SOLUTIONS AND MODELS FOR THE REALIZATION OF THE LAST MILE IN E-COMMERCE LOGISTICS

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Abstract: *Since the day e-commerce has appeared, products can be ordered from home, people don't have to go to shopping centre or wait in a queue, they can simply wait for the moment of home delivery. As information technology improves, customers' needs become greater and more miscellaneous daily and they accept advantages that digital technology brings, for example the experiences of other customers, comparison of product prices, wide assortment etc. The process of shopping starts with the choice of the products, then the product will be delivered and it is accepted or sent back in the end in some cases. In order to satisfy customers' needs, it is necessary to coordinate the realization of order, product demand and the time of delivery. Since logistic service is considered to be the main dimension of quality of business service in the e-commerce, this paper is about solutions and models of the last mile delivery.*

Keywords*: city logistics, last mile, e-commerce, delivery models*

1. INTRODUCTION

Nowadays when needs and demands of all of the products on the market are greater, bigger need for fulfilling of the customers' wants and needs appeared proportionally. With development of technology, the traditional way of purchase became insufficient for customers. Nowadays customers prefer simpler ways to get the products. The invention of the internet changed their awareness about convenience, speed, price and information about purchase and they count more on the home delivery. Due to enlargement of the urban areas and the number of citizens there, the delivery in the last mile is a huge problem in the cities, for the government and also for the citizens. The delivery to the end user very often represents the shortest phase in the system of the goods, material and cargo distribution, but it is the most complex, the most challenging and the most expensive task considering managing and functioning of supply chains of e-commerce (Gevaers et al., 2009). That is the reason of drawing significant attention in the last decades. According to Goodman (2005), the final delivery of the goods from the distribution centres to the customers is up to 28% of total transport costs. It is in the

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interest of the user and the service provider that the delivery is as fast, efficient and with minimal costs as possible. Home delivery, same day deliveries, time windows, on-time deliveries, alternative pickup locations and real-time tracking are just some of the challenges facing last mile delivery providers. As last mile delivery is one of the main tools of the company for gaining customer loyalty, but also one of the higher costs in the total value of the product, it is necessary to invest effort and conduct research to find adequate solutions and models for this part of the supply chain.

The aim of this paper is to consider the basic characteristics of the realization of the last mile in the logistics of e-commerce and to describe the basic solutions and models of last mile delivery realization. The paper is organized as follows. After the introduction, the the second section describes the basic characteristics of city logistics and last mile delivery in the city area. The third section describes the organization of last mile delivery through four main aspects: location, way, time and speed of delivery and points of consolidation/deconsolidation and transshipment. The fourth section is dedicated to the solutions and models of the realization of the last mile. Finally, concluding remarks and directions of future research are given.

2. BASIC CHARACTERISTICS OF THE LAST MILE DELIVERY

Logistics can be defined as a multidisciplinary science that deals with the tasks of planning, organizing, managing and controlling the flow of goods, materials, cargo, energy, information and persons. One of the most complex logistics systems is related to the supply of urban areas, which deals with city logistics. City logistics includes all movements of goods, materials and cargo to, from and within a certain urban area, all modes and means of transport that pick up or deliver goods, as well as accompanying logistics processes and activities (warehousing, inventory management, packaging, information exchange, routing, reverse logistics, etc.) (Hicks, 1977; Lu & Borbon-Galvez, 2012). In doing so, it is necessary to take into account the traffic environment, congestion, safety, energy saving and environmental protection. City logistics is an area that connects end users and logistics systems, including tasks and decisions at the macro level, across the meso level (urban distribution), to the micro level (last mile logistics) (Figure 1). At the macro level, city logistics refers to the overall flow of vehicles and goods in the city area, encompassing all participants, resources, standards and city policy. At the meso level, city logistics is focused on distribution within urban areas, organization of the city network, infrastructure and logistics services, and includes the inflow of freight traffic into the city and consolidation of cargo. The micro level is the last mile logistics that represents the final stage of urban distribution and thus connects the distribution network with end consumers (Cardenas et al., 2017).

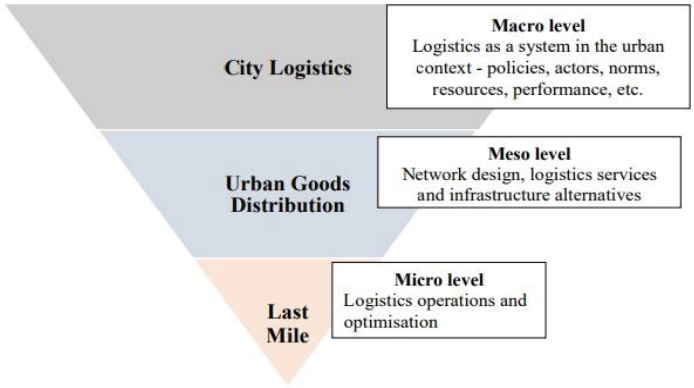

Figure 1. Hierarchical structure of urban freight (Ewedairo, 2019; Cardenas et al., 2017)

Last mile logistics encompasses the processes and activities during delivery from the last transit point of to the final consumer in the supply chain (Lindner, 2011). It also includes the consolidation of cargo as well as the reduction of transport units. Last mile logistics includes delivery, i.e. transport, storage, consolidation, inventory management, sorting, planning, etc. Last mile logistics is characterized by high-frequency distribution of small quantities of goods to end users, usually over short distances. (Anderson et al., 1996). Last mile delivery takes place not only in cities, but also in smaller towns or rural areas, but it is still predominantly developed in urban areas. The last mile is the most inefficient and expensive part of the supply chain and represents a significant problem of urban planning. It is necessary to efficiently and wisely plan the delivery of the last mile, because delays and inefficiency of this part of the supply chain can lead to economic losses for suppliers and end users, but also to traffic congestion and environmental pollution in the urban area.

The distances covered in the last mile can be from a few to a hundred kilometers, with the goal of delivering as quickly, efficiently and cheaply as possible. A special problem is the realization of the last mile in the Central Business District, where various factors must be taken into account - traffic restrictions, permitted types of vehicles, existing infrastructure, traffic organization, time intervals for receiving goods and the like.

The following are the types of last mile delivery systems (Figure 2) (Ewedairo, 2019):

- D2B (Distribution Center to Business) - Delivery of goods from the distribution center/warehouse to the company;
- B2B (Business to Business) - Delivery of goods between companies includes delivery of goods between two logistics centers/warehouses. Deliveries often involve greater distances and the use of larger vans;
- B2C (Business to Consumer) - Delivery of goods from the company to the end users is a delivery that involves the delivery of small quantities of goods but at high frequencies. It can include both larger and smaller distances;
- C2C (Consumer to Consumer) - Delivery of goods between end users is usually transaction of a smaller volume of goods between consumers;

- C2B Consumer to Business) - Delivery of goods from the end user to the companies includes the return of products from the end users to the companies.

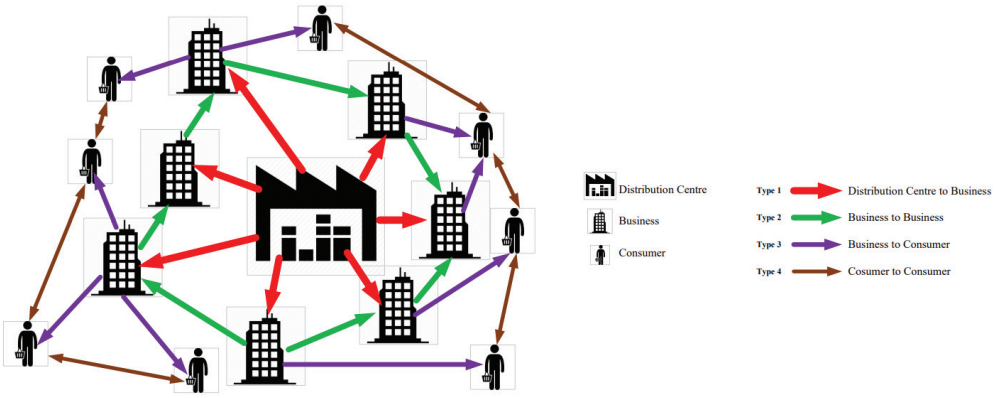

Figure 2. A typology of Last Mile Delivery system (Ewedairo, 2019)

As the significance and complexity of last mile delivery cannot be seen through definition only, several perspectives need to be considered (Ewedairo, 2019):

- Supply chain perspective - one of the key parts of the supply chain is last mile delivery. The supply chain cannot be completed until the goods have been delivered to the end user who started it. In order to maintain the level of customer demand, it is necessary to meet his expectations of both the product and the logistics service. Customer expectations will be met only by coordination of processes and activities in the entire supply chain and cooperation of all participants.
- Cost perspective - The goal of end users as well as distributors in last mile delivery is to minimize costs. Delivery is characterized by: restrictions (city government, infrastructure, transport network, location) that create a certain level of uncertainty for delivery, different levels of interest to be met (city government, end consumer and distributor), frequency of delivery in the last mile, which is so high that all the resources invested in delivering actually are long-term investments. All this is associated with high delivery costs and affects the importance of choosing criteria to minimize costs.
- Spatial perspective - considers last mile delivery as a service within the constraints imposed by the geographical characteristics of pick-up and delivery locations. Some of the spatial factors that can affect delivery are population density, availability and distance of locations, infrastructure system and connectivity. Each of the factors directly affects the time, reliability, flexibility and cost of delivery.
- The perspective of urban planning views the last mile delivery as an essential part of the development and design of urban infrastructure. Effective planning

and design of future construction facilitates the process of movement of people, information and goods.

3. ORGANIZATION OF THE LAST MILE IN E-COMMERCE

In order to understand and present the importance of logistics service for customers in e-commerce supply chains, it is necessary to first define e-commerce. Just as there is no universal definition for city logistics and last mile delivery, it is impossible to view e-commerce in just one definition. From the perspective of communications, e-commerce is the exchange of information, products or services and means of payment via telephone lines, computers or the Internet. From the point of view of end users, e-commerce provides the ability to easily purchase and deliver desired products or services, while from a business process perspective, e-commerce is a tool to increase revenue, sell products and services, while reducing costs and advertising material (Kalakota & Whinston, 1997).

E-commerce makes it much easier to reach the global market for different types of goods and services with flexible communication between manufacturers, suppliers and customers. E-commerce can cover any of the delivery types from Section 2 (D2B, B2B, B2C, C2C, C2B). Advanced Internet-based information technologies have enabled e-commerce users to sell or buy a wide range of products and services. E-commerce has other advantages such as the possibility of purchasing goods that are not sold locally, better price comparison, etc. The main challenge of e-commerce is how to deliver the ordered product to the end user, where there is usually a request for same or next day delivery. In addition, e-commerce has a higher number of product returns compared to traditional commerce (Tadić & Veljović, 2020).

In order to meet the expectations and demand of the end user, adequate last mile delivery is required, which requires complex planning. Due to the demanding nature of last mile delivery, companies usually leave delivery to logistics providers (3PL). A 3PL provider can be defined as a company that manages, controls and performs part or all of a logistics service from shipper to receiver (Hertz & Alfredsson, 2003). Logistics service is not just a product delivery service, but a complex concept that refers to the complete process of e-order realization, and includes activities such as: information, receipt and processing of orders, product packaging, warehousing and inventory, flow consolidation, transport, handling operations, mediation, customs procedures, shipment tracking, last mile delivery, product return from the market, processing and issuance of documents, complaints, etc. The organization of the last mile delivery can be seen through four basic aspects, location, way, time and speed of delivery and points of consolidation/deconsolidation and transshipment.

3.1. Delivery locations

The delivery location does not have to be just a home address. To reduce congestion and increased the efficiency of delivery, numerous contactless delivery solutions have been designed (Marcucci et al., 2020; Lal Das et al., 2018):

- Parcel lockers – Automatic lockers, located near public places (gas stations, bus stations, parking lots, supermarkets) where distributors leave products for

storage, then final users pick up them using specific codes. During online shopping, end users choose the location of the locker where they will pick up products, and receive a confirmation by e-mail. This type of delivery became widely used during the Covid-19 pandemic.

- Pickup points – usually are stored authorized to receive packages from e-retailers and deliver them to the consumer. Similarly to parcel lockers, they based on principle of the consolidation goods, and goal of minimizing missed deliveries. These can be gas stations, clothing stores, grocery stores, etc. who rent part of their space to an e-retailers. Pickup points can be gas station, clothing stores which lend their space to e-retailers.
- Reception boxes - locations to pick up packages in front of retailers' stores and warehouses. During online ordering, the end user receives a code with which he can download his order.

3.2. Way of delivery

Some of the most commonly used last-mile delivery methods are (Marcucci et al., 2020; Lal Das et al., 2018):

- Click & Collect concept involves purchasing online and then picking up the goods by the end user at one of the pick-up locations. This distribution channel is used by customers to buy products online and download them in stores when they want. The mentioned sales channel offers customers more flexibility, as they do not have to stay at home and wait for the product to be delivered to their home address.
- Reserve & Collect concept is very similar to the previously described model. The only difference is that customers pay for the products in the store, i.e. when they come to pick up the products they have booked online.
- Try & Buy concept involves ordering goods online, the ability to test the product in one of the stores and then pick up. This model is designed to reduce the return flow of goods. Also, if the end user enters the store, there is a possibility that he will buy more products.
- Crowdshipping concept involves the use of technology to organize a large group of people for the purpose of delivery. In other words, the platform involves hiring ordinary people who are already traveling from point A to point B and who on that occasion pick up the package to deliver to the end user.
- Order online & have the product home delivered is a concept where the customer orders the product online and waits for it to be delivered to the home address. Home delivery is usually the most expensive option. Products can be delivered to end users from logistics centers/warehouses or from stores.

3.3. Delivery time and speed

Deliveries can be performed during the day or night. Deliveries during the day are frequent, but include long delays due to traffic congestion and inability to access shops and customers, but often also due to insufficient demand, which must be aggregated, which is why deliveries are delayed. For these reasons, night deliveries can be performed. Night delivery is most often used together with parcel lockers (Gatta et al., 2019). Night deliveries can reduce mileage, traffic congestion, shorten delivery times and reduce costs. The main disadvantage of night delivery is vehicle noise and unloading operations, so quiet vehicles and staff vigilance during unloading are necessary.

From the aspect of speed, deliveries differ multi-day, next-day, the same-day and instant delivery (Tadić & Veljović, 2021). The speed of delivery depends on a number of factors, but the type of goods and costs are crucial for users (Joerss et al., 2016). Thus, food and time-sensitive goods usually require high speed of delivery, while long-term goods usually do not require.

3.4. Points of consolidation and transshipment

The performing of the last mile delivery may include various intermediate points, i.e. facilities in which the consolidation/deconsolidation of flows or transshipment between different transport modes or means of transport is performed. Various forms of consolidation centers, transshipment terminals, mobile warehouses, etc. can be used for this purpose.

Consolidation centers, managed by a 3PL provider, provide logistics services, including transportation, material handling, warehousing, distribution and order picking. Consolidation centers are facilities in which a certain amount of goods from several suppliers is stored, then sorted, packed to order and delivered to end users, by vehicles intended for urban traffic. The area served by the consolidation center is divided into zones to maximize vehicle capacity utilization and minimize transportation costs and delivery times (Mckinnon et al., 2010).

Transshipment terminals are used to transship goods from one vehicle to another, or from one mode of transport to another, in order to reduce total transport costs, transport unit and optimize the delivery route. The main advantage of using transshipment terminals is that there is no need to store goods, which directly reduces costs. The disadvantage of this solution is the time synchronization between vehicles (Cortes et al., 2010).

The use of mobile warehouses implies the introduction of areas in the central part of the city intended for parking vans and trucks, where they would remain parked, while deliveries to the area are made on foot, handcarts, bicycles, scooters or other alternative vehicles (Munuzuri et al., 2004). The idea stems from the fact that delivery vehicles do not move along congested areas during the peak hour of traffic.

4. LAST MILE REALIZATION MODELS

Authors Winkenbach and Janjevic (2018) defined 10 last mile realization models used by e-retailers based on 5 variables - order lead time (delivery speed), place of order preparation, route organization, intermediate transshipment and product exchange point (place of delivery). These models are described below.

Direct last mile realization to home address, near home or to workplace - This is the most common model of last mile delivery. Orders are prepared in a warehouse or distribution center, or redirected through regional consolidation centers from where they are delivered directly to customers' homes or workplaces. Warehousing operations are managed by an e-retailer or 3PL provider, while the distribution itself can be performed by postal operators, courier, express or parcel services (CEP services). Delivery time may vary from one day to one month depending on product availability.

Last mile realization using automatic lockers - In this model, the delivery process is managed by postal operators, CEP services or the e-retailer himself, but customer orders are not delivered to the home address but to automatic lockers. Amazon and DHL are some of the most well-known companies that use this delivery model.

Last mile realization using pick-up locations - The delivery process is managed by the postal operator or the e-retailer himself, but orders are not delivered to customers' homes or workplaces, but to pick-up points in the city, which are usually found in stores. Package suppliers can enter into cooperation agreements with local stores. In some cases, these agreements include exclusivity clauses, i.e. local stores can receive packages from only one supplier (Winkenbach & Janjevic, 2018). Retail facilities accept agreements, because this type of delivery can provide new customers for them. These locations can also offer additional home delivery at the customer's request.

Last mile realization using consolidation center - In this delivery model, customer orders are routed through a consolidation center managed by a 3PL provider or the e-retailer itself. One example is La Petite Reine in Paris, which manages three consolidation centers, from where last mile delivery is done by electric tricycles (Winkenbach & Janjevic, 2018).

Last mile realization using mobile warehouse - In this delivery model, the city part of the transport is performed with additional reloading in the mobile warehouse. One example of this model is Yamato transport in Japan, which uses a stationary truck as a mobile warehouse near an urban zone, then packages are delivered by hand or electric scooters to end users (Rodrigue, 2015).

Last mile realization using an intermediary transshipment point - This delivery model includes additional transshipment of goods from one mode of transport to another. An example of such a delivery is the concept of "Espace de Livrasion de Prokimite" in France (Gonzales-Feliu et al., 2013). An area near the city has been designated where trucks and delivery vehicles can be parked, and then electric bicycles are delivered to the end users.

Last mile realization with the consolidation and by local provider - This model of delivery involves consolidation in the logistics center of the provider, where stocks of products are kept. Delivery is made by the local provider on the same day as the ordering. One example is Colizen in Paris, which owns consolidation centers where it stores Nespresso machines and then, after an online order, delivers them to the end user on the same day using electric scooters or bicycles (Winkenbach & Janjevic, 2018).

Last mile realization on the same day by optimizing the process - E-retailers offer same-day delivery services, reducing time of delivery. This system includes twenty-four-hour operations with automatic machines for sorting and processing orders in facilities

in the immediate vicinity of the user. It does not mean keeping stocks, but optimizing existing capacities and traffic networks.

Last mile realization by pick-up by the user in e-fulfillment logistics centers/warehouses - This delivery model involves personal pick-up of goods by the user, on the same day in e-fulfillment logistics centers. These centers are specialized warehouses near the urban area where e-commerce customer orders are prepared immediately after online ordering, then on the same day the customer comes for the purchased product. They are also called cybermarkets because the products are bought online, but picked up in a warehouse.

Last mile realization using CEP services or crowdshipping network - This model involves delivery to the end user via CEP services or crowdshipping network. As CEP services are often not large enough to make all home deliveries during peak periods, e-retailers organize a group of non-professionals across the platform to deliver goods. For example, in Kenya, taxi drivers can apply to make a delivery for an e-retailer when needed.

5. CONCLUSION

Satisfied users, as the last part in supply chain, are the measure of business success of every company. The biggest challenge of the last mile delivery realization is the increase of online trading. With the rapid development of the cities, considering the present state in the world with the appearance of COVID-19, internet trading has drastically increased. The need of the users for special product assortments, which should be home delivered in the appropriate time has been appeared. Process organization and the realization of delivery to the end user must consider different limits (existing infrastructure, allowed vehicles, time intervals for reception, etc.) in order to plan optimal delivery strategy. In order to perform delivery effectively with the small expenses and the big level of satisfaction and reliability, it is necessary to introduce the particular solutions and models of the last mile delivery.

In this paper the possible solutions of the location, ways, delivery time and speed and points of consolidation/ deconsolidation and transshipment of the goods have been described, as well as ten primary models of last mile delivery. The future research should be referred to an advancement of these models in the order to save the environment, to minimize the use of the vehicles and the traffic congestion with the increase of satisfaction of the end users.

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