SOLUTIONS TO THE DELIVERY LAST MILE PROBLEM IN THE COURIER SERVICES MARKET

Marcin Cywiński, PhD[1]

[1]The Jabos fo Paradise University in Gorzow Wielkopolski (Gorzów Wielkopolski), Poland
e-mail:mcywinski@ajp.edu.pl

Absract: Logistic systems are the basis of the functioning of any economy. It is on this that flows of goods and information are based. Due to the development of economies globally, each company must look for ways to improve its competitive position in the market. The best solution is to look for innovation. Their creation and implementation is a guarantee of development. It is similar in the logistics industry. The article analyzes and evaluates implemented innovative solutions in logistic as a way to improve the efficiency of processes.

Keywords: Couriers services market, innovation, economy, supply chain,

Introduction

Changing customer expectations, the requirements of process autonomy and low-emission transport make a new approach to supply chains necessary. The Internet of Things, drones and robots are concepts that are increasingly entering the world of logistics. Nobody is questioning the use of robots and machines in warehouses anymore. Autonomous vehicles are no longer a distant perspective. One of the markets that attracts various industries is logistics, and especially the courier services market. The projected global increase in the value of the e-commerce market is as 4 trilion USD [www], on which this market based. The courier market is increasing turnover, but thus the demand for optimizing delivery processes is growing. At the end of the supply chain, customers are relocating, changing expectations, being less predictable and increasing the cost of the delivery process. We call the delivery process to the customer *the last mile*. Its effective implementation is not influenced by operational efficiency, but more and more often by technological and technical conditions. W 2020 in Poland, the courier market was worth 10 bilion USD and 200 million packages delivered. [Cywiński, 2021, p. 161]. The largest retail chains (Amazon) are constantly increasing the number of electronic

employees who improve the picking process. Thanks to the use of automation, the order picking process consisting of 50 different products was shortened to 5 minutes. Employees do not move around the warehouse. It is the robots who provide them with containers with the necessary products. The goods are stored in high density. This allowed for the elimination of communication routes. Computer algorithms determine which goods rotate the most and which less. As a result, the storage space is much better used. Robots are starting to enter the roads as well. Autonomous cars are being talked about more and more often, and everything indicates that autonomous vehicles will soon start replacing drivers on certain routes. The vehicles will be fully autonomous and, if necessary, remote control of the vehicle is taken over by the operator in the control center. A similar situation occurs in the air. On the ITS Wolrd Congress 2021 the first cargo electric drone took off (Volocopter). A drone equipped with a cargo box moved a cargo (the size of a Euro-pallet), and then the cargo was taken over by a cargo bike, which delivered the cargo to the recipient, thus completing the multimodal last mile delivery. The flight was basen on *proof of concept* (PoC), which proved that drone operations can develop the existing logistics infrastructure. This applies to land and sea transport, creating a completely new dimension of connectivity in the supply chain.

Industry 4.0 standard as the solution to the last mile delivery problem

The fourth industrial revolution, commonly known in the literature as Industry 4.0, is a collective term that most often means the combination of machines, computers and software into an integrated network, controlling, among other things, production processes in order to improve production efficiency, and the use of flexibility in assortment changes. [Cywiński, 2020, p. 69] The new revolution in industry does not only mean changes in technology. We can look for the implementation of this concept in new ways of performing work and the role of man in industry. In the history of industrial development so far, we have already experienced three fundamental principles of the market. The first was the invention and implementation of the steam engine. Thanks to mechanization, it was possible to bring production into the era of industrialization, and going one step further we experienced electricity. It was the current that displaced the steam engine, thanks to which the industry was able to start mass production. After many years, we live to the era of computers, which, while becoming more and more

efficient, enabled data processing and machine control. Thanks to digitization, the machines gained better efficiency, flexibility and precision, which in turn resulted in the implementation of automation. Planning and control systems were developed to coordinate the operation of machines and devices within production. We are currently witnessing systems integration and networking. Digitally controlled machines are integrated with people on the Internet using Internet and Communication Technology solutions (ICT). Materials and finished products can always be identified, they also have the possibility of uninterrupted communication with each other (for example as part of radio frequency identification - RFID), implementing the flow of information between machines and the production system and vice versa (for example in ERP, EDI, WMS systems).

The concept of Industry 4.0 can be classified as a merger of the real world of industry with the virtual world of the Internet and ICT. Society, machines and information and communication technologies can automatically exchange information about the product status in real time. This concept covers a wide value chain, from placing an order and supplying production to shipping goods to consumers. Therefore, we have the ability to access the broadly understood knowledge and information as never before, from any place and at any time, which allows for economically justified production of individualized products in short series. The solutions allow to reduce production costs and flexibly respond to customer needs. Thanks to the functioning in the network of connections and the exchange of huge amounts of data, each entity has the ability to quickly react to information coming from the market. The time spent on adapting machines to new requirements can be reduced to an optimal minimum, while increasing flexibility. The use of automatic logistics and production infrastructure allows for quick adaptation of machines to technological requirements. An example may be controlled numerically machines (CNC), which can automatically start the modules necessary to perform a specific technological process, and deactivate the unnecessary ones. Thanks to this, manufacturers can realize low-serial orders at relatively low costs. This means increasing the efficiency of the process as most of the waste is detected thanks to greater control along with the transparency of the value chain, and this in turn enables the competitive position of the entity to be increased. Intelligent manufacturing systems connect most of the system components to each other, from procurement to transport. Modern production systems show a greater degree of functional integration. The data generated by these systems is much more accessible and useful. Therefore, the Industry 4.0 standard allows as to create new business models that generate faster returns on investment. The fourth revolution is often equated as a synonym for new technologies that are to initiate a great change in business. Innovative

activities have been used since the inception of industrial production, and many of these innovations have proven to be groundbreaking. You should be aware that we will not run away from integration with the digital world. Any entity that does not enter the Internet data exchange platform is at risk of exclusion. An additional argument for the market are shortages in the labor market. This determines decisions about the introduction of robots, automation and ICT. There is a chance that the cost of implementing new technologies will pay off quickly, and other alternative no exists. It is a requirement for a change the direction of which is well known. Everyone cares about efficiency and cost reduction. The signal from the market is the speed of reaction. This in turn requires investing in innovation activities, knowledge and technologies. it seems necessary to modernize the existing structures and solutions, develop organizational innovations, activities to optimize operating costs, energy efficiency (especially in the face of cost increases) as well as cooperation with science and improving the quality of staff.

The report on the state of robotization of the Polish economy can testify to the advancement of the implementation of changes [www]. According to the International Federation of Robotics (IFR), global sales (in 2020) increased by 30% compared by 2019. In Europe the increase was 18%, in Middle-East Europe 36%, and 16% in Poland. Entrepreneurs appreciate robots in technological trends. In addition, they emphasize that the scope of collaborative applications is growing, and human-robot collaboration is also an opportunity for automation. Significant, from the point of view of the report, is also the simplicity of programming and operation of robotic solutions. The total number of robots operating in Central and Eastern Europe is 52,863 pieces. The robotization density in the European processing industry is 106 units per 10,000 employees. 151 in Slovakia, 98 in Hungary, 18 in Romania, and 4 in Russia [www]. The use of robots in individual industries defines the automotive industry in the first place, followed by the metal, plastics and chemical industries. Industries that, in most cases, operate within urban agglomerations. According to forecasts, the European economy will continue to experience growth, which we can see in 2021 (an increase in the number of robots at the level of 20%). Enterprises are trying to combine and integrate processes and devices, while deepening automation, which is the result of the following industrial revolution. Intriguingly, the assumption that the burden of planning production processes and process supervision is shifted from people to computers. This is especially true when using DCS / SCADA systems as part of the *Internet of Things* concept. This results in much easier access to products, sales and marketing channels. It is worth noting that vertical integration is easier (e.g. processes). However, the situation is worse in the case of horizontal interactions in the value chain (cooperation with suppliers, cooperators or partners).

Nevertheless, distrust towards the contractor remains one of the key barriers to integration under the Industrial 4.0 standard. In order to convince potential entities to implement solutions of the fourth industrial revolution, it is worth quoting the results of research on this concept [Dziurdzia, 2017, p. 17]:

- Industry 4.0 means higher revenues - entities that have successfully completed the digital transformation process and achieved the target level of integration within value chains are market leaders due to such a quick and efficient implementation of Industry 4.0 solutions. At the same time, it should be emphasized that the group studied in the report is relatively narrow and covers only 4% of the organizations participating in the study. Enterprises from this group have gained a huge advantage over other market players and expect tangible benefits related to the rapid transition of the fourth industrial revolution. Thanks to the introduced changes, 27% of respondents employed in leading companies expect an increase in revenues by approximately 30%, as well as a reduction in operating costs, also reaching 30% by 2020;
- possible leap increase in efficiency (due to the introduced changes), the average decrease in operating costs expected by entities implementing Industry 4.0 solutions amounts to 3.6 percent per year (by 2020). The expected decline varies across sectors of the economy. Representatives of the metallurgical industry, as well as transport and logistics, forecast a decrease in costs at the level of 3.2%, while the paper industry assumes that it will be possible to achieve a better result by 1 percentage point;
- deepened customer relations - the fourth industrial revolution is changing the way products reach the market. There is a shift from the push model, i.e. pushing products onto the market, to the pull model, where final recipients are more closely associated with producers. On the one hand, an analyst of data from the market enables the establishment of deeper relations with the consumer. Thanks to it, it will be possible to better adapt the product to the customer's needs, inter alia, thanks to ICT technology;
- change of organizational culture of enterprises - digital transformation and emerging ecosystems of devices force the change of organizational models of individual entities. Changes implemented relatively quickly make organizations want to be sure that their employees understand them thoroughly and that they master the new roles assigned to them;
- advanced data analytics - data and information are one of the foundations of the fourth industrial revolution. However, their huge number means that without analytical tools

they are simply worthless. It is worth noting, however, that the entities still have a long and difficult road ahead of them, leading to the achievement of advanced analytical skills. Currently, only 18% of the surveyed enterprises declare that they are able to do it in an advanced manner. More than half show that their organizations have significant shortcomings in this regard;

- an opportunity for everyone - another effect of the industrial revolution is the deepening of ties between individual economies, which in turn intensifies the globalization process. This is favored by the fact that many entities undergoing the industrial revolution operate on a global scale. At the same time, in order to sell products tailored to the preferences of consumers in different regions, they are looking for local partners;
- the prospect of large investments - representatives of many sectors declare that they plan to spend up to USD 900 billion on expenses related to adapting to the requirements of the new revolution. This sum seems huge, but entrepreneurs expect that the benefits will compensate for the expenditure incurred. The largest investments have been planned by enterprises from the electronics industry (7% of all expenses), companies from the paper and metallurgical sectors will invest the least. The funds will be spent primarily on investments in technology in plants. These will be, among others, sensors installed on individual production machines, as well as solutions that allow to connect production devices into a network and applications that create production implementation systems. Much of the project will be spent on employee training, as well as on hiring new specialists who will support the changes taking place in organizations.

Innovations in logistics and e-commerce industry

The term *innovation* comes from Latin word *innovatio/innovatore* which means renewal. [Janasz ao, 2011, p. 11]. They are an ambiguous concept, although innovations are usually associated with production processes (technology) and with the introduction of new products. One can observe , the coincidence of the phenomenom of innovation with such areas as culture, medicine, organizational, intellectual and administrative activities. The development of the economy is determined by knowledge and those entrepreneurs who are able to use its resources create more added value in their organization [Cywiński, 2018, p. 29]. Each entity needs innovation in order to develop efficiently and dynamically. There are many different

sources of innovation classified according to various criteria. The source of innovation may be anything that generates specific ideas, ideas, projects and may become the reason for searching or inventing new things, undertaking innovative projects, implementing them and improving them. Looking to the relationship between the producer and the consumer as a reference, there are two groups of sources of innovation [Cywiński, 2021, p. 119]:

- supply - created by science and not subject to the influence of the economic system, irrespective of the demand,
- demand - created in response to a specific production demand and the market.

Globalization, rapid technological development, changes in the environment (including threats) are factors that hinder the management of the enterprise. In these conditions, employees with creative problem-solving skills are in the lead, and technical and design solutions become more important if they favor the use of activity and invention.

E-commerce is an area that is still developing and becoming present in many economic entities. Attention should be paid to the distribution channels needed to sell the ware (commodity) and meet consumer needs. Thanks to analyzes using BigData , Internet of Things concept (IoT) and Industry 4.0 concept, entrepreneurs gain an overview of what areas of operation should pay special attention to, how to increase the number of consumers and how to encourage customers to make shopping. In the case of e-commerce, it is important to shorten distribution channels (increase efficiency) by the skipping the warehouse process and selling in retail stores. Distribution working in real time and the commercial offer is much wider than in traditional stores. Internet shops can sell products in any territory.

Logistics is a most important element of this type of trade, as it is used to deliver goods ordered on the Internet (mainly in online stores). The supply chain, which is created for the purpose of distributing goods to consumers (at the time, place and conditions determined by them) is largely based on courier services. The development of e-commerce has been observed for several years and thus the high activity of courier entities. Initially, couriers cooperated with several large online stores and the dominant position was the provision of standard services for current customers. Given the critical importance of going concern for economy, the most important tasks of many business owners, both women and men, include survival and running their own business operating effectively, maintaining good work organization as well as the passion and commitment of employees [Różycka, 2021, p. 2] The dynamic growth of online customers forced the interest in e-commerce of large logistics operators dealing with full service

of online stores and cooperating with carriers. In e-commerce we can distinguish three basic forms of logistics organization, which assume cooperation with the carriers services market [Kawa, 2014, p. 37]:

- own logistics,
- dropshipping,
- one stop e-commerce.

The first approach is common. The entities carry out all logistics activities independently (except for delivery). This solution is effective for small businesses (no need to spend money on logistics outsourcing). This allows them to effectively control them own business and become independent from external service providers. In this case, it is extremely important to be well prepared for the sudden development of the company. When the level of sales (orders) increases, employment or warehouse space increases. Dropshipping in turn, it is based on the shipment of the product directly from the external warehouse belonging to the manufacturer, specialized entity or distributor - to the customer. This type of service is mainly interested in medium-sized entities that avoid the risk of freezing cash in inventories, especially when they plan to increase the number of assortment items. The process consists in storing goods, accepting and completing orders, generating sales documents and sending them to online customers (Internet users, e-customers). This model enables greater involvement in acquiring new customers. Comprehensive service of online stores by specialized organizations refers to the one stop e-commerce model. On behalf of the client, we accept deliveries to the warehouse, manages the stock, accepts orders from e-customers, packs parcels, prepares documents (receipts, invoices, waybills), handles returns and cooperates with carriers. One stop e-commerce model assumes extensive support, both in the field of logistics, but also customer service, IT solutions, marketing activities, financial organization and accounting by one organization. This solution is very flexible, as a specialized operator is able to adapt to the volatility of demand depending on the needs. The operator of the one stop e-commerce model generates reports on its activities for the customer, such as sales volume, complaints, returns, etc. There are entities on the market that (in addition to the aforementioned services) undertake the repair, recycling or disposal of returned and advertised goods. This form of cooperation with one partner enables high coordination of activities and communication between the parties thanks to the integration of processes in one place [Kawa, 2014 p. 38].

Summary

The basic logistic mechanisms in the e-commerce market were discussed. The aspect of robotics, automation and drones analyzed at work shows that changes are necessary. Last mile options. Consumers are more demanding, require short supply chains (short time), change the delivery address, pay attention to the price of delivery. The e-commerce market continues to expand and will continue to do so. Information presented on specific market information and development trends, how quickly they occur to occur. The e-commerce market, despite the effects of time, has a very large offer of the bank. They prove that the number of users, user, company and the amount of work space. E-commerce can be seen to be very young and the market is making progress along with the services. This means that it can use anything related to the Internet (ICT), technology and innovation. Takeover takeover takes over the market (volodrone), autonomous computer-controlled, no driver needed. Many jobs will be replaced by artificial intelligence, checking that employees cannot. Specialization will be universal and the creation will be done by a Polish company that will create the material in the preparation of the material - in the air and on the ground. New high-level vehicle access, access to the edge of the point, access to access several days able to access the network. This advantage gives it access. B-Technology is working and a new technology of drone technology that uses technology in each technology. The vehicle will check, among others in the rescue or mining industry, the initial presentation also of the Pentagon. Instead of a team of people equipped with inventory scanners and lifters, a warehouse can make a swarm of drones that fly around the environment and take photos of goods. Only the system analyzes the image and looks for barcodes. Main workshops, main tasks, faster and faster than people. An additional benefit is the name of the so-called orthophotos of warehouses, so you can easily monitor inventory. The positive aspect is definitely the repair of digitization. Digitization of viewing documents and their dematerialisation of delays in the assessment of the time frame. Currently, fewer paper documents are placed electronically on managers' desks, because documents are signed. On the wave of e-commerce development, the demand for contract warehouse logistics services for this sector has also increased. Businesses that have so far exchanged inventory between points of sale have faced the need for technical support to support the number of online customers and to professionalize Internet services. On the rate and the stock market the evaluation of returns, progress also on the course has speculation. Recent only now, directly, directly, you got a science fiction movie immediately. However, the automation of various industries. No one

wondered anymore if driving a vehicle was driving vehicles that would not be possible only when it became a reality. The first one he did in this direction is the imminent introduction of an autonomous truck onto the streets.

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