative effects of the crisis, and thus ensures business stability and survival as well as shaping and maintaining competitive advantage respecting, at the same time, the goals of sustainable development.
Research limitations/implications: The article presents only selected aspects of the influence of logistics innovations on shaping competitive advantage in the context of a global crisis.
Practical implications: The article offers logistics managers practical suggestions on how to apply logistics innovations in times of a global crisis.

Originality/value: The article fills the cognitive and empirical gap concerning the issue of logistics innovations in the conditions of a global crisis. It provides an extensive review of the literature on the influence of logistics innovations on shaping competitive advantage in the conditions of a global crisis. It presents the results of own research on selected aspects of the influence of logistics innovations on shaping competitive advantage in the conditions of a global crisis.
Keywords: global crisis, enterprise, supply chain management, logistics, logistics innovations, competitive advantage.
Category of the paper: Research paper.

1. Introduction

Appropriate response to external crises constitutes a huge challenge for contemporary business managers. An external crisis results from an exogenous shock, occurs unexpectedly, is basically unpredictable and causes large changes in external factors that have a significant negative influence on enterprises (Ciravegna et al., 2023; Dunlap, Santos, Latham, 2024). Some external crises might have global effects. Global crises can differently affect the entire enterprise, enterprises being the links in supply chains throughout the industry and the world (Fasan et al., 2021; Sigala et al., 2022; Yu, et al., 2022; Chervenkova, Ivanov, 2023; Xiao et al., 2024; El Baz et al., 2025). In the conditions of an external crisis, enterprises are, on the one hand, more susceptible to negative effects resulting from the influence of the environment on their activities, and on the other hand, new opportunities arise (Clauss et al., 2021; Förster et al., 2022; Salamzadeh et al., 2023). External crises occur more frequently and superimpose onto other serious disturbances and crises (Ciravegna et al., 2023; Su, Junge, 2023; Alam et al., 2024; Dube et al., 2024; Klyver, McMullen, 2025).

Recent global crises, the COVID-19 pandemic and the war in Ukraine have caused unprecedented and enormous challenges in management of organizations (Handfield, Graham, Burns 2020; Sodhi, Tang, 2021; Duong et al., 2023; Sheth, Uslay, 2023; Bednarski et al., 2025, Moradlou et al., 2025; Hu et al., 2025, Shu et al., 2025). Serious disruptions caused by the war in Ukraine have been compounded by the negative effects of the pandemic. The war in Ukraine lasts and its influence on the management of organizations is complex. In such conditions, managers should take quick actions to limit the negative effects of the occurred event, and simultaneously, ensure business stability and survival, as well as create and maintain competitive advantages of enterprises (Vázquez-Martínez et al., 2025). Innovations can be an appropriate response to a crisis (Muzi et al., 2023; Lien, Timmermans, 2024). Relatively little research has been conducted on logistics innovations in the context of a global crisis. The aim of the article is to analyze and assess the influence of logistics innovations on shaping competitive advantage in the context of a global crisis on the example of selected Polish enterprises. The research presented in the article covered the period of the global crisis caused by the COVID-19 pandemic and the global crisis caused by the war in Ukraine.

2. Literature review concerning logistics innovations during the conditions of a global crisis

Global crises generate a huge increase in uncertainty, complexity and dynamics. The access of an enterprise to resources and the speed, efficiency and effectiveness of their use for creating activities leading to adequate changes in the company's products, services and processes as well as the appropriate risk management, enable survival and building competitive advantage in the conditions of a crisis (Ebersberger, Kuckertz, 2021; Do et al., 2022; Kyrdoda, Balzano, Marzi, 2023). According to scientists, in the conditions of a global crisis, enterprises and created by them supply chains should be more flexible, adaptive, agile, resilient and innovative and are supposed to implement the goals of sustainable development (Cefis, Bartoloni, Bonati, 2020; Cooper, 2021; Khurana, Dutta, Singh Ghura, 2022; Messabia, Fomi, Kooli, 2022; Nguyen et al., 2023; Chatterjee et al., 2024; Chowdhury et al., 2024; Zhao et al., 2024; Herold, Prataviera, Nowicka, 2025; Mishra, Pande Sharma, Chaudhary, 2025). Researchers point to the importance of cooperation, learning, sharing experiences and knowledge, and to the appropriate adaptation of strategies and operational activities during global crises (Zahra, 2021; Crespo N.F. et al., 2023; Enz et al., 2024; Kantaruk Pierre, Mogos Descotes, Pla-Barber, 2024; Lee, Kim, 2024). Adequate actions in the conditions of a crisis enable better preparation for future crises (Brem, Viardot, Nylund, 2021).

Innovations are the source of competitive advantage of contemporary enterprises (Wolniak, 2023; Shahadat et al., 2024; Abbas et al., 2025; Fajczak-Kowalska, Mazurkiewicz, 2025). Competitive advantage is the ability of an enterprise to use resources and competitive conditions in the procurement and sales markets in such a way that it creates greater added value for the enterprise and its actual and potential customers than the added value generated by its competitors (Rokita, 2005, pp. 60-61). The most effective managers treat innovations as a response to crises (Wenzel, Stanske, Lieberman, 2020; El Chaarani et al., 2022; Fawad Sharif et al., 2022; Ozdemir et al., 2022; Montes et al., 2024). In the face of new, enormous and multifaceted challenges caused by the last two global crises, the COVID-19 pandemic and the war in Ukraine, enterprises used innovations to maintain business stability and shape competitive advantage (Khatib, Ndiaye, Acquaye, 2024). In the literature of the subject, there can be found many definitions of innovation (Singh, Aggarwal, 2022; DeJong, de Vries, 2025). Innovations include a new or improved product or process that is significantly different from previous products or processes and is introduced to the market or implemented in an enterprise. The article focuses on logistics innovations in manufacturing and trading enterprises. The author of the article assumes that logistics innovation is an improvement, a new value from the customer's point of view, which translates into the market value and concerns the flow of various types of products and related with them information on the scale of an enterprise and between its economic entities.

Innovativeness is the ability to develop new products or processes (Wang et al., 2025). Innovativeness can increase the ability to share knowledge, flexibility, agility and resilience of an enterprise to disruptions in the supply chain (Sabahi, Parast, 2019; Ghomi et al., 2023; Humdan et al., 2023). In the conditions of a crisis, dynamic abilities are crucial as they constitute the potential of the organization to integrate, create and reconfigure internal and external competencies in order to adapt to the dynamically changing environment (Teece, Pisano, Shuen, 1997). Dynamic abilities strengthen the ability to innovate, enable building resilience, allow for shaping and modifying competencies, operational behaviours and resources of the enterprise, which in turn determine the effects of the enterprise's activities, its market advantage and competitive position (Klöckner et al., 2023; Dubey et al., 2024).

The COVID-19 pandemic has forced many enterprises to implement innovations (Heinonen, Strandvik, 2021; Lien, Timmermans, 2024; Khatib, Ndiaye, Acquaye, 2024). In the conditions of the COVID-19 pandemic, enterprises preferred innovations that could be implemented quickly and did not require large investments. Each innovation, especially during a global crisis, is associated with great uncertainty to the real effects. Implementing innovations in the conditions of a global crisis requires quick actions, often with limited resources. Cooperation with various partners allows for overcoming resource limitations and fast and effective implementation of innovations in crisis conditions enabling survival and building and maintaining competitive advantage (Kovács, Sigala, 2021; Marusak et al., 2021; Dovbischuk, 2022; Blais, Cloutier, 2023; Iftikhar et al., 2025). In the conditions of a global crisis, open innovations are the effective way to overcome difficulties and risks associated with innovative activities and enables achieving better outcomes of innovations (Chesbrough, 2020; Markovic et al., 2021; Chabbouh, Boujelbene, 2022; Sharma et al., 2022).

The above-average results of contemporary enterprises increasingly depend on logistics (van Hoek, 2020; Sharma et al., 2020; Park, 2021; Gąsowska, 2024). The domain of logistics is the management of physical flows, services and associated with them information in the enterprise and between economic entities participating in the process of delivering a product or service to a customer in order to ensure the desired level of customer service at the lowest possible cost. Logistics managers more frequently manage the flows of various types of products and information on the scale of the enterprise and the entire supply chain. Scientists use different definitions of the supply chain (Carter, Rogers, Choi, 2015; LeMay et al., 2017; Min et al., 2019; Wieland, 2020). The article assumes that the supply chain includes enterprises that cooperate with other companies participating in the process of delivering a product or service to a customer and their customers, between whom flow the physical flows, services, information and financial resources. The above mentioned flows in the supply chain are related to one product or a group of products, and as a consequence, individual enterprises can be perceived as participants in many supply chains. The supply chain can include both all flows from the beginning of value creation to the final customer, as well as a smaller scope of flow, e.g. from one entity to another (Gąsowska, 2018, pp. 107-108). Many authors emphasize that

the supply chain management has the strategic nature and is the source of competitive advantage (Fasan et al., 2021; Singh, Agrawal, Mohanty, 2022).

Logistics processes occurring in every enterprise are very susceptible to disruptions (Govindan et al., 2023; Kahalimoghadam, Thompson, Rajabifard, 2025; Shalpegin, Kumar, Browning, 2025). Global crises cause huge disruptions of logistics processes and serious, multifaceted challenges in the logistics of enterprises and the supply chains (Magableh, 2021; Xu, et al., 2023; Bani-Irshid et al., 2024; Kankoon, Amornsawadwatana, 2024; Sun et al., 2024). Recent global crises have put pressure on logistics innovations in enterprises: on the one hand, crises have strengthened the need to implement logistics innovations, and on the other hand, they could have resulted in the reduction of resources for logistics innovations (Strnad et al., 2021; Klein, Gutowska, Gutowski, 2022; Zondervan, Tolentino-Zondervan, Moeke, 2022; Ali et al., 2024). The literature emphasizes that currently logistics innovations more than ever determine organizational results (Gligor, Russo, Maloni, 2022). The dynamically changing conditions of functioning of contemporary enterprises mean that the need to implement logistics innovations is strengthened by increasingly frequent external crises and other current challenges (Kareem et al., 2025).

Logistics innovations in the conditions of a global crisis enable better use of limited resources, increase operational flexibility, build resilience, protect health and ensure safety, build customer trust, ensure efficient and effective functioning of supply chains, maintain business stability and survival, realize goals of sustainable development and achieve competitive advantage of an enterprise (Kiani Mavi, R. et al., 2022; Ruangsriroj, Suvittawat, 2022).

Digital technologies are more frequently used in logistics and supply chain operations (Perano et al., 2023). Studies conducted by various scholars show that digital technologies in logistics and supply chain operations enable enterprises to reduce uncertainty, increase the effectiveness and speed of the response to a crisis, boost innovativeness, realize the goals of sustainable development and shape competitive advantage (Li et al., 2023; Belhadi et al., 2024; Muhammad et al., 2025; Wang et al., 2025; Chen, Li, Huo, 2025; Dura et al., 2025). Many companies implemented digital technologies so as to mitigate the negative influence of the pandemic on the supply chain. Digital technologies implemented in enterprises allowed to achieve a high level of supply chain visibility, develop flexibility and agility of the supply chain, and consequently, enabled to adequately respond to the crisis and helped companies achieve better supply chain results during the COVID-19 crisis (Ye et al., 2022). Implementing digital technologies in the supply chain is difficult for most companies and involves significant costs (Reuschl, Deist, Maalaoui, 2022; Beglaryan, Drampyan, Sargsyan, 2025). Modern technologies implemented in logistics in the conditions of a global crisis should be adequate to the internal and external conditions of enterprises being links in the supply chain and enable faster and better response to a crisis, identification of areas requiring corrective actions, introduction of innovations, implementation of the goals of sustainable development and shaping and

maintaining competitive advantage (Jemala, 2021; Nand et al., 2023; Rawat, Kumar, Anbanandam, 2025).

Achieving above-average results of the enterprise during a global crisis is conditioned by implementation of logistics innovations which enable the identification of rapidly emerging threats associated with logistics processes, fast and adequate response to the negative effects of a crisis, and shaping and maintaining competitive advantage. The innovativeness of the enterprise in the area of logistics is determined by the engagement of appropriate financial outlays, suitable staff, knowledge, skills, the right culture supporting creativity and openness to new ideas and cooperation with customers and entities being links in the supply chain.

3. Research methodology

The article uses the results of author's own empirical research being the outcomes of more extensive research on the analysis of logistics systems and logistics process management in Polish manufacturing and trading enterprises in 2020-2022 in the context of building the competitiveness of an enterprise (Gąsowska, 2025). The research was being conducted from January 2023 to April 2024 using the direct interview method with managers responsible for logistics in the surveyed companies and the computer-assisted interview method using the Internet to interview the logistics managers. A detailed survey questionnaire consisting of 38 questions was used during the interviews.

The study covered 459 randomly selected Polish manufacturing and trading enterprises (based in Poland) from the following provinces: Masovia, Lesser Poland, Kuyavia-Pomerania, Lublin, Łódź, Opole, Subcarpathia, Podlaskie, Pomerania, Silesia, Świętokrzyskie, Warmia-Masuria, Greater Poland and West Pomerania. In the examined population, the largest group constituted enterprises from the Masovia Province. The examined enterprises were characterized by a diversified competitive position on the market.

Small, medium and large enterprises were examined. The largest group among the surveyed companies constituted small enterprises (51.2%). The share of medium-sized enterprises in the surveyed population was 27.5%. The smallest percentage of the surveyed companies constituted large companies (21.3%). Manufacturing and trading companies had a similar share in the surveyed population. Manufacturing enterprises accounted for 52.1% of the surveyed companies (24.0% small manufacturing enterprises, 15.5% medium-sized manufacturing enterprises, 12.6% large manufacturing enterprises), while trading enterprises accounted for 47.9% of the surveyed population (27.2% small trading enterprises, 12.0% medium-sized trading enterprises, 8.7% large trading enterprises).

In the structure of the surveyed enterprises, from the point of view of the sales revenue criterion, the largest group constituted companies achieving sales revenues of up to PLN 10 million in 2022 (45.3%). The second largest surveyed group were enterprises achieving sales revenues from PLN 10 to 50 million (20.0%). The next group constituted enterprises achieving sales revenues from PLN 100 to 500 million (10.7%). Enterprises achieving sales revenues from PLN 500 million to PLN 1 billion accounted for 8.5% of the surveyed population. 8.1% of the surveyed companies constituted enterprises achieving sales revenues above PLN 1 billion. The smallest share in the surveyed population constituted enterprises achieving sales revenues from PLN 50 to 100 (7.4%).

The majority of the surveyed enterprises (64.9%) conducted international operations in 2022. 73.3% of the surveyed enterprises with a national scope constituted small companies. Among international enterprises, the largest group were companies with an export share in sales value of up to 10% (23.3% of the surveyed sample of the enterprises). The second largest group among international enterprises were companies with an export share in sales value in the range of 10-30% (15.2% of the surveyed sample of the enterprises). Companies with an export share in sales value above 50% constituted 13.5% of the surveyed population. A similar share in the surveyed population constituted enterprises with an export share in sales value in the range of 30-50% (12.9% of the surveyed sample of the enterprises). The surveyed companies with an international scope of operations exported their products primarily to the European Union.

The research results presented in the article concern selected aspects of logistics innovations implemented in the surveyed enterprises in 2020-2022.

4. Logistics innovations implemented in the surveyed enterprises and shaping competitive advantage during the COVID-19 pandemic and the war in Ukraine

The importance of logistics in enterprise management in years 2020-2022 constituted the subject of the research. The analyzed period comprised the global crisis caused by the COVID-19 pandemic. In years 2020-2021, the largest number of respondents declared that logistics had a significant influence on the quality of customer service (84.5% in 2020, 87.1% in 2021), creating and maintaining competitive advantage (77.8% in 2020, 92.2% in 2021) and adapting the enterprise's operations to the conditions related to the COVID-19 pandemic (76.7% in 2020, 84.1% in 2021). The analysis of the research results allowed for the conclusion that in the vast majority of companies: logistics significantly influenced the increase in sales revenues (64.1% in 2020, 71.5% in 2021), the information system had a significant influence on the enterprise's economic and market results and achieving an advantage over competitors (62.5% in 2020, 69.3% in 2021), logistics enabled reliable deliveries (62.5% in 2020, 69.1% in

2021), logistics significantly influenced the reduction in operational costs (60.6% in 2020, 75.2% in 2021), there was still a very large potential for improvement in operational logistics (58.4% in 2020, 66.7% in 2021), logistics increased the enterprise's flexibility (57.7% in 2020, 72.8% in 2021), logistics significantly influenced the enterprise's value (56.9% in 2020, 58.4% in 2021), logistics significantly influenced the growth of the enterprise's innovativeness (54.2% in 2020, 61.7% in 2021), logistics significantly influenced the reduction of transport costs (53.4% in 2020, 57.5% in 2021), logistics increased the enterprise's resistance to disruptions (53.1% in 2020, 58.4% in 2021), logistics had more professional and organized character (52.7% in 2020, 63.6% in 2021), logistics significantly influenced the reduction of storage costs (52.3% in 2020, 56.4% in 2021), logistics significantly influenced the increase of financial liquidity (52.5% in 2020, 54.2% in 2021) and logistics significantly influenced the reduction of operational risk (51.6% in 2020, 57.3% in 2021). In most of the surveyed enterprises in 2021, logistics had a significant influence on faster and better response to changes in the environment than their competitors – agility (54.0%).

In 2022, significant disruptions resulting from the war in Ukraine increased the challenges resulting from the pandemic. The largest number of the survey participants indicated that logistics had a significant influence on creating and maintaining competitive advantage in 2022 (94.6%). According to 90.2% of the respondents, logistics had a significant influence on the quality of customer service. The analysis of the respondents' declarations allows for the conclusion that in over 70% of the surveyed enterprises logistics significantly influenced the increase in sales revenues (79.5%), the information system had a significant influence on the economic and market results of the enterprise and achieving an advantage over its competitors (79.1%), logistics increased the enterprise's flexibility (77.1%), logistics significantly influenced the reduction of operational costs (76.9%), logistics significantly influenced the adaptation of the enterprise's operations to the conditions related to the war in Ukraine (73.6%), logistics significantly influenced the adaptation of the enterprise's operations to the conditions related to the COVID-19 pandemic (72.1%), there was still a very large potential for improvement in operational logistics (71.2%) and logistics enabled reliable deliveries (70.8%). Further, the survey participants further indicated the following importance of logistics in enterprise management: logistics is becoming more professional and organized (67.8%), logistics has a significant influence on the growth of the enterprise's innovativeness (63.8%), logistics has a significant influence on faster and better response to changes in the environment than competitors – agility (63.6%), logistics has a significant influence on the reduction of transport costs (61.9%), logistics increases enterprise's resistance to disruptions (61.4%), logistics has a significant influence on the reduction of operational risk (60.6%), logistics has a significant influence on the enterprise's value (59.5%), logistics has a significant influence on increasing financial liquidity (57.3%), logistics has a significant influence on the reduction of storage costs (56.2%), logistics has a significant influence on increasing resource productivity (50.5%).

In order to check whether there are significant differences in frequency distributions between subsequent periods in the case of responses regarding the importance of logistics in the surveyed enterprises chi-square tests were performed. The statistical significance threshold was $p < 0.05$. In the following years, a statistically significant increase in the frequency of selecting the following response options regarding the importance of logistics in the surveyed enterprises was observed: logistics has a significant influence on creating and maintaining competitive advantage ($p < 0.001$), logistics has a significant influence on adapting the enterprise's operations to the conditions related to the COVID-19 pandemic ($p < 0.001$), logistics has a significant influence on the increase in sales revenues ($p < 0.001$), the information system has a significant influence on the economic and market results of the enterprise and achieving an advantage over its competitors ($p < 0.001$), logistics has a significant influence on the reduction of operational costs ($p < 0.001$), there is still a very large potential for improvement in operational logistics ($p < 0.001$), logistics increases the enterprise's flexibility ($p < 0.001$), logistics has a significant influence on the growth of the enterprise's innovativeness ($p < 0.001$), logistics is becoming more professional and organized ($p < 0.001$), logistics has a significant influence on faster and better response to changes in the environment than competitors – agility ($p < 0.001$), logistics is included in the overall strategy of the enterprise ($p < 0.001$), logistics is a tool for sustainable development ($p < 0.001$), logistics is a task management at the highest level ($p = 0.004$), logistics enables reliable deliveries ($p = 0.018$), logistics has a significant influence on the reduction of operational risk ($p = 0.02$), logistics increases the enterprise's resistance to disruptions ($p = 0.037$), logistics has a significant influence on the quality of customer service ($p = 0.04$), logistics has a significant influence on the reduction of transport costs ($p = 0.04$).

Respondents were asked to indicate logistics innovations implemented in the surveyed enterprises in years 2020-2022 (Table 1). The research results provided the basis for the conclusion that in 2020-2022, 94.1% of the surveyed enterprises implemented logistics innovations. The most frequently implemented logistics innovations in the surveyed enterprises in 2020 were: improvement of work organization (58.2%), improvement and development of logistics processes to achieve improved customer service (50.8%), improvement and development of logistics processes to achieve flexibility advantage (40.5%), improvement and development of logistics processes to achieve advantage resulting from customer trust and sense of security (37.3%), improvement and development of logistics processes to achieve quality advantage (36.4%), improvement and development of logistics processes to achieve time advantage (36.2%), improvement and development of logistics processes to achieve reliability advantage (35.5%), use of information and communication technologies (33.8%), use of new distribution channels (33.1%), use of digital technologies (32.7%) and improvement and development of logistics processes to achieve cost advantage (32.4%).

Table 1.
Logistics innovations implemented in the surveyed enterprises in years 2020-2022

Logistics innovations	2020 (%)	2021 (%)	2022 (%)
Improvement of work organization	58.2	64.1	63.2
Improvement and development of logistics processes to achieve improved customer service	50.8	54.2	56.9
Improvement and development of logistics processes to achieve flexibility advantage	40.5	42.3	49.7
Improvement and development of logistics processes to achieve advantage resulting from customer trust and sense of security	37.3	41.6	49.2
Improvement and development of logistics processes to achieve quality advantage	36.4	38.3	47.9
Improvement and development of logistics processes to achieve time advantage	36.2	38.1	49.5
Improvement and development of logistics processes to achieve reliability advantage	35.5	39.7	46.6
Use of information and communication technologies	33.8	34.6	37.7
Use of new distribution channels	33.1	40.5	49.9
Use of digital technologies	32.7	34.2	36.6
Improvement and development of logistics processes to achieve cost advantage	32.4	40.3	53.8
Use of logistics technologies	31.8	32.5	35.3
Improvement and development of logistics processes to reduce capital engagement	30.7	35.9	42.7
Improvement and development of procurement processes to reduce costs in the area of inventory management and warehouse management	30.1	32.9	38.3
Introduction of new goods that better meet identified customer needs	19.2	18.1	20.9
Improvement and development of applied manufacturing processes	17.4	18.1	21.6
Improvement and further development of already manufactured goods	15.9	17.4	21.1
Introduction of new methods to manufacture goods	15.7	17.9	18.5
Improvement and development of logistics processes in order to achieve the goals of sustainable development	12.2	15.9	23.1

Source: own elaboration.

In 2021, most survey participants indicated that logistics innovations consisted in improving work organization (64.1%). The subsequently most frequently implemented logistics innovations in the surveyed enterprises were: improvement and development of logistics processes to achieve improved customer service (54.2%), improvement and development of logistics processes to achieve flexibility advantage (42.3%), improvement and development of logistics processes to achieve advantage resulting from customer trust and sense of security (41.6%), use of new distribution channels (40.5%), improvement and development of logistics processes to achieve cost advantage (40.3%), improvement and development of logistics processes to achieve reliability advantage (39.7%), improvement and development of logistics processes to achieve quality advantage (38.3%), improvement and development of logistics processes to achieve time advantage (38.1%), improvement and development of logistics processes to reduce capital engagement (35.9%), use of information and communication technologies (34.6%) and use of digital technologies (34.2%).

The research results provided the basis for the conclusion that the most frequently implemented logistics innovations in the surveyed enterprises in 2022 were: improvement of work organization (63.2%), improvement and development of logistics processes to achieve improved customer service (56.9%), improvement and development of logistics processes to

achieve cost advantage (53.8%), use of new distribution channels (49.9%), improvement and development of logistics processes to achieve flexibility advantage (49.7%), improvement and development of logistics processes to achieve time advantage (49.5%), improvement and development of logistics processes to achieve advantage resulting from customer trust and sense of security (49.2%), improvement and development of logistics processes to achieve quality advantage (47.9%), improvement and development of logistics processes to achieve reliability advantage (46.6%), improvement and development of logistics processes to reduce capital engagement (42.7%), improvement and development of procurement processes to reduce costs in the area of inventory management and warehouse management (38.3%), use of information and communication technologies (37.7%) and use of digital technologies (36.6%).

In the following years, a statistically significant increase in the frequency of selecting the following response options regarding logistics innovations implemented in the surveyed enterprises was observed: improvement and development of logistics processes in order to achieve advantage resulting from customer trust and sense of security ($p < 0.001$), improvement and development of logistics processes in order to achieve quality advantage ($p < 0.001$), improvement and development of logistics processes in order to achieve time advantage ($p < 0.001$), use of new distribution channels ($p < 0.001$), improvement and development of logistics processes in order to achieve cost advantage ($p < 0.001$), improvement and development of logistics processes in order to reduce capital engagement ($p < 0.001$), improvement and development of logistics processes in order to achieve the goals of sustainable development ($p < 0.001$), improvement and development of logistics processes in order to achieve reliability advantage ($p = 0.002$), improvement and development of logistics processes in order to achieve a flexibility advantage ($p = 0.01$), improvement and development of logistics processes in order to achieve improved customer service ($p = 0.03$), improvement and development of procurement processes in order to reduce costs in the area of inventory management and warehouse management ($p = 0.03$).

The sources of logistics innovations implemented in the surveyed enterprises in years 2020-2022 constituted the subject of the research. The analysis of the respondents' declarations shows that in 2020 and 2021 in the vast majority of the surveyed enterprises implemented logistics innovations constituted the response to the COVID-19 pandemic (70.6% in 2020, 71.5% in 2021). Subsequently, the respondents indicated that the source of innovation in 2020-2021 were: employees' ideas and the enterprise's own resources (63.4% in 2020, 64.9% in 2021), monitoring competitive enterprises and products on the market (59.3% in 2020, 61.7% in 2021), customers (58.6% in 2020, 59.5% in 2021) and suppliers (54.9% in 2020, 54.2% in 2021).

The research results provided the basis for the conclusion that in 2022, nearly 70% of the surveyed enterprises implemented logistics innovations in response to the war in Ukraine (67.1%). Subsequently, the respondents indicated that the source of logistics innovations were: the employees' ideas and enterprise's own resources (66.2%), monitoring competitive enterprises and products on the market (63.6%), customers (60.1%) and suppliers (56.0%).

The analysis of the declarations shows that in 2022, 14.6% of the surveyed enterprises implemented logistics innovations in response to the COVID-19 pandemic.

Barriers to the logistics innovations in the surveyed enterprises in 2020-2022 were also examined. In 2020, the majority of the respondents indicated that the barrier to logistics innovations was unfavourable market conditions related to the COVID-19 pandemic (72.5%). Further, the respondents listed the following barriers to logistics innovations: high costs (65.8%), uncertain demand (62.5%), lack of financial resources (57.5%), legal regulations (55.8%) and innovative competencies of employees (54.9%).

The analysis of the respondents' declarations shows that in 2021, in the vast majority of the surveyed enterprises, the barriers to logistics innovations were: unfavourable market conditions related to the COVID-19 pandemic (71.7%), high costs (66.9%), uncertain demand (61.7%), legal regulations (56.4%), lack of financial resources (56.0%) and innovative competencies of employees (55.1%).

In 2022, the largest number of the respondents indicated that the barrier to logistics innovations was unfavourable market conditions related to the war in Ukraine (66.7%). The next most frequently indicated barriers to logistics innovations were: high costs (65.1%), uncertain demand (59.9%), unfavourable market conditions related to the COVID-19 pandemic (51.6%), lack of financial resources (50.1%) and legal regulations (49.9%).

The analysis of the research results allowed fort the conclusion that in the vast majority of the surveyed enterprises, logistics had a significant influence on creating and maintaining competitive advantage and adapting the enterprise's operations to the conditions related to the COVID-19 pandemic and the war in Ukraine. Over 90% of the surveyed enterprises implemented logistics innovations in the analyzed period. Logistics innovations implemented in almost 70% of the enterprises were forced by the COVID-19 pandemic and the war in Ukraine. Most enterprises implementing logistics innovations in the conditions of the global crisis used the employees' ideas and enterprise's own resources, monitored competitive enterprises on the market, cooperated with customers and suppliers to increase customer satisfaction and adapt the enterprise's operations to dynamically changing market conditions at the lowest possible cost.

Enterprises achieving the best economic and market results implemented the supply chain management strategy. Most of the enterprises achieving the best results in the analyzed period implemented a supply chain management strategy that was in a constant stage of creation, shaping and was characterized by rapid response to the changing customer requirements, environmental conditions and competitors' activities, respecting, at the same time, the principles of sustainable development. Enterprises competing by the supply chain had the greatest innovative potential. The best enterprises used partnership relations with entities being links in the supply chain, based on the exchange of strategic and operational information in order to jointly implement logistics innovations that ensured the delivery of greater value to a customer than their competitors, the greatest possible increase in operational efficiency,

reduction of the negative influence of the COVID-19 pandemic and the war in Ukraine on economic and market results, improvement of the flow of information, reduction of the risk associated with the implementation of logistics processes, faster and better response to the dynamically changing market conditions, building resilience and shaping and maintaining competitive advantage respecting, at the same time, the principles of sustainable development.

5. Conclusion

The unprecedented and enormous challenges caused by the recent global crises, the COVID-19 pandemic and the war in Ukraine, resulted in a significant increase in the influence of logistics on creating and maintaining the competitive advantage of the surveyed enterprises. Over 90% of the surveyed enterprises implemented logistics innovations in the analyzed period. The implemented logistics innovations in the vast majority of the companies were not a consequence of planned activities, but were forced by the unfavourable market conditions related to the COVID-19 pandemic and the war in Ukraine, while the economic calculation played a key role in the decisions to implement them. Most of the enterprises implementing logistics innovations used the employees' ideas and enterprise's own resources, monitored competitive enterprises on the market, cooperated with customers and suppliers to increase customer satisfaction and adapt the enterprise's operations to the dynamically changing market conditions at the lowest possible cost. The most common effects of logistics innovations implemented in the enterprises were: improved work organization, improved level of customer service, increased flexibility, increased customer trust and sense of security, reduced costs, use of new distribution channels, faster and better response to changes in the environment – agility, increased reliability, reduced capital engagement and improved flow of information.

The enterprises achieving the best economic and market results implemented the supply chain management strategy. The enterprises competing by the supply chain had the greatest innovative potential. The best enterprises used partnership relations with entities being links in the supply chain, based on the exchange of strategic and operational information, to jointly implement logistics innovations that ensured the delivery of greater value to a customer than their competitors, the greatest possible increase in operational efficiency, reduction of the negative influence of the COVID-19 pandemic and the war in Ukraine on economic and market results, improvement of the flow of information, reduction of the risk associated with the implementation of logistics processes, faster and better response to the dynamically changing conditions – agility, building resilience and shaping competitive advantage respecting, at the same time, the principles of sustainable development. Enterprises achieving the best economic and market results used digital technologies in the area of logistics, thanks to which they improved the flow of information, reduced the risk associated with the implementation of

logistics processes and increased innovativeness. The studies have confirmed that the rapid implementation of adequate logistics innovations in the face of a global crisis is extremely important as it enables the rapid reduction of the negative effects of the crisis, and thus ensures business stability and survival as well as shaping and maintaining competitive advantage respecting, at the same time, the goals of sustainable development.

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