
Changes in the Functioning of Logistics Entities on the E-Commerce Market in Relation to the Industry 5.0 Concept

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Abstract:

Purpose: The article aims to show the changes taking place in logistics supply chain management in the e-commerce market in the context of the Industry 5.0 concept.

Approach/Methodology/Design: The main research methods are a review of national and world scientific and practical literature and case studies among businesses.

Findings: The new business model for logistics services in the e-commerce market identified as a result of the analysis will allow the development of recommendations for the optimal management of these entities, which results in opportunities for further growth in the global market economy.

Practical Implications: The article's research findings will have practical implications, including recommendations for actions in logistics supply chain management in the e-commerce marketplace that can be used in business practice and result in higher financial performance.

Originality/Value: The article's original value is the new business model developed for logistics services in the e-commerce market resulting from the Industry 5.0 strategy.

Keywords: Management, economy, technology, logistics, firm strategy, business and management.

JEL codes: A11, L10, L25, O30, O33.

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1. Introduction

In today's economic realities, every market entity with the goal of profit is looking for methods, tools and ways to build a competitive advantage while relatively reducing the cost of doing business. Modern management of the organization is oriented towards the end customer and, ultimately, towards satisfying his consumption needs.

Thus, it should be assumed that at the end of the logistics supply chain stands the final consumer, who determines the operation of logistics processes in the market. The volatility of consumer behavior and the large number of consumers determine the need to model and create systems with intelligent solutions, whose main task is to optimize and accelerate processes, create added value and build competitive advantages.

The development of information and communication technologies and the new standards of the Industry 5.0 concept imply changes in the logistics and e-commerce market, contributing to the modification of the business models of companies operating in these sectors, towards the use of artificial intelligence tools.

The purpose of the article is to show the changes that are taking place in the logistics supply chain management in the e-commerce market, in the context of the Industry 5.0 concept. For the purpose of the article, a literature study, an analysis of reports of technical industry organizations present in logistics processes and an assessment of the performance of leading e-commerce operators operating in Poland were carried out.

2. Literature Review

The global Internet, which dates back to the 1960s, is growing rapidly. By 2016, nearly half of the world's population (3.5 billion people) had access to the Internet (Meltwater, 2022). By the beginning of this year, 5.35 billion people had access to the Internet, representing 66.2% of the world's total population (Eurostat, 2023).

Thanks to the development of the Internet and information technology, universal connectivity (hyperconnectivity) began to play a key role in the economy, which today no longer refers to human-to-human connectivity via email, instant messaging or social networks, but to machine-to-machine connectivity based on automated data exchange.

Machine-to-machine data exchange using sensors is what gave rise to the Internet of Things (IoT) network, in which the physical world exchanges information with the virtual world. Heating appliances, home appliances, lighting systems, city traffic management systems, etc., exchange data with the digital network, enabling the

creation of a digital ecosystem in which human-machine and machine-to-machine interactions become an everyday reality.

New technologies have created new opportunities, and with them, new business models. This can be seen in the emergence and rapid development of e-commerce, which has experienced significant growth in recent years. An important factor in the development of e-commerce is the number of mobile devices, the estimated number of which already exceeds the number of connected desktop devices (Pieriegud, 2016). More and more smartphone and tablet owners are making online purchases and payments, and interestingly, more than half of Poles make purchases using mobile devices when shopping online (e-izba.pl).

Mobile devices, without the knowledge of their users, transfer data between each other on a huge scale. Just look into the car navigation of the world's most popular Internet portal. It's an oversized network of billions of devices that is causing a bigger revolution than phones and the Internet combined.

Huge numbers of devices, running on a network - the cloud is the reason for the creation of distributed computing models, a usage-based service provided by external entities, available on demand at any time and built as needed (Allegro, 2022). It's a whole new level of outsourcing that doesn't require the creation of an in-house computing center, doesn't require huge monetary outlays, and doesn't require the construction of a significant ICT infrastructure.

Thanks to the growing digitization of the entire economy, classic companies and organizations offering multiple services (multi-services), which combine different industries in their activities and reach customers through different channels (multiplicative marketing), in a pyramid ecosystem arrangement like Google or Amazon, are increasingly beginning to compete with each other. Such a developed system is the basis for creating a 5PL distribution model.

We are witnessing a continuous process of digitization of social and economic life, in which the real world intertwines with the virtual world. Among the most important factors that have led to this are (Gajewski, 2016):

- Internet of Things, understood as the Internet of Things, a network of interconnected devices that exchange data with each other, without an operator,
- hyperconnectivity; understood as universal connectivity,
- cloud computing; systems and applications based on so-called cloud computing,
- automation and robotization of processes,
- Big Data analytics; understood as analytics of large mathematical sets and data transmitted from sensors in real time,
- multi-channel models for distribution of goods and services.

Radical for some and disruptive for many, the changes taking place are bringing new values to organizations operating in the market, as well as consumers. The changes taking place are forcing a digital transformation on every market participant, businesses, society, government and local authorities, without which every entity in the market will remain marginalized.

Digital transformation is a special factor in changing the functioning of organizations. It is the ability to use digital technologies to significantly improve an organization's performance, and it applies to areas of operation such as customer experience (understanding customer needs, establishing effective communication channels), operational processes (work environment, performance monitoring mechanisms, internal processes) and the organization's business model (what the organization offers to the market) (Walicka and Czemieli-Grzybowska, 2023).

The transformation of the economy and changes in the organization's activities in the market can be divided into several areas, within which certain technologies are used (Berger, 2015):

- (a) communications
 - cloud computing,
 - broadband internet,
 - remote maintenance of the flow of goods,
 - digital products,
- (b) digital data,
 - BigData,
 - IoT,
 - demand forecasting,
 - security buffers,
- (c) automation
 - robotics,
 - drones,
 - autonomous vehicles,
 - additive manufacturing,
- (d) digital consumer
 - 5PL logistics,
 - e-commerce,
 - social networks,
 - mobile applications.

The Industry 5.0 concept is present in the European economy thanks to the European Commission, which confirmed the continuation of the Industry 4.0 concept currently operating in the literature and economy. The main idea was therefore to further develop industry and improve it. After the use of electronics, automated manufacturing and widespread Internet, the time has come for cyber-physical systems equipped with computers, sensors, mobile applications and a range of 21st

century conveniences. There has been an integration of man and machine, thanks to which cyber-physical systems have begun to provide users with real-time information, thus enabling better planning, organization and distribution of goods in the market, and allowing market participants a wide range of access to products, information about them, purchases, payments, returns, complaints, etc.

Thus, it can be said that we are dealing with a disruptive change. This is the term for solutions that significantly change the way consumers act and leapfrog the efficiency of systems activity in the economy. Breakthrough is defined by the prism of two factors: the effect of implementing a modern solution must result in a significant change in economic processes, and a leap in efficiency on a massive scale must be achieved (Paprocki, 2016).

The phenomenon started with the Industry 4.0 concept was, among other things, the widespread digitization of social and economic life providing a constant possibility for people to communicate with each other, for computer devices and applications to communicate with users, and for the devices themselves to communicate with each other.

Thanks to the widespread network of information transmission, it was possible to increase the effectiveness and efficiency of the economy and offer products on the market tailored to the expectations of consumers in terms of place, time, price, quantity, etc. A continuation of the concept moving toward the fifth breakthrough (Industry 5.0) became the achievement of such a development of machines and devices that they gained the ability to behave autonomously, thanks to the use of artificial intelligence algorithms in their control process.

Ubiquitous changes in the environment also affect the development of logistics services, which have evolved over the years, as illustrated by the transformation of the business model of these services from 1PL to 5PL.

The 1PL model, or First Party Logistics, also referred to as In-House Logistics, is characterized by the participation of only one entity, the parent company, which handles and is responsible for the entire logistics process from start to finish (Burinskiene and Lingaitiene, 2023). This model, taken as a base model for further development, unfortunately also has its drawbacks. One of them, for example, is the need to have the necessary resources needed to carry out all the processes in the supply chain, for which only the manufacturer is responsible. The primary purpose of using this model is to meet its own needs.

In the second model - 2 PL - we are already dealing with outsourcing. Some of the elements of the logistics process, such as transportation, handling, warehousing, are carried out by an external company (Leończuk and Golubniewska, 2021). This is usually the one area chosen by the manufacturer, the most costly for the parent entity. Instead, it is the producer's responsibility to handle the transaction.

There appears a lack of full control over elements of the logistics process, but this is compensated by lower costs for manufacturers due to the absence of the need to purchase, for example, means of transportation.

Third party logistics (3PL) offers integrated warehousing and transportation services (Hosie *et al.*, 2012). Logistics operators are intermediaries between the parent company and the end customer. The manufacturer or vendor is responsible for handling the transaction.

The 4PL (Fourth Party Logistics) model, in addition to the solutions of the previous model, offers transport operational logistics, inventory management, that is, it manages the entire supply chain. Essentially, a 4PL is “an integrator that brings together its own and other organizations' resources, capabilities and technology to design, build and launch a comprehensive supply chain service” (Li *et al.*, 2003). Great emphasis is placed on the 4PL provider being the single point of contact for the shipper, an integral part of the business solution for the customer.

The most advanced model, in terms of innovation, is the 5 PL (Fifth Party Logistics) model. In addition to 4PL solutions, it uses cutting-edge technologies, such as AI, to forecast demand, optimize delivery logistics, by at least tracking and monitoring shipments. It is a solution that turns, from the customer's perspective, the supply chain into a function that is completely technology-driven, has physical assets, extensive knowledge, and uses cutting-edge technology (Rocha and Lehenbauer, 2020).

Distribution based on the fifth level of logistics service provider from the point of view of economics is a process of industrial improvement and development. The new approach to the organization of procurement, production and distribution emphasizes strengthening supply chains to achieve increased economic and technical effects (e.g., increased productivity).

It should be remembered that when moving from the level of machine-system_IT communication in the logistics process, to the idea of Industry 5.0, one should look for a symbiosis of operator and machine (man-machine). Such a combination or synergy, using digital technologies, makes it possible to level out disruptions in supply chains.

Taking advantage of digital transformation, companies are increasingly turning to artificial intelligence algorithms, thereby attempting to more accurately pinpoint demand for their goods, analyze inventory levels, payment utilization, or order levels.

It is well known that supply chains are the result of constantly developing technological solutions in the global market, which are designed to support the processes of their effective management. The need to gain a competitive advantage in

the market determines to look for opportunities to create added value for the buyer (Krys, 2020). Modern supply chains are structured similar to interconnected supply dependencies of groups of companies and buyers, whose goal is to generate value in the form of products (Skowron - Grabowski 2016).

Activities undertaken in logistic supply chains considering 5PL, in addition to planning, controlling and implementing flows of goods and information takes into account advanced consumer information collection systems and computer forecasting. At the beginning of the era of capitalism in Poland, the execution of orders and deliveries taking into account the company's own resources required only subjective expert forecasts.

The inclusion in the procurement and distribution systems of partners specializing in broad outsourcing necessitated the use of statistical and mathematical analysis using simple computer systems. Nowadays, in the face of the idea of Industry 5.0, the concept of Logistics 4.0 and 5.0, with the huge amount of information collected about the market, the behavior of buyers, their needs, social trends, fashions, requires huge computing power for computer simulations.

With the help of logisticians comes artificial intelligence and cloud-based analysis. In the current socio-economic conditions, only a few organizations manage to take advantage of the technological and innovative potential of digital transformation. Market leaders, with profits to prove the technological advancements being achieved, include Amazon and Google with their world-leading artificial intelligence (AI) lab Google Brain and Deep Mind.

This is one focused team that boasts some of the biggest breakthroughs in AI, neuroscience, engineering, mathematics, computing infrastructure and simulation. The effects of AI's implications can be seen in the financial results of the aforementioned companies. Amazon, in Q1 2024 alone, earned \$143 billion (Amazon, 2024), while Google earned \$85.7 billion (Investing Pro, 2024).

Noteworthy are new AI-based systems that are successfully applied in logistics and supply chains. Among the interesting ones are:

- *Blue Yonder*; a service (system) that enables the implementation of end-to-end service-based optimization solutions via a unified platform and data cloud, enabling real-time, cross-functional enterprise collaboration, which undoubtedly supports faster decision-making, improves profitability, customer satisfaction and fosters organizational growth (Forbes, 2024),
- *Locus Robotics*; support robotics in the warehouse environment, in both brownfield and greenfield modes, improving automation and automation of warehouse processes (ViaRobotics, 2024),
- *Grey Orange*; enterprise services offer persistence in maintaining connectivity and data when communication points are on the move, mobile

- spatial awareness so robots, humans and inventory can move efficiently without getting in each other's way, decision-making that runs multiple scenarios simultaneously to consider multiple options in real time and achieve the best choice at any time, and provides a future of seamless logic using AI and real-time data to avoid being limited to rigidly coded standard operating procedures. Functional Solutions (GreyOrange, 2024),
- *Grey Matter* provide process execution, able to work independently or with other applications. GreyOrange robots are leading the industry in 'goods-to-person' automation, intelligent zone transfer, picking support and unmanned inventory movement. The robots allow people to stay at a safe distance without putting themselves in danger. The company also offers certified robot control systems that provide the software needed to operate more advanced machines and equipment (GreyOrange, 2024).

Electronic commerce (e-commerce), is one of the sectors of the economy that has achieved significant development over the past few years, which, through the Internet, allows users to buy or sell goods without restrictions, both organizational and geographic-spatial (Grottel, 2018).

E-commerce transactions can take place between different entities, business-to-business (B2B), consumer-to-consumer (C2C) and business-to-consumer (B2C). Thanks to the e-commerce market, it is possible to establish cooperation between local government entities, legal and public organizations.

The various participants in the digital services market are linked by a number of channels for communication and transactions, such as electronic communication tools, sales platforms that bring together a number of entities offering their goods or services, through online store websites or mobile applications (Strzębicki, 2016).

E-commerce is a market where *multiplicative marketing* is widely used. In addition to classic marketing, dedicated promotions for individual consumers (depending on their online activity), advertisements and promotions on social media are used, and, what is particularly interesting, artificial intelligence algorithms are used, which, thanks to the collection of huge amounts of data, cloud computing and systems, can forecast consumer behavior in the market and predict declared needs.

With this information, the logistics services market can respond optimally to ensure reliable on-time delivery of goods (*dropshipping*, 5PL) (Kazmierczak, Szymczyk, 2016). Many predict that the e-commerce market will change or revolutionize traditional methods of commerce within a decade (Perek, 2022). The e-commerce market has demonstrated its reliability in the face of pandemonium, reaffirming, even to those of dubious conviction, that it is worthwhile to buy or sell online.

Convenience, various forms of payment, reliability of delivery, or just-in-time delivery are many of the arguments that have enabled the e-commerce market to

grow so significantly (Skurpel, 2019). The key one seems to be the introduced new payment standard *BLIK*. It is currently the most common form of payment on the e-commerce market (Konpielko *et al.*, 2016). Convenience, security, the ability to control payments and the speed of making payments are undoubtedly arguments for using the *blik* payment standard.

By December 2023, there were more than 15.8 million active Internet users in Poland. In the analyzed period, from January to December 2023, 921 million *blik* transactions in online payments were recorded, an increase of 29% over 2022. The value of these transactions reached 125.6 billion zlotys, compared to 89.2 billion zlotys in 2022 (Blik, 2024).

E-commerce would not have been possible without courier service providers. It was their determination, commitment, optimization of processes and efficiency that made the needs of customers for delivery in place, time, quantity and condition, with acceptable payment possible. The development of the parcel machine network deserves the service.

Research shows that more than 80% of e-commerce market participants prefer parcel machine delivery (Gemius, 2022). Interestingly, traditional deliveries to a postal point are preferred by only 4% of users. The Polish e-commerce market is growing rapidly (Drozd, 2021). In 2023 alone, 16.7 million Poles, or about 44% of the population aged 16-74, made purchases using the Internet.

Taking age and occupation into account, we can see the greatest growth among those aged 45-54, an increase of 2.4%, and those engaged in agriculture, an increase of 3.2% (CSOa, 2024). In comparison, in 2013, 13million people, or about 34% of the population, made online purchases, so we can see an increase of 10% over 10 years (CSOb, 2024).

3. Research Results

Operating in a turbulent environment forces business entities to make changes. In the case of the logistics and e-commerce services market, as a result of numerous trends in the economy, they are the result of evolution, are disruptive and innovative. We are talking about trends of both social (civilization) and economic-technological nature (Bujak, 2017).

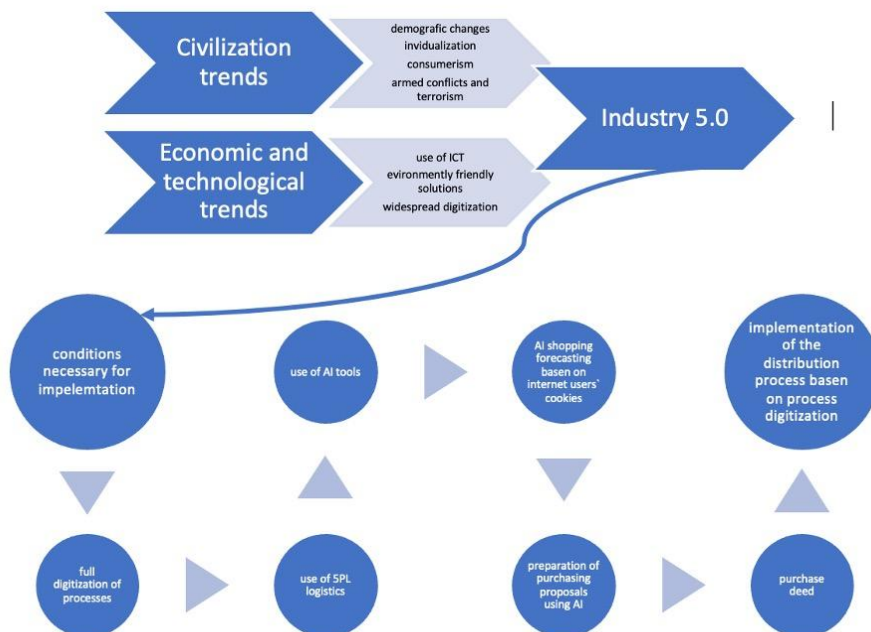
The first type is related to, among other things, demographic changes (aging societies and the consequent decrease in the number of qualified personnel), individualization and expansion of customer power (resulting from the ability to find necessary information on the Internet), consumerism (24/7 access to products that can be purchased online), armed conflicts, terrorism or pandemics.

The second type, on the other hand, refers to the increase in automation and robotization of processes, the wider use of ICT, the development and implementation of green technologies, shrinking resources, widespread digitization and the use of its tools, such as AI, Cloud, BigData. All of this has undoubtedly influenced the formulation of the new Industry 5.0 strategy. It has also had an impact on the development of commerce and the e-commerce market, as well as the transformation of logistics services.

Industry 5.0 guidelines and new IT solutions are causing the economy to create a new business model for the operation of logistics services and e-commerce operators, based on the full digitization of business. A model that in a way nurtures its customers by going in the direction of sustainability, offering them what they need at the moment. It is based on AI solutions that prepare purchase offers for customers based on cookies.

Once the purchase is completed, the entire logistics process takes place online, forcing full digitization of the processes carried out in logistics and e-commerce entities. The new business model is shown in Figure 1.

Figure 1. A new business model for logistics services in the e-commerce market in the context of Industry 5.0 strategy.



Source: Own study.

4. Conclusion

The changes brought about by the transformation of civilization, economic and technological space affect the operation of business entities. This is particularly evident in the logistics services and e-commerce sectors. High competition causes the search for new ways to gain market advantage.

Modern organizational management is oriented towards the final customer, and ultimately, towards satisfying his consumer needs. Thus, it should be assumed that at the end of the logistics supply chain stands the final consumer, who determines the operation of logistics processes in the market.

The volatility in consumer behavior and the large number of consumers determine the necessity of modeling and creating systems with intelligent solutions, whose main task is to optimize and accelerate processes, create added value and build competitive advantage.

This also determines the ever-present convergence of technologies, which leads to the fusion and cooperation of various systems and devices, using artificial intelligence tools, resulting in innovative and breakthrough solutions, which are the result of evolution, as evident in the emergence of new business models in the logistics services and e-commerce sectors. The basis for the activities of business entities in the future becomes taking into account the possibilities of using modern technologies in the face of the transformation of the fifth generation industry.

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