E-commerce effect on last mile logistics in smart cities and opportunities for case company X

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Abstract

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This bachelor thesis research was conducted for the commissioning company X to identify potential for their business on the scene of e-commerce last mile delivery in smart cities.

The study aimed at analyzing the impact of e-commerce on retail and delivery industries, identifying major trends on the last mile delivery market and discovering solutions that companies are developing in response to these trends.

The theoretical framework drawn in the first part of this thesis provides an overview of the key theoretical concepts behind the researched topic with a focus on smart city logistics and comparison of traditional and modern retail and delivery models. The empirical part of the study contains two major sections of qualitative research. While the e-commerce effect on the entities of the retail delivery ecosystem is analyzed in the first section, the second one explores disruptive solutions currently developed for improving last mile delivery.

Analysis of the primary and secondary data gathered from experts, world's leading research consultancies and industry players allowed to identify some potential for the case company in last mile delivery. As a result, several opportunities for development of smart solutions were proposed, such as software development for micro hub and micro warehousing concepts, digital platforms for retailer-deliverer integration, smart delivery vehicle loading solutions, or warehousing software for retail stores of the new generation.

Keywords

E-commerce, e-commerce delivery, smart city logistics, last mile delivery, smart last mile solutions

Table of contents

1   Introduction

In the introductory chapter of this thesis research, the research background and the case company's business are presented to the reader. Also, the objective of this work is explained and key investigative questions are discussed.

1.1   Industry background

We live in the era of exploding e-commerce: although its growth is expected to slightly slow down from 2020 onwards, it still keeps the impressive annual sales growth rate of above 20% in 2019, with the share of global retail sales projected to reach 17.5% in 2021 from 7.4% in 2015 (Statista E-commerce worldwide 2019). Meanwhile, the number of consignments to cities is increasing at an ever-growing pace demonstrating a year-to-year volume change of 8.7% from 2012 to 2017 (Statista 2018). As a result, new infrastructural, environmental, social and political challenges are arising. While consumers' expectations are climbing higher, companies are fighting to satisfy the demand faster, cheaper and more reliably, which drives them to innovate along the entire supply chain – especially in terms of storage and delivery.

To traditional retailers, e-commerce is giving a push to play "catch-up" (catching up with the requirements imposed by e-commerce) – in the light of brick & mortar trade losing power, they are often adapting omni-channel retail models, integrating offline and online fulfilment operations. The complexity of omni-channel operations is particularly critical at the stage of last mile delivery, where the ***last mile*** is "the final leg of the logistics journey between the hub and the ultimate destination" (Cordon & al. 2016, 86).

In response to the challenges posed by e-commerce, cities are adopting new technologies at an increasingly high pace, as they are considered to be promising solutions to challenges. Thus, urban areas are going "smart", meaning they are heading towards "existing on the intersection of digital technology, disruptive innovation and urban environments" (Van Dijk 2015, 16-18).

A smart city implies that its infrastructure and processes are smart, and logistics is no exception. Smart logistics allows citizens to enjoy personalized delivery – flexible speed, time and place of delivery – provided by omni-channel retailers. It involves concepts of robotized intralogistics solutions (automation of logistical operations within warehouses and distribution centres performed, for example, by robots), essential for realizing instant delivery efficiently already at the stage of the distribution centre, and smart distribution – the automated last mile. (Van Dijk 2015, 16-18.)

Automation of the last mile delivery has been a progression of the Internet development and electrification, sensing and actuation technology that all together have enabled disruptive innovations in delivery transportation. From flying drones used for small-size package delivery in cities to driverless trucks for long-haul bulk shipments, the next decade is going to see a radical change on the scene of parcel delivery. (IEC-Tech 2016.)

Given these trends, successful companies not only prepare to tackle challenges, but also see opportunity. With e-commerce disrupting the last mile delivery and dictating new requirements, Case Company X sees potential for applying their expertise to engage in the optimization of last-mile solutions in smart cities – which became the central research question of this thesis work, as will be explained in the following subchapters.

1.2 Case company X

Company X is a leading provider of fully integrated applications for optimization of complex internal and external logistics processes. Its umbrella brand unites companies operating in three key business divisions: System Integration (in-house logistics), Product Solutions (in-house logistics), and Software (global supply chain).

The System Integration business unit is a general contractor and systems integrator for automatic intralogistics systems and dynamic automation projects, with service offering ranging from consulting to maintenance.

The Product Solutions division provides intralogistics solutions and production logistics, customized to individual customer and project requirements. Companies of this business unit offer transport, palletizing and de-palletizing systems, product design, automation solutions and maintenance.

Software companies of the umbrella brand specialize in providing supply chain execution software solutions. In particular, they offer software for controlling and monitoring logistics, developed in-house, as well as SAP-integrated solutions for warehouse and transport management. Among others, the software allows for effective control of material flow, paperless warehouse handling and resource optimization.

All business units under the umbrella share the same values – customer satisfaction, innovation, responsibility, focus on the future and connecting people and knowledge and work towards the same vision – being an international leader in solving logistics challenges of the future together.

1.3 Research question

The rapid growth of e-commerce and the changes it causes to the modern retail and delivery industries, with the new arising challenges and evolving requirements, has been a hot topic among both retailers and logistics service providers during the last decade. Top consulting companies such as Deloitte, McKinsey&Company, Accenture and PwC have issued numerous research articles analysing the current state of the industry, major trends, and have made forecasts on the further development. As technological innovations in online platforms, software and delivery methods all keep changing the retail and delivery processes on a seemingly day-to-day basis, research can be actual enough. Yet, the race creates even more interest towards analysing the opportunities this development offers.

The commissioning company for this thesis has been particularly interested in identifying opportunities for its business on the scene of last mile logistics. Thus, the research question of the thesis work was articulated as the following:

Research Question (RQ): *"What are the opportunities for Company X on the scene of last-mile logistics in smart cities?"*

Prior to diving into last-mile delivery solutions and identifying Company X's potential for entering the new field, it was essential to provide an overview of the geographic areas where the logistics processes in question take place. For this purpose, the term "smart city logistics" was first broken down.

As this research aimed at being highly actual and future-oriented, the delivery solutions in focus did not concern traditional retailing, for it is being rapidly replaced by e-commerce. It was therefore important to build understanding of what new, changing delivery requirements e-commerce dictates. Already today these requirements, combined with arising challenges, serve as a base for building new business models and open new opportunities for operations, identifying which was the goal of Company X.

The case company's core competencies and strengths can be summarized as warehousing, supply chain software and automation equipment for providing fully-automated logistics systems. Operating on the scene of last-mile solutions will require a high degree of service integration between automated warehouses and automated delivery – and filling this gap is exactly where Company X sees potential.

The research question was further split into investigative questions (IQs) to provide a backbone to the entire research. The IQs were answered through the course of the chosen research method and secondary data analysis, which discussed in chapters 4 and 5. They include:

IQ 1. *How is logistics industry affected by e-commerce?*
IQ 2. *What are the new delivery requirements on the e-commerce market?*
IQ 3. *What challenges are retailers and deliverers facing on today's market?*
IQ 4. *What solutions are retailers and delivery parties developing in response to these challenges?*

Primarily, smart city logistics was studied and its key characteristics were outlined. Next, the reader will find e-commerce delivery trends and its latest requirements, followed by examination of challenges that delivery companies are facing and the cutting-edge solutions. The thesis work then presents findings about solutions for the last mile logistics middle chain. The research is finalized with figuring out opportunities in e-commerce last mile logistics for the case company.

Figure 1 illustrates an idealized version of an e-commerce last mile logistics chain. It helps to visually demonstrate which part of the chain is central for the research: the "in-between" of a potentially fully automated warehousing (which implies application of smart high-tech intralogistics software solutions) and automated last mile delivery (robotics, drones, self-driving vehicles, etc.).
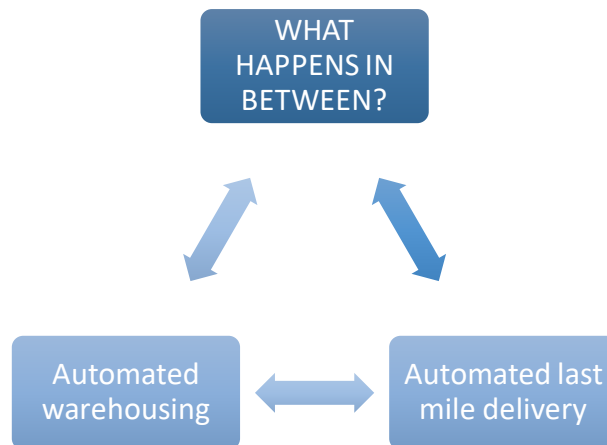
Figure 1 Simplified future-oriented last mile logistics chain

The commissioning company of this thesis, being an expert in the area of intralogistics solutions, aims to identify the smart trends and solutions for filling the "gap" in last mile logistics and answering the question "What happens in between?". Because the case company's expertise does not involve delivery itself, the author made a decision to analyse the automation process from the deliverers' viewpoint, for which an expert from an agile delivery businesses was be interviewed. This allowed for a more complex understanding of the entire last mile logistics chain state, providing food for integration and cooperation ideas.

The thesis research was essentially conducted from four perspectives: the case company on the side of automated intralogistics solutions, retailers and customers as the main parties in e-commerce, and last mile delivery companies.

The table below presents an overview of investigative questions, theoretical framework and methods used throughout the research, followed by results.

Table 1 Overlay Matrix

Investigative question	Theoretical Framework	Research Methods	Results (Chapter)
IQ 1. *How is logistics industry affected by e-commerce?*	E-commerce: retail models; Smart city logistics and last mile; Modern retail delivery models		4,6
IQ 2. *What are the new delivery requirements on the e-commerce market?*	Retail logistics value chains; Last mile in modern retail	Qualitative research: Primary research (interviews) and secondary research (publications and online sources)	4,5,6
IQ 3. *What challenges are retailers and deliverers facing on today's market?*	E-commerce: retail models; Smart city logistics and last mile; Modern retail delivery models; Retail logistics value chains; Last mile in modern retail		4,6

IQ 4. *What solutions are retailers and delivery parties developing in response to these challenges?*	Smart city logistics		5,6

1.4 Demarcation

The primary focus of the research was on last-mile logistics in the B2C retail industry in smart cities – urban areas that are ready for technologically advanced solutions. Business-to-Consumer (B2C*)* is defined as "electronic commerce that involves retailing products and services to individual shoppers" (Laudon & Laudon 2019, 389). The thesis was conducted with a view to identify opportunities for implementing case company's expertise on the scene of last mile logistics, but was limited to researching the potential for development of smart solutions without examining practical implications. The limitation was caused by the author's area of specialization and competencies that do not include software development, as well as general expectations of the commissioning company whose aim was to gain a full picture of the existing and future trends and disruptive concepts currently developed or discussed on the market.

Although in general e-commerce affects retail and delivery industries across the European Union, the US and China in roughly the same way, the growth rates are highly different. According to Statista forecasts, by 2023, the number of users on the Asian markets will be 4 times greater than the number of European users, and China's market will see a tremendous 70 % growth from $636M to $1.086,0M.

Table 2 E-commerce users' growth forecast (Statista 2019)

Market	2019	2023	Percentage growth
Asia	2,080.37 million	2,526.4 million	21.4%
Americas	672.7 million	775.6 million	15.3%
Europe	596.02 million	641.6 million	7.6%

Given the drastic difference in e-commerce growth rates, the effect on retailers and delivery logistics on these markets differs as well, with each market having their own characteristics in last mile solutions development. Thus, cutting-edge technology designed for the Chinese market might not be applicable to the European market and vice versa.

Because the scope of a Bachelor thesis did not allow to conduct a study across all markets and make sufficient comparisons, a mutual decision between the commissioning company and the thesis author was made to focus solely on the European market trends and practices. Although the reader might find several smart solutions developed outside the EU discussed in the empirical research findings part of this thesis, their analysis will signify that the author found them promising for being applied on the European market.

1.5 International aspect and benefits

The commissioning business unit of this thesis consists of internationally operating companies located in several countries around the world both within and outside the EU area. What was more important, however, is that the subject of the research – identification of operation opportunities in the field of last-mile logistics in European smart cities – was internationally-oriented.

The commissioning company is ambitious to innovate on new markets, making use of arising opportunities and changing requirements. Serving as a commissioner of this research, the company expected to benefit from its findings – the most important current and future trends and respective solutions in e-commerce last mile delivery developed by both retailers and courier companies. It was expected that by analysing the solutions that the author found promising the case company would be able to assess their potential and make conclusions on whether the company should try to join the innovations race and enter the e-commerce last mile delivery market in smart cities.

Since the trends for last mile delivery automation are new and the entire topic is highly actual, the company could benefit from raising awareness about today's market state, as all the most recent innovative practices that were put together in this research.

The author of this thesis work enjoyed the opportunity of broadening horizons and deepening knowledge about both internal and external logistics. Most importantly, during the research process the author was able to learn about the latest last mile delivery industry trends and disruptive smart solutions, study how technology affects entities in retail all across the supply chain and see how they are adapting to the new requirements of the smart environment.

1.6 Key concepts

Prior to presenting the theory analysis in the next part of the thesis, the author ends the introductory chapter with a list of core concepts used in the upcoming discussion. The

concepts were derived from topics of online and offline retail business models and logistics delivery models. Although the majority of the terms are further detailed in the theoretical framework, the reader might benefit from familiarizing themselves with them in advance, so as to better understand the analysis.

Distribution – "a term equivalent to Outbound Logistics. Distribution includes those activities associated with the movement of products, usually finished products or service parts, from the manufacturer to the customer. These activities encompass the functions of transportation, warehousing, inventory control, material handling, order administration, site and location analysis, industrial packaging, data processing, and the communication network necessary for effective management". (BARCELOC 2017, 3.)

E-commerce – *1.* "a type of business model, or segment of a larger business model, that enables a firm or individual to conduct business over an electronic network, typically the internet" (Investopedia 2017).
2. "The use of computer and telecommunications technologies to conduct business via electronic transfer of data and documents" (Bozarth and Handfield 2013, 492).
3. "Exchange transactions which take place over the Internet primarily using digital technology" (Schniederjans 2014, 4).

Last-mile delivery – "the movement of people and goods from a transportation hub to a final destination" (Bouvet & Kaltenbach 2017, 2).

Logistics – 1. "The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods. It includes services, and related information from the point of origin to the point of consumption, for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements". (BARCELOC 2017, 2.)

Smart logistics – "application of ubiquitous technologies to logistics processes" (Blecker, Kersten & Ringle 2012, 91).

8

2 Theoretical framework of e-commerce retail and last mile delivery

In this part of the thesis research, the reader will find analysis of existing theory behind the researched topic gathered from academic literature to create a theoretical framework. For the purpose of clarity and coherence, the theory was divided into two main sections: e-commerce and smart (last mile) logistics. The former deals with tracking the development of retail models from traditional to modern ones, studying the extension of retail supply chains that serves as a ground concept for potential in-between warehousing and auto-mated delivery solutions. In the latter, a closer look is taken at logistics in smart cities – or smart logistics, including comparison of several delivery models. Ensuring a solid theoreti-cal basis for both e-commerce and smart logistics allowed the research to proceed to ex-ploring the impact of e-commerce on urban logistics and last mile through the secondary data analysis in chapters 4 and 5. The key target of this analysis was to establish the phe-nomenon-impact-solution chain, which was looped up by "solutions" discussed in the find-ings chapter of the research.

It was of critical importance that literature analysis was aligned with the qualitative re-search, serving as a solid base for understanding and interpreting the results of the empir-ical research. Together, theoretical analysis and qualitative research were expected to help Company X "determine their role and how they will deliver value in this ecosystem" (Bouvet & Kaltenbach 2017, 8).

2.1 E-commerce: trends in retail models

In the literature review of e-commerce trends and future directions, Bruno, Esposito & Sandeep (2019, 3) point out that no common definition of e-commerce can be articulated due to the complexity of the business model. Yet, five major directions can be summa-rised as "information sharing, use of technology, buy-sell transaction, monetary transac-tion and competition". (Bruno & al. 2019, 3.)

Although the majority of goods are still purchased at traditional retail stores, specialists are sceptical: Hayley Peterson (Business Insider 2014) argues that shopping malls are "dying a slow, ugly death", forecasting that in the upcoming 10 years, almost 15% of them will either fail, or will be transformed into non-retail spaces. Meanwhile, e-commerce keeps the status of the fastest-growing commerce, reshaping the way companies do busi-ness and customers – shop. Having moved from laptops and tablets to smartphones for searching an item to buy online, today's consumers are expecting a possibility of shopping

with whatever device that is convenient at any given moment – making the 2018 e-com-merce "social, mobile, local" – as these forms of e-commerce are growing at the highest pace. (Laudon & Laudon 2019, 379-381.)

Today, as the number of pure e-commerce business models is rising and developing fur-ther, traditional brick-and-mortar retail businesses are following two paths: either shutting down with no chance to withstand online retail competition, or adjust, setting omni-channel business models. **Brick-and-mortar businesses** are "traditional or regular business com-merce (i.e., non-ecommerce) exchange transactions" (Schniederjans 2014, 488).

Laudon & Traver (2015, 743) name four main types of online retail business models: vir-tual merchants, omni-channel retailers (also referred to bricks-and-clicks), catalogue mer-chants and manufacturer-direct firms. The authors discuss the following key characteris-tics of each model:

- **Virtual merchants** are e-commerce retailers, generating all of their business revenue from online sales. While these firms are free from costs associated with physical retail stores, they bare heavy investment costs in e-commerce presence itself, and online fulfilment infrastructure;
- **Omni-channel retailers** are those that have a network of physical stores, but also sell goods online. "They sell products through a variety of channels and intergrade their physical stores with their Web site and mobile platform" (Laudon & Traver 2016, 734). Typically, these merchants enjoy advantages of established brand name, customer base, warehouses, experienced staff and larger scale;
- **Catalogue merchants** are companies with an established name, operating through offline national catalogues and often running online operations. As catalogue sales have fallen in the last years, many companies chose to establish an even stronger Web presence;
- **Manufacturer-direct** are companies selling their goods online, without intermediaries. (Laudon & Traver 2015, 743.)

2.1.1 Omni-channel retail

Traditional brick-and-mortar stores have long attracted customers with an opportunity of touching and trying on items prior to making a purchase – in contrast, online stores are trying to impress customers with a broad selection of goods at lower prices. As technology is erasing the line between online and offline commerce, it allows retailers to interact with consumers through a larger number of different channels. As a result, more and more re-tailers are going "omnichannel" – having both offline and online operations. (Brynjolfsson,

Hu & Rahman 2013, 1.) Yet, according to A.T. Kearney (2014, 8), both for consumers and retailers themselves, brick-and-mortar stores have a much higher value than the sales taking place in them.

From the consumer viewpoint, the use of apps, visits to brick-and-mortar stores and browsing websites all make one whole purchasing experience: the customer might want to use an app that will tailor a personalized outfit, then surf the net to compare prices, head to a physical store to try the item on and finally put an order for same-day-delivery online. (Cordon & al. 2016, 10.)

The change undergone by retailers - from single channel to first multi-, and then omni-channel – is demonstrated in the Figure 2. Multi-channel retailers, leading separate parallel business lines for brick-and-mortar, catalogue and online activities in terms of logistics and distribution, are now seeking ways to transmit to an omni-channel model, following the same supply chain route to the market whenever possible. The challenge and simultaneously the aim of this shift is to ensure that each and every former channel complements another to create a full, unique customer experience. (Christopher 2016, 66.)
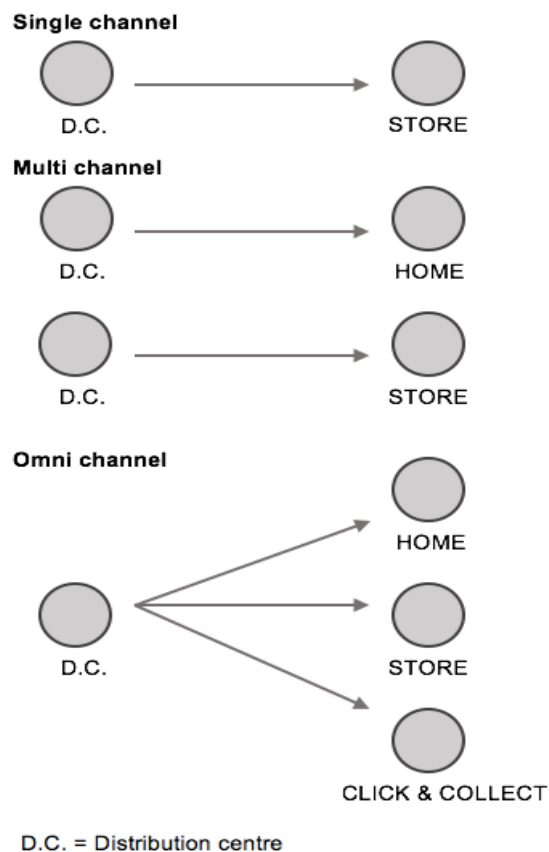
Single channel

D.C. → STORE

Multi channel

D.C. → HOME

D.C. → STORE

Omni channel

D.C. → HOME

D.C. → STORE

D.C. → CLICK & COLLECT

D.C. = Distribution centre

Figure 2 "From single channel to omni channel" (Christoph 2016, 67)

For their supply chains, brick-and-mortar stores play much more than just a role of physical stores. Today, the functions of brick-and-mortar in the omni-channel retail businesses range from click and collect, distribution centre, e-commerce fulfilment, and returning returns to stock, to processing e-commerce returns, showroom for e-commerce, online order location and repair centre (eft 2018, 4). Having shipped over 5 billion packages with Prime in 2017, Amazon is currently taking measures to save on "return tax", by owning more than 600 brick-and-mortar locations for handling returns (Absolunet 2019).

2.1.2   Retail logistics value chains

With limited computing power and access to data, companies used to design their value chains taking these constraints into account – and produced in large scale to fulfil huge orders (Cordon & al. 2016, 10). These value chains were based on push models, where demand was forecasted and production was scheduled accordingly. As a result, companies have long been selling what they produced, "pushing" the product to customers. On the contrary, in the modern pull-based, or demand-driven models, the customer – or, more precisely, their order – are the starting point, the trigger of supply chain operations. The pull-based approach allows companies to make what they sell instead of selling what they make. (Laudon & Laudon 2019, 352-353.) The big data revolution allows to build value chains that are designed to satisfy specific customer needs and to produce, plan and deliver products for much smaller, individual orders (Cordon & al. 2016, 10).

Until recently, distribution channels in the supply chain saw little to no change, having the same seller, distributor, stocklist, retailer roles and structures in place for decades. The change came with the soaring use of the Internet, leading to much greater connectivity between the seller and the buyer. (Christopher 2016, 62.) Today, e-commerce business models on digital markets allow to incur lower transactional costs, and thus offer a lower purchase price to customers. This is possible due to disintermediation – "removal of organizations or business process layers responsible for intermediary steps in the value chain" – leading to simplification of the distribution chain, where goods can be sold directly to customers, as illustrated in Figure 3. (Laudon & Laudon 2019, 386.)
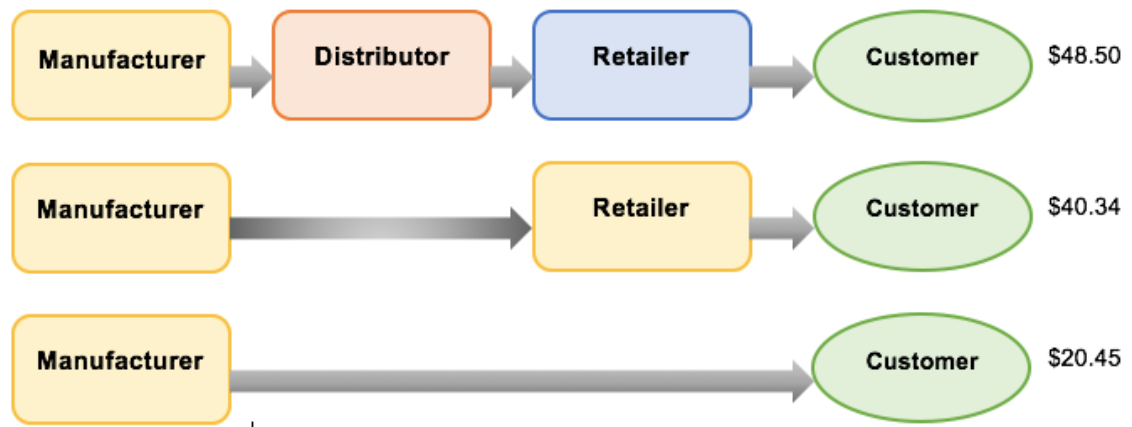
Figure 3 "The Benefits of Disintermediation to the Consumer" (Laudon & Laudon 2019, 386)

The first row of the process scheme in Figure 3 demonstrates a traditional, former chain where a company pushed its products through the sales channel to the customers. The second and third rows show different kinds of disintermediation, where the stages of distributor or distributor and retailer are bypassed, enabling the manufacturer to sell directly to the end customer. (Chaffey 2015, 54.)

2.2 Smart city logistics and last mile

Rapid growth of e-commerce has had tremendous impact on the logistics and transportation industry, posing various new challenges and promising opportunities (Cordon & al. 2016, 85). To understand the smart innovative solutions currently developed by companies to tackle arising problems and make best use of opportunities, it is important to comprehend the bigger picture: the scene where it all takes place – smart cities – and the traditional logistics models, which are the basis of newer systems.

2.2.1 Smart city and smart logistics concepts

British Standards Institution (BSI) defines a smart city as one with "effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens" (BSI 2014). In a city like this, technology, society and government are brought together, to enable the following: a smart economy, smart mobility, a smart environment, smart people, smart living and smart governance (Mohanty, Choppali & Kougianos 2016, 61).

A city becomes "smart" when its production and living infrastructure and facilities – from power supply systems to transportation – are equipped with sensors and other tracking devices that together form the Internet of Things (IoT), which, by means of connection to

the internet itself, though cloud computing and supercomputers allow for integration of its society with the physical systems. (Lingli 2015, 729.) Applying these technologically advanced systems enables cities to embed citizen-centricity and improve service delivery, ensure better safety, reduce congestion and pollution and make cities more liveable (IBM 2017).

Some examples of smart cities are San Jose, Barcelona and Singapore, where smart services are already being implemented. Smart cities' systems are independent, which provides infrastructure for such public systems and services as generation and transition of water and energy, logistics, transport, street and home lighting, etc. (Chaudhuri 2019, 105-108.)

As mentioned above, in a smart city there is smart logistics. Blecker & al. (2012, 93-94) defined it as "application of ubiquitous technologies to logistics processes such as transport, warehousing and storage processes for their efficiency improvement", where ubiquitous technologies comprise auto-ID, data-capturing, sensors, information processing, and decision support.

2.2.2 Last mile in retail

During the Internet boom of 1998-2000, retail industry experienced the first wave of last-mile-oriented merchandisers, yet most of them – such as Pets.com, eToys.com and Webvan – failed to deliver the bold promises on quality, speed and experience. Although the idea of extending supply chains to cover the last mile and offer customized home delivery proved to be successful over the years, these companies' failure was mainly attributed to underestimation of operational challenges in last mile, unrealistic last mile costs and timing estimations and poor information flow. (Boyer, Frohlich & Hult 2004, 16-17.)

Figure 4 below represents a typology of four extended last-mile models developed by Boyer and Hult (2005, 19). Although this study on the design of last mile distribution is based on practices of pre-digital era (Lim & Srai 2018), it provides a good overview of the first now-traditional practices.
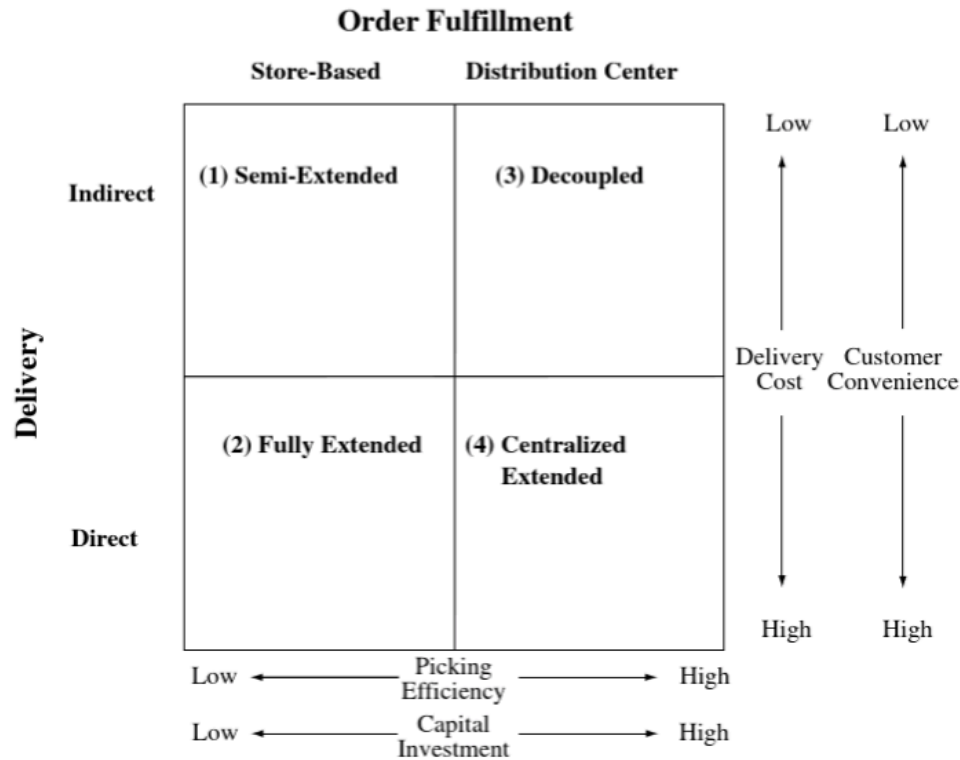
Order Fulfillment

Figure 4 Strategies for extending the supply chain (Boyer & Hult 2005, 19)

The typology offers 4 types of order fulfilment, where each type corresponds to a certain type of supply chains: semi-extended, fully extended, decoupled and centralized extended. In the first place, extension of the supply chain to cover the last mile involves two ways of order fulfilment (picking the item for which an order was placed): at existing retail stores or centralized distribution centres. As can be seen from Figure 4, store-based fulfilment models where stores are used as pick-up points do not involve high investments, yet have lower efficiency and weaker inventory tracking than distribution centres. In these models, delivery can be realized either directly (to customer's home), where the company performs deliveries itself, or indirectly, where deliveries are outsourced to a 3PL (third party logistics provider). A decoupled model largely relies on distribution centres, involving outsourcing delivery services to a third party – and so does the centralized extended model, with the difference of performing deliveries without outsourcing. The authors point out that while direct delivery clearly provides more value to the customer, it is associated with much higher costs. The key differences between the business models are *customer convenience, delivery cost, picking efficiency* and *capital investment.* (Boyer & Hult 2005, 19-21.)

Back in 2000, Fernie & Sparks (2004, 20-21) described future models in retail logistics designing schemes that illustrate two main fulfilment models for e-commerce: store based

and dedicated order picking. In the store based model, customers were to pick up items purchased online at the store – where the goods arrived from regional distribution centres (see Figures 5 and 6). It is notable that van delivery was considered as the only option to cover the very last leg of the transportation.
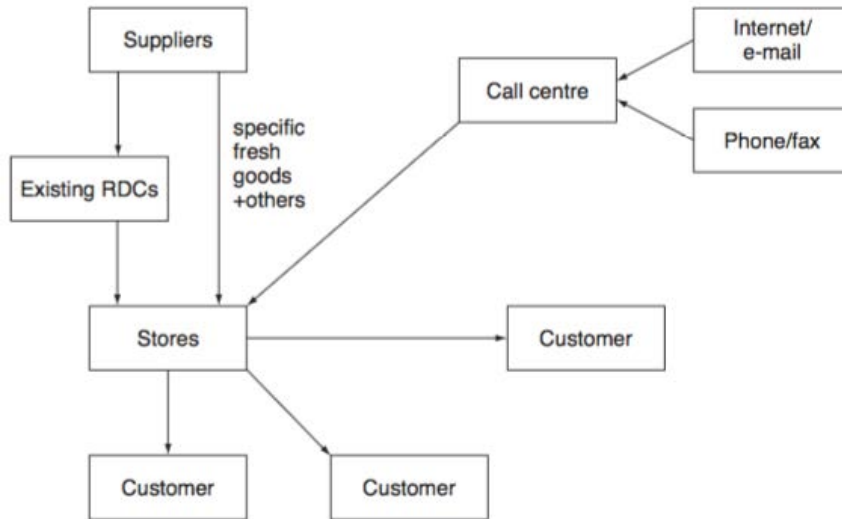
Figure 5 Logistics model of store fulfilment (Fernie & Sparks 2004, 20)

The issue with regards to this model was availability of items – out-of-stock and substitution cases were a major challenge, as both online and in-store customers had to "compete" for the limited number of products. At the same time, this was not an issue for the e-fulfilment centre model dedicated fully to online shoppers – which, however, still had such drawbacks as a smaller product range. Nevertheless, Foresight emphasised the potential of picking centres as a long-term e-commerce solution. (Fernie & Sparks 2009, 27-30.)
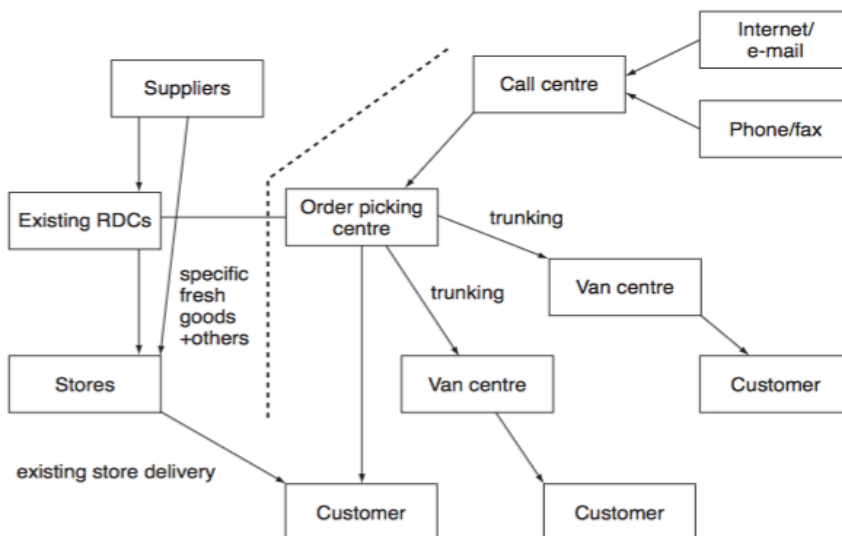
Figure 6 "Logistics model for the e-fulfilment centre route" (Fernie & Sparks 2004, 21)

These days, last mile is the most challenging and expensive part of a delivery process. Despite the growth in the transportation industry over the last years, online retailers are struggling to make profits due to the last mile battle. (Cordon & al. 2014, 86-88.) While older business models relied on economies of scale, now, retailers that want to deliver directly to individuals are facing a brand-new set of problems such as small quantity of purchases, irregular purchasing patterns, and missed delivery windows (Lim and Winkenbanch 2018).

Harrington, Kumar & Singh Srai (2016, 3) researched the design criteria for last mile solutions in urban areas, and argued that performance of the last mile highly depends on the urban system in which it is performed. They exemplified it with regions of higher customer density being less expensive and having wider delivery windows. Given the complexity of environment last mile solutions were studied in – urban areas – the scientists proposed the following definition of the last mile:

"The final component of a B2C delivery process. It takes place within a pre-defined urban system, with specific characteristics, and includes upstream logistics to the last transit point until the destination point of a delivery. It involves a series of activities and processes, of critical value to all the involved stakeholder groups, within an urban system".
(Harrington & al. 2016, 4.)

2.2.3 Modern delivery models and last mile

Choe & al. (2017) describe modern delivery models as "dynamic networks that can adjust flexibly based on capacity and demand". The authors break down the phases of a delivery journey as follows from Figure 7.

First mile
- The item is transported from a production facility to a warehouse

Middle mile
- The item is taken from a warehouse to the distribution hub

Last mile
- Large shipments are split into thousands of individual deliveries
- Each delivery has its own location, route and timing

Figure 7 Delivery journey (adapted from Chloe & al. 2017)

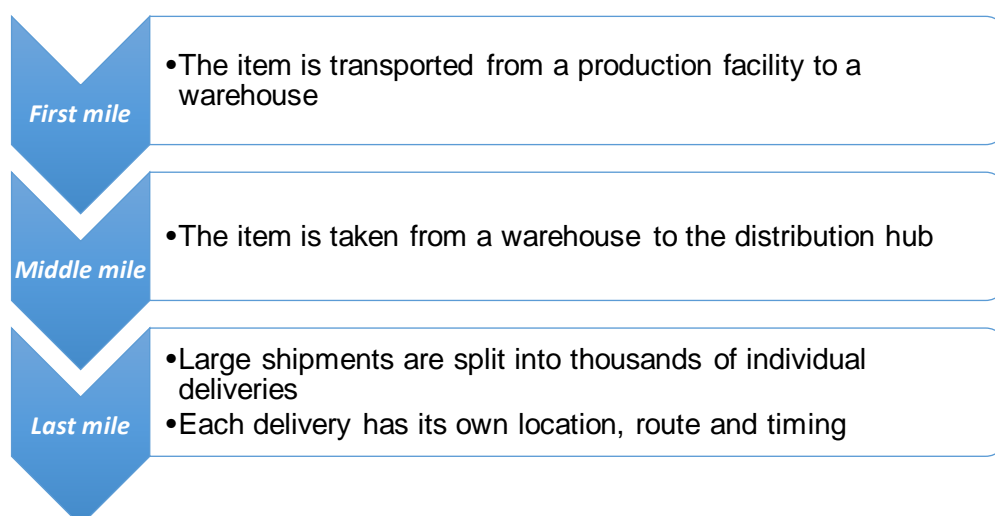In last mile delivery, these days there are three existing models: attended home delivery (AHD), where the goods are sent to customers' doorsteps; reception boxes (RBs), which can be independent (installed nearby the customer's home, e.g. in the yard), boxes with a docking mechanism or shared reception boxes, operated with passwords received via messages; and collection-and-delivery points (CDPs) such as convenience stores (Wang & al. 2014, 1-2).

In 2016, McKinsey&Company investigated the start-up scene in last mile delivery (approximately 300 start-ups) with the aim of identifying the most recent delivery solutions, and created a future-oriented list of operational models, including:

- Today's model - a dedicated delivery person collects the order from a consolidation point and delivers it to the customer by van;
- Drones - autonomous aircrafts that carry orders to the customer by the shortest direct air route;
- Crowdsourcing – members of a crowdsourcing network fulfil specific orders that they choose themselves, using their own vehicles;
- Autonomous Ground Vehicles (AGVs) with lockers – operating under the coordination of a central supervisor (managing 8-10 AGVs at a time), arriving at the customer's desired location, sending a notification to their smartphone for the parcel to be picked up from a specific locker mounted in the van;
- Droids (Autonomous Mobile Robots, AMRs) – delivering parcels to customers' doorsteps, driving on sidewalks at a low speed of up to 10 km/h, of the size slightly bigger than the parcel;
- Bike couriers – point-to-point delivery of small parcels;
- Semiautonomous ground vehicles – instead of driving (as the vehicle drives autonomously), the delivery person is expected to perform other administrative tasks during the delivery journey such as sorting or scanning parcels. (Joerss & al. 2016, 20-21.)

2.2.4 Hub and spoke model

As will be discussed further in the research, some smart delivery solutions require micro hubs – small depots – around the urban areas for successful delivery journeys. The micro his system that will be detailed in the upcoming chapters of this study are nothing but a

more complex version of the Hub and Spoke delivery model, which is why the author believes this model deserves to be part of the theoretical framework. For comparison, a micro hub system is defined as "a flexible consolidation point located in and around medium to high-density areas close to the consumer that allows for deliveries to specific post code groups to be consolidated for last mile delivery" (Techgistics 2016).

Meanwhile, Bozarth and Handfield (2013, 245) offer the following definition of a hub and spoke model: "a form of warehousing in which strategically placed hubs are used as sorting or transfer facilities. The hubs are typically located at convenient, high-traffic locations. The "spokes" refer to the routes serving the destinations associated with the hubs". The high collaboration nature of the system was discussed by Greasely & Assi (2012, 796-797), who viewed hub and spoke logistical networks as supporting centralized distribution and consolidation activities. Rodrigue, Comtois & Slack (2017, 48-49) also pointed out the increased flexibility of the transport system in this network structure, ensured through the concentration of flows. A typical hub and spoke model is demonstrated in the Figure 8.

Every location is interconnected through one intermediary location – the hub (Rodrigue & al. 2017, 48-49). The "hub", or "warehouse", is not designed to hold inventory, and is solely a transfer or sorting facility that takes advantage of the transportation economies of scale. The location of a hub is traditionally convenient and high-traffic (e.g. airports or ports). (Bozarth & Handfield 2013, 245.)

As Figure 8 illustrates, the hub supplies network members by means of line haul trunking (marked in red colour). Further, local delivery and collection routes are performed from each network member – spoke – separately, facilitating either last mile deliveries or collection of items performed by customers themselves.
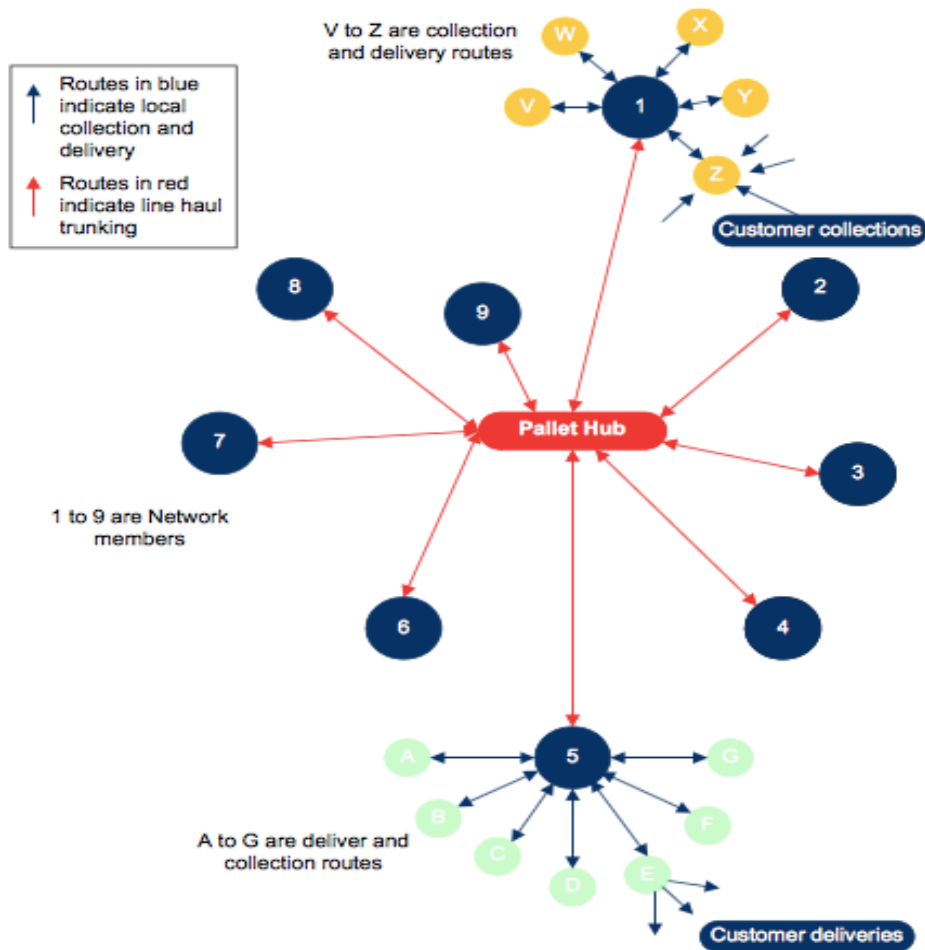
Figure 8 A single allocation hub and spoke model (Greasely & Assi 2009)

2.3 Relevance and impact on the research

The theory analysis presented in this chapter discussed key concepts behind retail and last mile logistics and talked about retail and delivery business models. The theoretical framework allowed to gain a better understanding of the trends, challenges and respective smart solutions developed by industry players in the face of market changes that will be presented in chapters 4 and 5.

Studying changing retail models and retail value chains was essential for obtaining a picture of the delivery scene – as it used to be and as it is today. As was previously explained, the retail industry has seen a radical shift from offline to online and then to omnichannel operations. It was discussed that today, brick-and-mortar stores not only function as physical points of trade, but also as show rooms, e-commerce pick up points, return stations and e-fulfilment centres. Thus, unlike the traditional "distribution centre – to –

store" delivery model, today's omni-channel approach puts both retailers and courier companies under the pressure of facilitating delivery to various points (customers' homes, stores, click&collect centres, etc.). Instead of shipping large quantities, much smaller individual parcels are delivered, which requires for more sophisticated logistics solutions.

Because the thesis research was centred around last mile delivery and not the entire retail logistics process, it was important to provide sufficient explanation to this particular leg in the delivery process – when it takes place, who is involved in it and how it changes depending on the complexity of a retail business model.

To successfully facilitate and cover the last mile in the most efficient ways, companies are test-and-trying various options. Some of them are entirely new, while others are modified versions of existing ones. For example, the Hub and spoke delivery model can be considered as a base for modern micro-hub solutions, which is further detailed in chapter 5.

3 Research methods

The following chapter presents the research process and the research methods applied in this thesis work, explaining to the reader the data collection and analyses processes.

The thesis process had 3 major phases to it as illustrated in the Figure 9. In Chapter 2, the reader has already had a chance to learn the theoretical framework built for this study, which was the first major phase of the research. The second phase was the empirical part, where qualitative research method was used. Literature-based reasoning in favour of qualitative research is discussed in the upcoming subchapter, where practical benefits of the selected research method to the company are also presented. While primary data was collected through interviews, secondary data – industry trends and companies' best practices – was gathered for analysis from various sources such as reports, surveys, articles, journals, blogs and whitepapers.
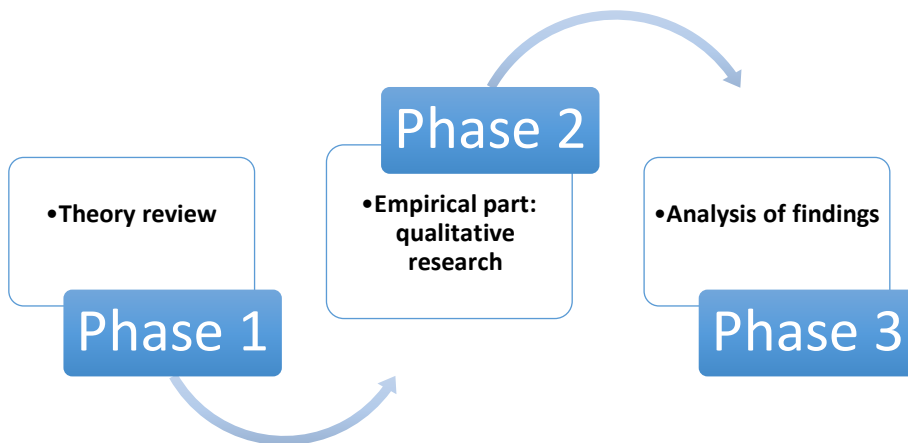
Figure 9 Thesis process

The last phase of the research was devoted to analysing the findings, making conclusions and articulating suggestions for the commissioning company.

3.1 Qualitative research

According to Ghauri and Grønhaug (2010, 10), the key differences between qualitative and quantitative research lay in their emphasis, focus and interpretation. The qualitative research puts stress on understanding – the understanding from respondent's point of view. It allows to approach the research question rationally, obtain subjective insider views and, most importantly, remains exploration-oriented.

The need for *exploring* a problem or issue was also discussed by Creswell (2013, 47), who emphasised that qualitative research is used when there is a need for *complex, detailed* understanding of the researched issue. Adrian Holliday (2016, 6) argues: "While quantitative research seeks to control and pin down, the qualitative mode maintains that we can explore, catch glimpses, illuminate and then try to interpret bits of reality".

The explorative nature of this research is dictated by the field itself – the practices in focus are not yet established, they are to be discovered. The qualitative research method is applied "because quantitative measures and the statistical analysis simply do not fit the problem" (Creswell 2013, 48). For this reason, the commissioning company together with the thesis author came to an agreement of maximising the use of field interviews and analyse opinions of the industry experts and existing secondary data. Gathering subjective opinions, combined with literature analysis and analysing them will provide room for interpretation and creativity.

3.2   Data collection

"Talk as data" makes a large part of any qualitative research, and Flick (2014, 43) suggests three approaches to gathering information in this method: doing single interviews, eliciting several narratives in a single interview and simulating discussions in groups. Another method the author highlights is using exising data, where researchers analyse existing information instead of producing it. (Flick 2014, 43-44.)

In this thesis work, individual field interviews were conducted – collecting data internally within the case company's business, and externally among commissioning company's customers and other field players.

According to Marshan-Piekkari & Welch (2004, 186), there are three key reasons for collecting data through interviews in International Business. First of all, they are particularly suitable for exploratory studies, "when researchers study an issue with little or no pre-existing theoretical bias"; second, interviews are useful when the number of possible respondents is small; third, interviews help establish rapport with respondents, and thus increase the chances of more honest, accurate answers.

3.3   Interviews: method and structure

In qualitative research, there are several types of verbal data that can be differentiated depending on the way they were produced. Uwe Flick identifies five types of interviews: Focused interviews, conducted with structured questions and aimed at analysing subjective

meanings; Semi-standardised interviews, where the questions are hypothesis-directed; Problem-centred, usually covering socially relevant problems, and is object- and research process-oriented; Ethnographic interviews, applied in the context of ethnographic field research; and, finally, Expert interviews, which will be discussed in more detail. (Flick 2014, 201-202.)

Bogner, Littig & Wolfgang (2009, 17) define the expert interview as "a method of qualitative empirical research, designed to explore expert knowledge, which has been developed considerably since the early 1990s". The authors emphasize the importance of distinguishing between experts and non-experts, with experts having unique process-oriented knowledge in their specific professional area. (Bogner & al. 2009, 19). The commissioning company and the thesis author made a decision to utilize this qualitative research interview method, due to the specificity of data that needs to be collected, where industry experts are treated as main sources.

Out of the three basic interview forms – structured, semi-structured and unstructured – the semi-structured approach was implemented for all remote interviews. Thus, the author will control the direction of the interview and ensure covering all topical questions, while simultaneously giving the respondent room for taking the role of a narrator going beyond the set of pre-planned questions. This approach was expected to bring up new aspects that weren't articulated in interview questions by the author but still lied within the scope of the research topic. (Denzin & Lincoln 2000, 645.)

Together with the commissioning company, the author decided to interview the following experts: one expert from a leading parcel delivery company; an expert from a fashion and retail business unit of a leading logistics company; an internal expert from the commissioning company (Figure 10). It was predicted that the interviewees would be able to deliver valuable insights into the researched topic from different perspectives, helping to form a solid understanding of various industry trends and practices.

The interviews took place either via phone. Prior to the interviews, the author will send detailed briefings to interviewees by email, with the aim of allowing respondents to prepare and gather all the necessary information in advance. Phone interviews were audio-recorded with the permission of every interviewee. This way, the author was able to focus on the process of the interview better. As a follow-up, transcripts were sent to respondents for approval in a form of emails. The interviewer was taking notes during the interviews, too. (Blaxter et al. 2010, 194-196.)

Figure 10 Qualitative research: Interviews

3.4 Data analysis

When conducting a qualitative research, Cohen, Manion & Morrison (2011, 537) argue there is "no one single or correct way to analyse and present the data; how one does it should abide by the issue of **fitness for purpose**". They mention that researchers must carefully consider the need for transcription of the interviews, as, on the one hand, transcripts can provide very important detail and accuracy, but on other, practical side, might be very time consuming to use. The authors point out that selecting the most important and relevant parts for writing an analysis of the data directly from the original source might be a good alternative to full interview transcription. (Cohen & al. 2011, 537.)

Data transcription is the first step of the coding process, commonly utilised for qualitative data analysis (Gray 2009, 496). For the second stage, content analysis, Cohen & al. (2011, 550) suggest selecting one of the seven ways of organizing and presenting data, grouping concepts by: *groups, individuals, issue or theme, by research question, by instrument, by one or more case studies,* or *by constructing a narrative.* Whichever way is selected, the ultimate goal of content analysis is to reduce the amount of data, reaching comprehensible proportions that would allow to assess its *quality*.

By the time segmentation takes place, the coding process has started. Strauss and Corbin (2008, 62) define **open coding** as "the naming and categorizing of phenomena through close examination of the data". That is, when certain words, phrases, or sentences are highlighted from the interview transcripts, the author selects parts that might create patterns (Flick 2009, 311).

4   E-commerce influence on the delivery ecosystem

Chapters 4 and 5 will present findings of the empirical part of this thesis research, analysing primary and secondary data gathered through interviews and journals, online articles, researches, reports and whitepapers produced by industry players.

The reason for dividing the empirical part into two was to build an understandable phenomenon – impact – solution chain, where the reader would be able to have a clear picture of what has caused the need for innovative solutions on the last mile delivery market and among competing retailers and couriers, and what kind of challenges these solutions are designed to tackle.

The purpose of conducting the empirical research was to gain an understanding of the industry trends and find out how market players are reacting to them, learn the most innovative practices among both retailers and couriers and discover expert opinions about the future development paths. While Chapter 4 focuses solely on the ways that e-commerce affects the entities of the retail delivery ecosystem, Chapter 5 discusses solutions developed to respond to these effects and survive and thrive on the changing market.

4.1   Overall state of the ecosystem

In 2018, eft conducted a research among 129 supply chain executives from retailers, manufacturers and brands and 194 executives from leading logistics service providers from North America and Europe. The research revealed a 50% increase in last mile logistics services over the course of the preceding 18 months, with the biggest proportion of the demand coming from B2C e-retail. (eft 2018, 2.) In general, it can be said that the e-commerce last mile "is becoming more crowded, more rushed, more expensive, and an even-more-critical contributor to a positive customer experience" (Oracle 2018.)

In last mile delivery, the three main entities involved– customers themselves, retailers and couriers – are all equally affected by e-commerce, and all have their own challenges and expectations (Lee & al. 2016, 4). According to Swisslog, member of the KUKA Group, ability to demonstrate adaptability on a purchase-to-purchase basis to the changing consumer priorities of choice, convenience and speed through a true omni-channel experience is the make-or-break factor to the future success of retail companies (Swisslog 2017, 2).

"To meet this new world of demand, ecosystem players should understand the ways different new technologies and practices are evolving" (Chloe & al. 2017, 15). Deloitte's research article offers an overview matrix of the e-commerce impact on the stakeholders of the delivery ecosystem (see Figure 11). As the figure demonstrates, customers' new expectations include increased delivery speed, lower shipping prices, the possibility of delivering items to various selected locations as well as dynamic live tracking of the shipment. In turn, retailers are pushed to make their distribution even more distributed to enable faster delivery, enhance the visibility of the shipments both within the company and for customers, introduce new delivery options. Meanwhile, e-commerce forces couriers to come up with ways to cut delivery costs and rethink the entire delivery structure, making the planning more analytical, dynamic and predictive, as well as increase accuracy in operations to meet the customers' expectations. They are also encouraged to gain predictive and perspective insights through utilizing machine learning and data analysis.

Customers
Individuals/businesses buying goods through retailers and e-commerce

- **Increased delivery speed:** Drive to decrease time between order placement and order receipt
- **Lower shipping price:** Desire for insight into different price points and "free" shipping options included in a subscription (e.g., Amazon Prime)
- **Flexible destinations:** Push for flexibility on location to pick up a package (home vs. smart locker)
- **Dynamic shipments:** Ability to divert a package mid-shipment

Retailers
Amazon, Target, and Macy's

- **Shifted shipping mix:** Rebalance the shipping portfolio (e.g., third parties vs. in-house)
- **Increased customer insight:** Provide insight into customers through digital touchpoints
- **Enhanced visibility:** Enhance visibility to shipments, both internally and externally sourced
- **Distributed distribution:** Increase the need for distribution centers near urban centers to enhance delivery speed

Carriers
US Postal Service, FedEx, and XPO Logistics

- **Reduced cost:** Reduce the cost structure of each individual delivery
- **Increased accuracy:** Help to manage the network to achieve higher accuracy
- **Analytic insights:** Enable predictive and prescriptive insights from network data
- **Increased utilization:** Increase utilized capacity and throughput
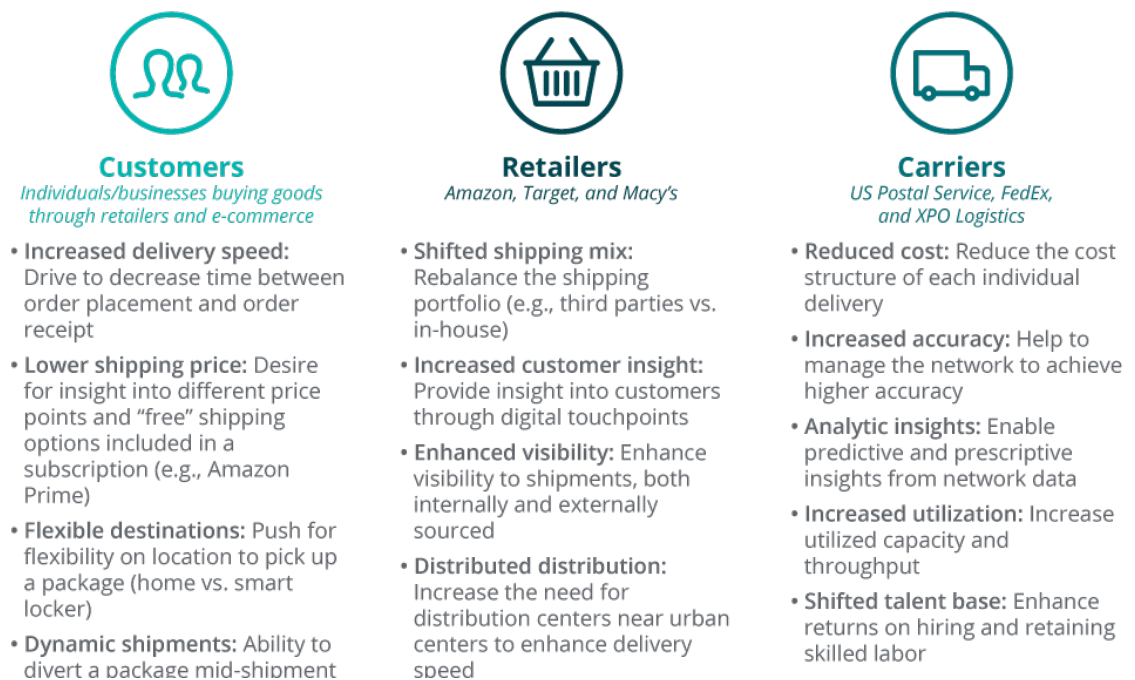- **Shifted talent base:** Enhance returns on hiring and retaining skilled labor

Figure 11 Influence of trends on stakeholders across the ecosystem (Chloe & al. 2017, 5)

The reader will find a more detailed examination of each of the entities in further in the chapter.

4.2 Effect on customers

Consumer expectations are clearly on the rise and the bare minimum expectation today is: *"What I want, where I want and when I want it"* (eft 2018, 5). The better customer experience retailers provide, the more demanding consumers get, challenging retailers to keep up with their growing expectations. Today, customers' main focus is on the speed of delivery, product selection and availability of various pick-up options, cost, and security. (Swisslog 2017, 3.) Cordon & al. (2016, 12) predict that in the upcoming future and its new reality, digital fusion will lead consumers to perceive the purely physical experience as incomplete. Looking into the future, Expert Y (4 April 2019) quotes Jack Ma, that predicts there is going to be no e-commerce any more: "it will be a total omni-channel approach, a total combination, with new players, with marketplaces coming up, and stock availability close to the customer, to offer even a better convenience is the key". That is, many companies will need to revise their strategies to stay competitive, providing the digital part as an essential component of nearly any experience. (Cordon & al. 2016, 12.)

4.2.1 Delivery speed and convenience

According to Statista report on Last Mile Delivery (2018, 13), the most used method in package delivery worldwide is home delivery, with 68% of respondents using this method either always or very often. This method is nearly three times more popular than its closest ranking alternative, pick-up at the post office, chosen by 23% of respondents. Postal service points, workplaces, courier's parcel shops, "safe places at home" and parcel lockers all account for between 10% to 16% of preferences, whereas only 7% of the buyers choose to collect items from retailers' physical stores. As for services offered by shipping providers, as many as 87% of online shoppers have used the tracking option, and 57% used delivery notification systems. Roughly a third of the respondents (27%) have ever made use of express delivery, and only 15% chose to have goods delivered the same day. (Statista 2018, 12-13.)

One thing is for sure: same-day and next-day delivery have become a norm, and convenience is perceived by customers an integral component of the delivery process (Singer 2013, 4). According to Company Y expert (Appendix 3), overall, convenience is the most important factor influencing today's retailers. The factor will be detailed further in the chapter.

4.2.2 Speed alone is not enough

Accenture research conducted in February 2019 revealed that the key trend in e-commerce delivery process among customers is their increasing desire of having control over

the delivery process. Customers perceive same-day or 2-hour delivery as a norm, and thus focus more on the experience. They want to receive notifications to stay updated about the delivery status; be able to rate the delivery experience; select convenient delivery windows that would suit their schedule; have full visibility of the delivery process through real-time tracking; be able to provide specific delivery instructions directly to the driver and finally change the delivery window or location last minute. (Accenture 2019, 2-6.)

4.3   Effect on retailers

In the last mile delivery process, cost is the main challenge retailers have reported to face in the eft 2018 survey about last mile challenges, with nearly one third of the retailers (28%) finding overall cost difficult to deal with (Figure 12). Other major challenges included meeting the growing customer demands and maintaining delivery efficiency. (eft 2018, 7.)
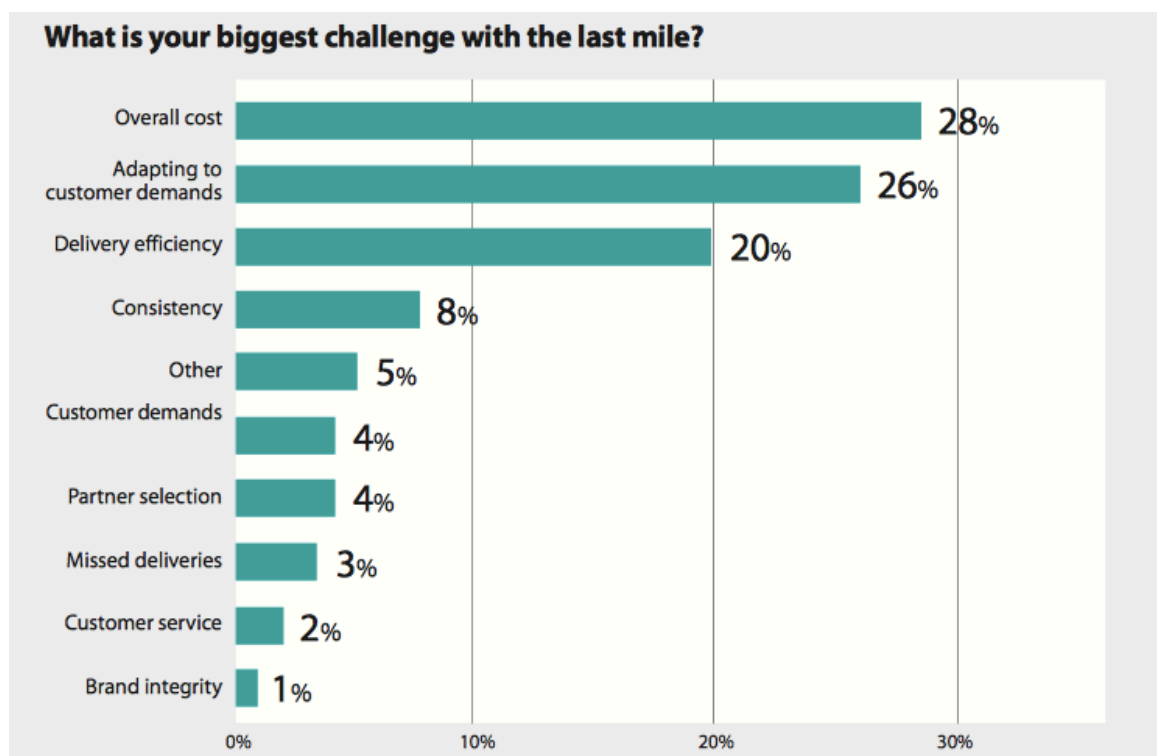
Figure 12 Retailers' biggest challenge with last mile (eft 2018, 7)

Out of six strategies that retailers can utilize to survive and thrive in today's highly competitive market – dynamic pricing, developing brand loyalty, offering the right assortment, providing user-friendly platforms for digital interaction, constant innovation and focusing on instant fulfilment – the latter is the most critical and promising aspect from the logistics

perspective. To fulfil the same-day delivery that has recently become "the new normal", retailers are experimenting with different speedy delivery approaches from crowdsourcing to small external shippers. (Barr & al. 2017, 3.)

As has been mentioned before, Expert Y highlighted during the interview that "convenience" provided to the customer – the possibility to make purchases whenever and wherever, and with the service the customer chooses – is the key factor affecting retailers' businesses. The requirements brands have to meet are dictated by the end customers – and those are purchasing any product at any time, with a reliable, convenient service. (Expert Y 4 April 2019.)

The need for speedy delivery to various locations creates the need for outsourcing delivery to third-party logistics providers. One example of such cooperation is Company Y's solution: in order to get to the market of instant or same-day delivery, Company Y established a partnership with a Hamburg start-up Angel Last Mile, that provides same-day delivery to areas like Hamburg, Berlin and Cologne (Expert Y 4 April 2019).

4.4 Effect on couriers

E-commerce poses the challenge of increasing parcel deliveries by courier, express and package services which highly raises pollution levels and congestion in urban areas. The urban environment is a particular challenge for parcel delivery companies, as the last leg of the entire logistics process is commonly the most expensive one due to inefficiencies in loading and unloading points and low load factors and underdeveloped predictive fulfilment. (Harrington 2015, 17.)

In 2018 presentation on the European Technology Platform "Alliance for Logistics Innovation through Collaboration in Europe", the question of CO_2 emission levels by vehicles was brought up as one of the most critical ones, due to the fact that the last decade saw no change in the levels in spite of the initiatives towards improving the environmental footprint. As a result, several urban logistics emission reduction paths were discussed: lowering carbon energy technologies through electrification of the vehicles and reducing transport intensity. (Etp-ALICE 2018.)

As couriers are expected to take measures to minimize air pollution, noise and congestion in cities, attempts to respond to these requirements and challenges lead to complications in the logistics processes, which is illustrated in the Figure 13 below. (Harrington 2015, 18.)

On the left side of the picture, a traditional shopping and delivery journey is demonstrated. As can be noticed, the traditional process has only three options to it: the items are either delivered to the buyer directly from the warehouse or from the store, or are collected by the buyer at the store himself. As more and more possibilities for order placement, delivery and pick-up arise, the process becomes more and more complex for the retailer, who is challenged to facilitate all fulfilment options.

Figure 13 Complication of the logistics processes (Harrington 2015, 18)

The right side of the picture shows 9 possible options for the item journey:
- 1 – the product can be bought at the store as in the traditional model;
- 2, 6 – the product can be ordered at and delivered from the distribution centre to the customer;
- 3, 3a, 5 – the product can be ordered online from the store, delivered to the store from the distribution centre for pick-up, and collected from the store by the buyer;
- 4, 7, 7a – the order for an item can be placed online, which will bring the item from a distribution centre to the hub and then further to the customer;
- 4, 8 – the product can be ordered online and delivered to the buyer from the closest store;
- 4, 9, 9a – the product can be ordered online to be collected by the buyer from the pick-up box, to which the product is delivered from a warehouse. (Harrington 2015, 18-20.)

Hence, from the 3 delivery stages discussed in Chapter 2 – first mile, middle mile, and last mile – the latter can be performed in the largest number of ways (a total of 5 is exemplified above), and it is up to parcel delivery companies to experiment and discover which solutions works best for the given retailer.

5 Disruptive solutions to e-commerce impact

The impact of e-commerce on the delivery eco-system discussed in the previous chapter creates both a need and an opportunity for retailers and logistics service providers to find solutions to remain competitive. Today, smart cities are a battlefield for companies that try to outperform each other on delivery speed, price and service quality utilizing the cutting-edge technology.

Hence, this chapter of the thesis looks at existing and developed innovative solutions in smart-city last mile delivery that are currently researched, tested, or even implemented by retailers, parcel delivery companies, and software development and integration providers. An overview of the discussed solutions is presented in the Figure 14.
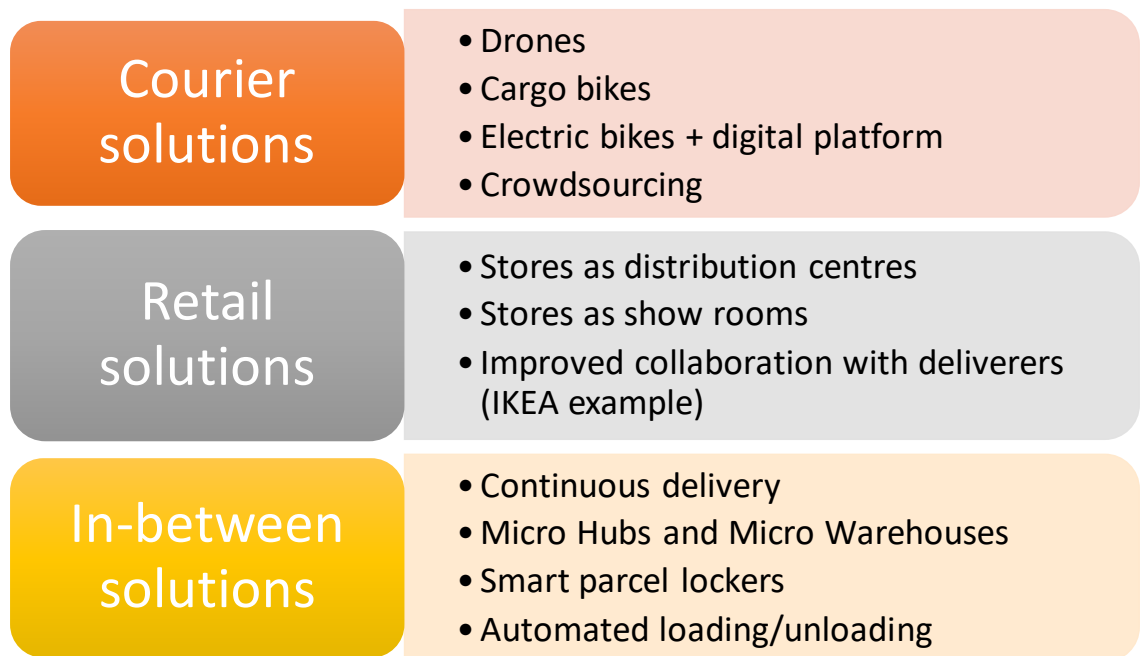
Courier solutions	• Drones • Cargo bikes • Electric bikes + digital platform • Crowdsourcing
Retail solutions	• Stores as distribution centres • Stores as show rooms • Improved collaboration with deliverers (IKEA example)
In-between solutions	• Continuous delivery • Micro Hubs and Micro Warehouses • Smart parcel lockers • Automated loading/unloading

Figure 14 Disruptive solutions to e-commerce impact

5.1 Continuous delivery

Accenture (2019, 18) has recently articulated the following vision for the future of e-commerce last mile delivery: the concept of "continuous delivery". Ideally, introduction of this concept will allow retailers and delivery companies to enjoy an expanded delivery ecosystem and achieve significant increases in cost efficiency.

The main idea of the continuous delivery is to make a delivery driver's route much more flexible with a possibility of adding extra parcel collection and delivery throughout the day. The three key benefits predicted for this approach are delivery cost reduction, increased fleet utilization and reaching a higher route density. Figure 15 below illustrates the four capabilities that Accenture researchers (2019, 17-18) highlight as key success factors for performing continuous delivery:
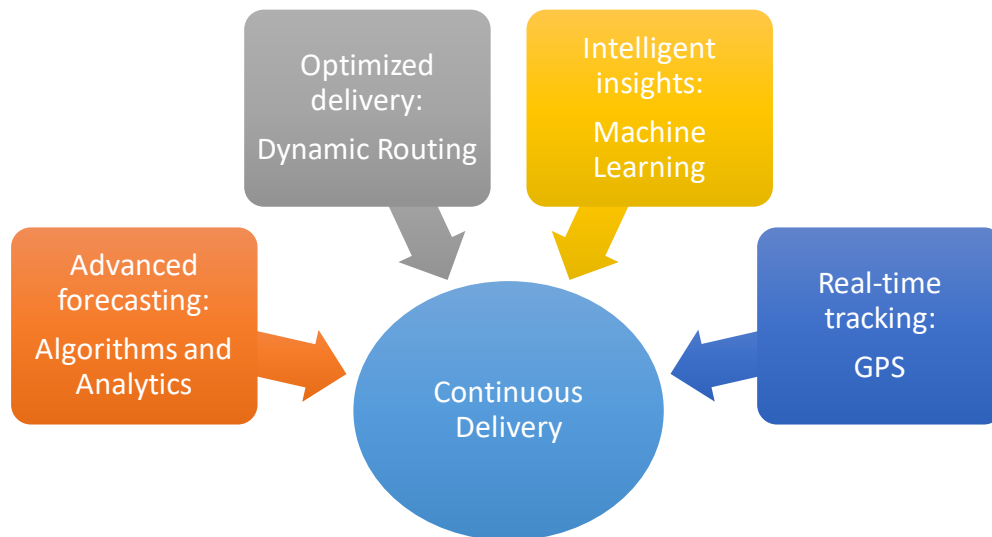

Figure 15 Continuous delivery (Accenture 2019, 18-19)

Delivery companies could utilize advanced analytics for demand forecasting of their services in the same way that retailers do. In data-driven forecasting, gathered data allows to better plan operations involving scheduling and vehicle maintenance. Meanwhile, unlike static routing, dynamic routing would enable delivery companies to adjust the route in accordance with requirements and traffic information in real time mode, sending and receiving updates. As a result, companies can already now better respond to customers' needs without incurring losses from long waiting times at the delivery destination in case the recipient is unavailable. Simultaneously, they can offer real-time tracking enabled by GPS navigation systems. (Stanford Business 2016, 9.) Finally, the delivery performance could be analysed with machine learning so as to point out areas for potential further enhancements, such as increases in route density and delivery efficiency. (Accenture 2019, 18-20).

The "Exclusive survey report" conducted by Retail TouchPoints in cooperation with Oracle and Conveyo in 2018, interviewing 146 retail executives, discovered how companies are currently tackling last mile challenges and what kind of smart technologies they are plan-

ning to apply in the future. As can be seen from Figure 16, these days the majority of re-tailers stick to tried-and-true TMS solutions, and route optimization systems are utilized by close to a third of retailers. However, quite remarkably, only 10% of companies are al-ready using IoT sensors in their business. Today even less common are robot and drone deliveries, accounting for 6% and 2% respectively, and these technologies are not planned to be implemented by the absolute majority of 82% to 84% in the near future. The researchers conclude that the reason for reluctant application of smart technologies might lie in lack of trust – they assume retailers might be waiting for the solutions to be perfected prior to investing in them. (Retail TouchPoints 2018, 16-17.)

Which Technologies Do You Use To Manage Last-Mile Activities?

	USE NOW	PLAN TO ADOPT WITHIN 18 MONTHS	NO PLANS TO ADOPT
TRANSPORTATION MANAGEMENT SOLUTION	35%	21%	44%
ROUTE OPTIMIZATION SYSTEM	27%	27%	46%
VEHICLE MONITORING TECHNOLOGY	18%	24%	58%
RFID ON SHIPPING CONTAINERS	16%	24%	60%
MOBILE DEVICE MONITORING OF DELIVERY PEOPLE	14%	31%	55%
RFID ON PRODUCTS/PACKAGING	14%	28%	58%
IOT SENSORS	10%	26%	64%
AI/MACHINE LEARNING	7%	33%	60%
LAND-BASED ROBOTIC DELIVERIES	6%	12%	82%
DRONE DELIVERIES	2%	14%	84%

Figure 16 Technologies used to manage last mile activities (Retail TouchPoints 2018,17)

5.2   Courier solutions

Rising environmental concerns, congestion in cities, and challenges in facilitating speedy last mile delivery all put companies under the pressure of finding solutions to decrease emissions, reduce traffic on the city roads and deliver items fast enough to various loca-tions within busy urban areas. This gives momentum to companies for experimenting with various smart delivery solutions such as electric bikes, drones, and robots.

5.2.1   Drone delivery

Delivery is by far the most talked-about form of commercial drone application. A relatively low-cost drone could potentially replace not only the delivery personnel but also the vehi-

cles, allowing to significantly decrease the costs for the most expensive part of the delivery process. One example of drone utilization today that is still being tested in the US is Amazon's Prime Air, designed to facilitate local parcel deliveries. (Miller 2015, 171-173.)

Over 3,000 successful drone flights have been completed in Switzerland, where Swiss post and the American drone manufacturer Matternet use drones for healthcare services – fast transportation of blood samples (Swiss Post 2019).

In Europe, tests of drone for commercial purposes such as retail delivery are going to take place in Helsinki, Finland. This was announced by James Burgess, the CEO of Wing – a drone delivery start-up owned by Google's parent company Alphabet Inc. during the Slush conference in winter of 2018.

"If drones can fly here in Finland they can fly anywhere", - said Burgess.

For Finland, however, this pilot program is not going to be the first time of drone testing: back in 2015, Posti (Finnish national postal, logistics and e-commerce service provider) already did a four-day trial of helicopter drones to deliver parcels to Suomenlinna (a former island fortress that is part of Helsinki). (Yle 2015.)

In spite of attractive delivery speed, flexibility and environmental friendliness, the costs for the drone service are still much higher than for other delivery vehicles, alongside the small weight parcel capacity for drones. As customers do not show any willingness to pay significant premiums, this might be one of the key challenges to their day-to-day business implementation. (Joerss & al. 2016, 9-10.) Also, the applicability of drones for specific areas needs to be considered: while drones might be a perfect solution for deliveries in areas that would take too long to cover by a land vehicle, they might be cost inefficient in cities (Expert from company V). Hence, for drones to be widely introduced to the market of last mile delivery, a way needs to be found to decrease their cost. In addition, smarter navigation needs to be developed to ensure accuracy and reliability in the delivery (Miller 2015, 171-173). The smart concept still brings various risks along with benefits – such the risk of collision with passenger jets or danger of falling into the wrong hands, which in the worst-case scenario could be used for remote terrorist attacks. That is, operating drones might indeed become a revolutionary solution for last mile delivery in the near future, but regulations require careful consideration first. (Boland 2018.)

5.2.2 Cargo bikes

Sheth & al. (2019, 11-12) researched the cost effectiveness of cargo bikes compared to delivery trucks. They discovered that this "back to the future" means of delivery is most economically viable when used for short-distance deliveries (less than 2 miles for a pre-determined route delivery of 50 parcels and less than 6 miles for deliveries of less than 10 parcels per stop). The main competitive advantages of cargo bikes include high manoeu-vring capacity: a cargo bike driver can use not only the main road, but also the bike line and sidewalks, accessing pedestrian areas closed for vehicles and easy parking possibili-ties (while a truck deliverer might get stuck in traffic or create jams while stopping for un-loading in the middle of the streets). Yet, as was mentioned before, cargo bikes have very limited carrying capacity and are therefore viable for short deliveries in dense urban areas with high traffic. (Sheth & al. 2019, 11-12.)

5.2.3 E-bikes on a digital platform

The case of traditional cargo bikes might be different with the latest version of electrically-assisted bikes that promise much bigger freight volume capacity – one latest version car-ries an entire pallet, a load of up to 250 kilograms alongside parcels, and can travel as fast as 25 kilometres per hour, running on replaceable electric batteries that should be sufficient for performing the trips. One example of these disruptive electric cargo bikes is the product from the "DB Smart City" business unit of Deutsche Bahn – weColli. So far, the project has been launched in Hamburg and Berlin. A digital platform was dsigned to connect DB Schenker's dispatchers with local bicycle couriers (in Hamburg, CargoCycle is the partner). (DB Schenker 2018.)

5.2.4 Crowdsourcing

Efforts to meet the same-day delivery expectations of online orders through implementing the most cost-efficient delivery methods have led both courier companies and retailers to cooperate with on-demand deliverers from today's large start-up scene, few examples of which include Ackator, Quiqup, Cubyn, Ontruck, and Qlivery. With gig-economy character-istics, these start-ups mostly function as point-to-point delivery taxis in busy urban areas, operating with very thin margins. (Accenture 2019, 13.)

Yet another even more low-investment delivery model helping to fulfil same-day deliveries is crowdsourcing. The model of having an item delivered by whoever is signed up in the crowdsourcing network is attractive due to its high flexibility in supply, particularly conven-ient for fulfilling orders during peak seasons such as Christmas. (Joerss & al. 2016, 20.)

Despite its obvious benefits, crowdsourcing as a model brings along higher risks of safety issues, liability concerns and legal issues, which makes the model leaves plenty of room for improvement in model (Lam & Li 2015, 2).

5.3 Retail solutions

According to the Expert Y, retailers are challenged by an inefficient middle chain between automated fulfilment centres and automated last mile delivery, and sees the lack of IT agility of most retail systems as the key factor. Alongside the need for strong and flexible IT, which would allow retailers, for example, to reserve goods from the store, pick those goods directly from the stock and hand them to the customer by a provider like Angel mentioned earlier, the specialist believes that retailers need to take a closer look at their retail space. He sees potential in transforming the existing retail space, that very often is used purposelessly for brand display, into logistical micro-hub storage. That could be realized if the most actual and on-demand-goods would be preselected and stored to fulfil instant delivery orders. The professional shared a rather critical opinion on automated last mile delivery: "While everybody is looking at the drones, and robots driving through the streets, the basis isn't there yet. It is not possible to pick up from store, and that's something that really needs to change very quickly. For me, the drone delivery and alike is nice marketing, but you need to do your homework first." (Expert Y 4 April 2019.)

5.3.1 Stores as distribution centres

In a research conducted by PwC two years ago, Amazon was presented as an undefeated leader in the e-commerce industry, whose sustainable growth could be largely attributed to a wide network of e-fulfilment centres driven nationwide. The system allows Amazon to enjoy the lowest pick and pack costs across the industry (achieved through economies of scale). At the same time, close proximity to customers allows providing reliable instant delivery at low cost for the company. While traditional retailers might not withstand competition with their much smaller e-commerce businesses, there still is a hidden promising solution for them to remain competitive – and that is benefitting from existing premises using them for e-commerce fulfilment. (Barr & al. 2017, 11-13.)

Swisslog, a member of the KUKA Group that designs, develops and delivers solutions for health systems, warehouses and distribution centres also believes in the potential of adjusting omni-channel retailers' stores to facilitate e-commerce fulfilment. They are considering realizing it by means of "expanding the back rooms {of brick-and-mortar stores} for order fulfilment and even putting up glass windows so consumers can see the robots whirring around to put together the orders". (Swisslog 2017.)

Company X expert, too, sees potential in utilizing retail space for facilitating online trade. In the interview, he mentioned that several companies have already been looking at warehousing solutions that fit into the retail store. The expert imagines that out of 3 standard floors in a store, 1 would be emptied and freed from item displays, and reutilized for storage facilities. Although it would be possible to operate the floor manually, he points out there must be room for applying specific technology – similar to robotics currently used by Amazon. (Expert X 26 April 2019.)

5.3.2 Stores as show rooms

Deloitte research on the Future of Freight (2017, 15) suggests that one possible development path for retail stores could be their full transmission to operating as a showroom for displaying sample products sold in online stores to be tried before buying. Simultaneously, researchers say, the shop could be utilized as a departure point for same-day deliveries via some of the automated delivery alternatives. (Future of Freight 2017, 15.)

However, Company Y expert points out that show rooms are an option for omni-channel retailers only, as otherwise the approach might be too risky: consumers can come and see the goods at the showroom but buy them somewhere else. (Expert X 26 April 2019.)

5.3.3 Electric trucks and smaller delivery e-vehicles

During the Global Climate Action Summit in 2018, the CEO of IKEA, a Swedish retailer of ready-to-assemble furniture well known for their high environmental awareness, announced that the company set a goal of electrifying the last mile delivery of all their products in all countries by 2025. To reach the ambitious goal, its parent company Inkga Group is planning to start using electric trucks in Shanghai, Paris, Los Angeles, New York and Amsterdam as soon as by 2020. The goal for Shanghai has been achieved earlier this year, 2019 – already now, IKEA performs every single delivery in that city with electric trucks. To make things even more impressive, IKEA does not own any fleet – instead, it partners with delivery companies such as DHL, UPS and PostNord around the globe, that operate with nearly 10000 vehicles. (Fehrenbacher 2019.)

That is, in order to electrify the last mile delivery, IKEA has to "convince" couriers that using electric vehicles is essential. The head of sustainable mobility at Inkga Group Angela Hultberg explains:

*"**Collaboration** is one of the biggest lessons learned. We can't do this by ourselves, and this can't happen in isolation."*

The benefits of electric delivery trucks are not at all limited to being harmless for the environment: they also have lower maintenance and operational costs that diesel-powered traditional ones. (Fehrenbacher 2019.)

Development of simultaneous fulfilment of both retail and e-commerce orders has been discussed by SSI Schäfer – one of the world's leading providers of intralogistics and products, operating in sectors of fashion, industry, food retail, food and beverage, healthcare and cosmetics, retail and wholesale and acting as a general contractor on planning and consulting and energy efficiency. The company expects electric delivery vehicles will be smaller in size, operating with much higher shuttle frequency between the depot and the customer, in contrast to the existing one-per-shift frequency, where the driver aims to utilize the vehicle space to the most.

Given the significant decrease in per-journey costs, SSI Schaefer foresees new possibilities for warehouse and distribution centres. As the delivery vehicles will shuttle back and forth at higher frequency, it will be possible to regulate the flow by reducing the load amounts. The company believes that shops' warehouses could be relocated to depots on the outskirts, where they could simultaneously supply the retail store and fulfil the last mile of e-commerce orders during the day. (SSI Schäfer 2018.)

5.4   Smart In-between solutions

The last mile delivery vehicles – autonomous vehicles, bikes, drones and robots discussed above – have very limited capacity both from cargo and distance coverage perspectives. A typical cargo bike can only hold as many as 20 parcels. The idea behind these vehicles is that they can perform multiple short-distance journeys to the delivery point and back, which creates a clear need for in-between solutions such as micro hubs. (Company X Expert.)

5.4.1   Micro-hubs and micro-warehouses

Today, parcel companies are testing smaller sortations, or micro hubs, located in various points of an urban area for immediate individual order fulfilment of small to medium sized-parcels.

According to Expert X, no matter how you look at the micro hubs, they are still an additional step in the delivery process, which is also obviously an additional cost. To optimize the process, the expert believes it might be a good idea to add a storage function to the micro hub. Inventory could be held there on an hourly or daily rent basis. He imagines that

the micro-warehouses could be shared between retailers that are very good at big data analytics and predictive shipping such as Amazon and Zalando, who might be interested in the system for short-term storage of the predictive fulfilment goods in various locations around the city. (Expert X 26 April 2019.)

Today, there are new companies are emerging offering micro hub solutions as the core of their business. One of them is a Dutch "The Hub Company". Established in early 2019, it builds semi-mobile hubs for smart city logistics, aiming at utilizing available spaces within the city areas, with cargo bikes and electric vehicles as complementary services. The start-up's ambition is to tailor micro hubs on wheels accordingly to the needs of the customers and making "the most flexible hubs and create a whole new level of mobility. (The Hub Company 2019.)

The expert from a leading delivery company (Expert V) explains that one option of having a micro hub is using a large lorry that occupies a parking slot somewhere in the city and "feeds" smaller delivery vehicles. Another possibility is having some kind of a milk run, where a bigger lorry is driving around the same route at fixed timing, with smaller delivery vehicles approaching it at specific times for loading and smaller deliveries. According to the expert, it is important to remember that even for mobile depots like these lorries the space in cities is limited, which causes the need for creating a "feed on the go" process. (Expert V 2 May 2019.)

5.4.2 Parcel lockers

Another way of dealing with rising consumer expectations in delivery that companies have started to utilize is SST that stands for "Self-Service Technologies". In the context of last mile delivery, SSTs are parcel lockers, utilized for receipt and return of online orders (Vakulenko 2018, 421). Morganti et al. (2014, 23-31) expect that this type of delivery will account for a significant proportion of all last mile deliveries.

However, as Company X expert points out, it might be challenging to operate on the scene of smart lockers in a way that the new model is more successful than others, as the competition is already very high. (Expert X 26 April 2019.) Expert V (2 May 2019) from the leading parcel delivery company also pointed out in his interview that many companies are providing smart lockers these days – yet, the system has seen few disruptive changes lately. The lockers are still loaded manually, and the expert saw little need for automating that step.

Yet, some companies are experimenting with that – for example, Cleveron, an automated delivery company from Estonia, published a video with an AGV delivering parcels to smart lockers with no human intervention. After Cleveron vehicle is manually loaded at the warehouse, it sets off for the delivery journey. Having reached the Cleveron smart locker, the machine extends a robotic arm that places the parcel inside the locker, after which it notifies the customer that the parcel is ready for pick-up. Although issues of security, locker availability and cost are yet to be solved, the innovation has the rights to be called groundbraking. (Parcel and Post Technology International 2018.) According to the expert, what is also being discussed these days is why provide smaller lockers inside the living buildings, where there are several customers living. This way, it will be possible to prevent the commonplace violence against these machines, they are more protected. (Expert V 2 May 2019.)

5.4.3   Automatic loading and more

Until recently, the loading process of the delivery vehicle remained a fully manual step in the last mile delivery process and saw no innovation at all. In 2019, however, Dematic – a member of the KION Group, a leading provider of integration technology software and supply chain optimization services – has committed to developing a concept of automatic loading in cooperation with DPD – "PackMyRide". In a nutshell, the first fully automated process currently tested at a DPD's distribution centre can be split into the following steps:

- The parcel is picked up from the intralogistics system and placed on a conveyor belt;
- The conveyor transports the parcel to the scanning unit;
- At the scanning unit, volume, barcode data, and weight are verified;
- After verification, the Dematic sequencing Tower stores desired parcels for a short term to create the perfect sequence;
- The parcels are then loaded on rack-feeder-machines to be delivered to the precalculated location on the rack;
- Full racks are moved to the delivery vehicle either manually or via an Automated Guided Vehicle (AGV)

Dematic claims that the concept has no comparable solutions yet, and can be applied to any industry relying on repetitive manual loading. The developers believe PackMyRide will allow to benefit from operational excellence and apply is as yet another step on the way to fully automated delivery. (Dematic 2019.)

Meanwhile, a revolutionary smart delivery vehicle combining multiple innovative technologies is currently researched by Mercedes-Benz Vans: it is The Vision Van. It is predicted that the van would be facilitated with a joystick control, integrated drones for autonomous delivery and entirely automated cargo space (where the parcels will be first loaded on the van with no human intervention and then automatically sorted during the delivery journey to push the right parcel to the driver short before reaching the customer). It is also expected that the electric vision Van will be eligible for deliveries in urban areas that banned vehicles with combustion engines, as well as will be silent enough to perform late-night deliveries. (Daimler 2019.)

To name a few, the vehicle will be designed with such smart capabilities as communicating with surroundings via LED on the front and rear displays (showing warnings about traffic lights or pedestrians, drone take-offs, and returns, etc.), while the dashboard will provide all kinds of information the driver might need for his work, in real time. To sum up, the Mercedes-Benz Vision Van is believed to "set the standard of performance requirements and solutions for future generations of vans." (Daimler 2019.)

6 Discussion and conclusions

The specificity of this research was its pure future orientation. The author was expected to analyse the current trends in retail and last mile logistics, establish the cause-phenomenon-consequence chain and examine the innovative solutions that are being developed by retail and delivery industry players.

As was discussed in Chapter 2, negotiations with the commissioning company and the research methodology required conducting qualitative research based on secondary data analysis for gathering available secondary data and interviews for collecting primary data. The amount of publicly available secondary data – journal articles, data on companies' websites, researches and reports conducted by leading research consultancies, whitepapers and blogs – all together made it challenging to analyse, as the author aimed at being selective and critical, including only reliable sources in the thesis analysis. The decision of doing secondary data research (alongside the primary research) was attributed to the nature of data that this study was seeking to gather and examine: most trends could best be derived from high-ranking research consultancies that had previously conducted researches retrieving the trends the author was interested in. Secondary data also contained a full range of innovative solutions currently developed on the market – both those in the state of development or implementation and those discussed as promising concepts, the viability of which is yet to be proved.

While secondary data analysis allowed to gather plenty of data that the author believed the commissioning company would find useful, the primary research – interviews – could not provide comparable insights due to the number of experts interviewed. Although the three experts who agreed to participate in the study provided truly valuable insights into the industries they operate in and shared their opinions on the future development of several concepts, the interview questions, designed to cover the expertise of each interviewee to reveal the most competent and valuable information, had too little in common and their responses had too few interceptions to be analysed with coding. The author still managed to, however, to track interceptions between primary and secondary research data, as several concepts discussed by the experts could be well intergraded with secondary research findings.

6.1 Key findings

To make the key findings as illustrative as possible, the author decided to use a mind map as the main tool, presented as Figure 17.

The goal of this mind map was to create a distinct picture of the e-commerce growth trends and increasing consignments to cities, rising consumer expectations of same-day delivery, available at low price with flexibility on delivery windows and high visibility of the delivery process with live tracking opportunity, as well as a critical state of environment, with stable-high CO_2 emission levels in cities as the main phenomena that affects delivery ecosystem entities in the ways presented under "Impact", which in turn calls for all the innovative smart solutions.

As summarized in the mind map, retailers are affected by the aforementioned trends in the way that their whole existing business models demand reconsideration. This thesis discovered that modern retailers must work hard to fulfill the customers' expectations on having the items available anywhere, at any time – be it in the brick-and-mortar store, in an online shop, with home delivery, pick-up at the store, or the possibility of collecting the parcel from a nearby smart locker. That is, retailers are challenged to provide the full online and offline shopping experience, which forces retailers to operate through omni-channel models – in a highly complex manner that requires delivery models of the same degree of complexity. In response to the e-commerce impact, retailers are seeking ways to rethink their supply chains, focusing on the potential of smart solutions for optimizing or redesigning their physical store functions. The most promising ideas retailers have come up with so far include turning retail stores into distribution centers which would allow to store goods sold online closer to the customers, facilitating shorter and thus faster last mile delivery; using retail stores purely for displaying goods that can be bought online; replacing some store displays with storage spaces for e-fulfillment, installing glass windows to allow customers to see the automated pick and pack process performed by robots, while keeping other regular physical store operations; putting emphasis on improved collaboration with delivery partners, reaching a consensus on utilizing electric vehicles for delivery – making it faster and environmentally friendlier.

As for delivery parties, cities and customers put them under the pressure of finding solutions that would allow to decrease emissions, noise and congestion, while simultaneously providing outstandingly fast delivery at adequate costs. The omni-channel operations path retailers are turning to makes the delivery process more complicated. Expert V from the leading delivery company confessed that, as a delivery party, they are facing a significant number of challenges that could be overcome if the data possessed by retailers was shared with them. He voiced some ideas about one possibility for this: a neutral third party creating a platform where retailers and delivery companies could exchange data regarding sales forecasts, as this knowledge would significantly improve the delivery speed and process, as it would be possible to plan it in advance.

PHENOMENA

E-commerce is growing

2019 - 20% sales gowth

Consignments to cities are growing

8% yearly volume gowth

Consumer expectations are growing

- on price
- on speed
- on flexibility
- on visibility

Pollution and congestion in cities is growing

IMPACT

On retailers

On couriers

- **Cost of last mile delivery is too high**

- The need to adjust --> **Omni-channel retail models**

- Pressure of instant delivery

- Amazon dominance

- Environmental pressure --> **need for electrification**

- Need to find ways to **facilitate same-day delivery cost-efficiently**

- More **complex** delivery models

SMART SOLUTIONS

From retailers

Turning retail stores into:
- **Distribution centre** for e-commerce
- A **show room** for display only
- 50-50 **retail store and logistical storage for e-fulfilment**
- Cooperation: convincing courier partners to use electric vehicles (IKEA example)

From couriers

Facilitating last mile with:
- **Drones**
- **Cargo bikes** and **e-bikes** (**with digital platform** for interaction with dispatchers
- **Crowdsourcing**

In-between solutions

Micro Hubs and **Micro Warehouses**

- To facilitate loading of smaller delivery vehicles
- **Lorry as a dynamic feeder** for smaller vehicles
- Micro warehouses: shared storage for predictive fulfilment

Automatic loading of electric trucks

Parcel lockers

Figure 17 Mind map of the key findings

Technological advancements in machine learning, sensors, artificial intelligence and alike give room to couriers for experimenting with applying smart technologies in creating smart delivery vehicles of the new generation. However, here two trends can be pointed out: although huge effort is invested into developing flying drones, robots and droids for last mile delivery, long test periods, restrictions in freight weight volume, energy and distance coverage restrictions, as well as governmental regulations prevent these smart solutions from instant appearance on the market. That is why many European countries are "going back to the future", using cargo bikes for city deliveries. Although delivery bikes do have their limitations – such as small radius for operations where bikes are more cost-efficient than delivery vans, and their lower freight weight capacity, companies are increasingly interested in finding ways to optimize this particular last mile delivery vehicle. As a result, the latest models that have been developed today are electric, with the capacity of handling a whole pallet and a weight of up to 250 kilograms, driving at a speed of 25 km/h. These bikes have also been operated through a digital platform, which allows to connect drives around the city with larger freight dispatchers. Finally, a less sustainable, yet currently successful delivery model has been crowdsourcing – driven by the gig economy of sharing where any driver that subscribes on the platform can assist in delivery of individual parcels around the city, allowing some start-ups to operate fully asset-free and with minor investments.

The third section of the mind map presents smart in-between solutions that are of huge importance for smart delivery vehicle operations described above. As all outlined means of delivery are designed for short-distance journeys within busy urban areas, it is essential that there are micro depots around the city to "feed" them. Some experts believe micro hubs could be large lorries arriving in certain areas around the city, occupying a parking slot and feeding smaller delivery vehicles. Another idea is to operate on-the-go, with small delivery vehicles approaching larger trucks (during their own delivery journey) for loading. Expert X has seen potential in operating micro hubs – which so far have only been considered as small sortation and feeding points – as actual warehouses for shared storage of predictive fulfilment goods on an hourly or daily basis. The delivery trucks themselves, that saw little innovation in a long time, can not only be largely electrified, but could also see automatic loading and unloading in the near future, according to the concepts developed by Mercedez Benz and Dematic. Lastly, the smart locker systems currently provided by many industry players in a very similar manner, might be redesigned to be placed even closer to the customers – inside living buildings. Yet again, as Expert X (26 April 2019) pointed out, it might be challenging to find a solution that will be drastically different from the competition – and thus successful.

6.2 Opportunities identified for the Case Company

It was negotiated with the commissioning company that the author is not expected to suggest options for practical implementation of the promising smart innovative solutions identified on the scene of last mile delivery in smart cities due to the author's lack of technical knowledge. However, in the primary research the author had a chance to ask for expert opinion on what opportunities there might be for a business like the one of the commissioning company (the name and details of the business could not be revealed for confidentiality reasons), which have been summarised in the Table 3 below.

Table 3 Expert opinions on opportunities for new smart solutions

Expert opinions

Promising Area	Opportunities for a new smart solution
Expert X SOFTWARE; LOADING/ UNLOADING	• An open platform for collaboration between retailers and delivery companies to enable dynamic flow coordination in the new complex omni-channel retail models • A standardised, flexible and easy to set up software solution for micro hubs combined with warehouse functionality for dynamic shared rent of space for storage of predictive fulfilment goods • Smart solutions for automising loading and unloading processes of delivery vehicles (as this bit of technology is not widely available on the market yet)
Expert V SOFTWARE	• Software for a mobile micro hub concept where a large lorry brings parcels to the city, occupies a parking slot for unloading and directly "feeds" smaller delivery vehicles • Software for a milk run mobile micro hub concept where a large lorry has its own delivery route, but meets smaller delivery vehicles at specific times in specific places in the city to "feed" them • A digital platform as a neutral party that would allow retailers to share data with deliverers to enable precise delivery journey planning (thus improving speed of delivery and cutting costs)
Expert Y SOFTWARE	• Warehousing software for retail stores redesigned into show rooms with logistical storages for e-fulfilment

6.3   Data validity and reliability

In the primary data research, where data was collected through interviews with field experts, all interviewees requested to keep their own and companies' names unrevealed due to confidentiality issues. Although the author and the commissioning company share responsibility for the reliability of these experts' knowledge as sources of primary data, the information gathered through interviews should be subject to critical assessment for several reasons. In the first place, despite the author's effort to ensure that interviewees are well-aware of the upcoming questions and thus best-prepared to provide relevant insights, only one of the three experts interviewed by phone had familiarised themselves with the interview questions and had all the necessary data at hand during the interview. Even though in no way is the author considering lack of preparation as a factor that would radically distort experts' opinions on the issues discussed, she believes that questions asked spontaneously could have received not as comprehensive detailed answers as those known in advance would. Nevertheless, the author managed to gain insights necessary for all research questions, and could later find support to these opinions during the secondary data analysis.

To ensure that secondary data gathered for analysis is reliable, the author selected secondary sources with care. For examining e-commerce effect on the entities of the last mile logistics ecosystem, the author studied researches conducted by the leading research consultancies such as Deloitte, PwC, Oracle, McKinsey&Company, A.T. Kearney and Accenture, as well as collected insights from researches and analyses published on business intelligence platforms trusted by senior industry executives such as eft Supply Chain and Logistics Business Intelligence, platforms providing statistical analysis (Statista) and several platforms for EU innovation initiatives (such as the European Technology Platform ALICE). The author also found it necessary to see what companies themselves feel are the main effects of e-commerce on their businesses, and the same applied to exploring the smart solutions developed by companies – hence, the author retrieved the relevant data from companies' official websites, relying on its credibility. The websites contained articles, blog publications, whitepapers, and annual reports. In particular, the author took a closer look at the logistics industry players' activities on the scene of last mile innovation and the case company's competitors, including Swisslog, SSI Schäfer, DB Schenker, Dematic, and others.

6.4   Limitations and suggestions for further research

As discussed in the demarcation part of Chapter 2, the focus area of this thesis study was limited to last-mile solutions that could be or are being implemented in European smart cities. Therefore, expert statements about the potential for software development by the case company outlined in Table 3 were EU-oriented – which might be too narrow for software development in the face of online trade going increasingly international. Hence, the author believes it is important to conduct further research to analyze the trends in the US and China, the markets with the fastest growing e-commerce.

Furthermore, the scope of the bachelor thesis did not allow to research each of the discussed smart solutions – both developed by retailers and courier companies – in-depth, which prevented the author from gathering and analyzing more data from a bigger number of industry players. Thus, it is unclear how many companies are concerned with finding disruptive smart solutions and predict future competition. For this reason, the author believes further research is needed on each of the opportunities that the commissioning company might find promising.

6.5   Personal learnings

At the beginning of the thesis research process, the author's awareness of both smart cities and e-commerce last mile logistics was very limited. When the topic of the study was articulated, it became clear that the future learning journey had a whole lot to discover.

Having reached the end of the research, the author finds creating the theoretical framework the most difficult part of the entire process. In the beginning, the future-oriented topic of the research made it challenging to identify relevant academic literature, and discussing anything but current trends. Then, however, the author went back to the starting point, realizing that analysis of current and forward-looking trends required a solid understanding of the industries where the trends are taking place and of business models that the trends are affecting. This taught the author to look beneath the surface, developing analytical and logical skills.

Selection of data from reliable sources was another challenge the author faced. When browsing the Internet in search of journals, whitepapers, articles, research papers and reports, the author was highly tempted to gather information from the first websites that seemed to have relevant and much-sought-after facts. Although finding a trust-worthy source was often uneasy, the author learned that secondary research requires strong critical thinking skills that the author needed to improve.

Conducting the primary research – interviews – gave the author an opportunity to have the first complete experience of interviewing from the stages of planning and preparation of questions to audio transcription. The latter serves as a good example for the importance of accurate timing: having invested 4 hours into transcribing the first interview, the author realized the need for analyzing how time-consuming the task is prior to scheduling and prioritizing tasks. Time management has been the skill that the author developed the most during the thesis research process.

Overall, it can be summarised that this bachelor thesis research allowed the author to understand how retail and delivery models are changing, what opportunities smart technologies – IoT, machine learning and artificial intelligence – can provide in last mile delivery, what innovations are already out on the market and what concepts are being developed and, last but not least, to get truly valuable expert insights into how companies themselves view the future of retail and parcel delivery industries in smart cities, and how they see the future last mile.

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Appendix 1. Interview with Expert X

Expert Introduction

I joined Company X 2 months ago. Before that, I was at Company Y for 10 years.
For the last few years, I was managing our competence in warehouse and distribution so-
lutions, which was looking at the new technologies and how to use them in our projects.
For example, robotic picking or robotic palletizing, AGV-based solutions – those were all
developed by my team. I've also run the project X about the future of the warehouses –
that's where my knowledge for the last mile comes from.

Questions:

1. *What do you feel is the most significant effect that e-commerce has had – or is
   having – on last mile delivery in the retail industry?*

2. *What is Company X's current state of involvement in the area of e-commerce ful-
   fillment / omnichannel retail fulfillment?*

3. *Under the Smart Last Mile Logistics project (SMILE) running in Hamburg since
   2016 and aimed at tackling challenges posed by e-commerce in urban areas, UPS
   and DHL are currently testing decentralized package depots, or "micro hubs".
   Could you comment on the potential of the micro-hub solution?*

4. *Do you see any potential for Company X on the scene of micro-hubs?*

   4.1 *Would micro-warehouses be designed for per-retailer use, or will they be shared?*

5. *What is the potential of smart lockers?*

6. *Could you discuss utilization of retail space for e-commerce fulfilment?*

Appendix 2. Interview with Expert Y

Company Y introduction

Company Y is a leading European company providing efficient supply chain solutions, with Zalando, Media Markt and Deichmann being their main customers in the business unit of Fashion and Online Retail. One expert taking a leading position at the company kindly shared his opinion and thoughts on the market state of e-commerce and traditional retail, the new requirements retail companies are facing, as well as courier selection and the potential of last mile optimization.

Expert Introduction

I'm 16 years with the Company Y, and for 5 years I'm the Managing Director for the Fashion and Online retail. The main, if not all of the business unit will change within the next year, as the business is developing from Fashion and E-commerce to the omni-channel approach.

Questions:

1. *What is the current market state of e-commerce from the perspective of retailers and how is it changing? What are the main challenges that companies are facing?*

2. *One of the videos posted by your company on social media says: "With our in-house project management and development team, we are able to react rapidly to new requirements from our customers and markets" – could you talk about brick-and-mortar, e-commerce and omni-channel retailers' new requirements?*

3. *Is customer experience "dictating" and shaping the supply chains of today and future on the e-commerce market? If so, how?*

4. *Since your company offers a full range of services to online retailers, it also takes care of the smooth delivery. What couriers do you partner with? What is the process like today? Is there a need for optimization of the process, in the light of automation of the last mile?*

Appendix 3 Interview with Expert V

Company V introduction

Company V is the world's leading logistics company operating in more than 200 countries around the globe. With more than 50 years of experience behind, the company's expertise ranges from express parcel delivering to freight forwarding to supply chain management.

Expert V introduction

Expert V has worked at the company for over 10 years and is currently leading the division responsible for innovation.

Questions:

1. *Could you your opinion on the flexible delivery solutions for pick-up options such as smart lockers?*

2. *Are the lockers loaded manually? Is there any potential for automation?*

3. *What potential do you see in micro hubs and micro warehouses?*

4. *What are the main drivers for innovation on the scene of last mile delivery?*

5. *What can retailers do to compete against Amazon, especially in terms of speedy delivery?*

6. *What is your opinion about the potential for flying delivery drones?*