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Geographical location of warehouses and its impact on delivery time

A study of e-commerce companies in Sweden

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Abstract

E-commerce is challenging the traditional way of distributing goods. An increase in parcels, lower filling rates, more trips to distribute the parcels and a demand of fast deliveries within a limited time-window lead to increased logistics costs and environmentally unsustainable means of delivering packages to end-customers. Urbanization, congestion and expansion of cities lead to higher land costs and slower distribution of parcels. Historically, companies have moved their warehouses to suburban areas to avoid high costs for land. In some parts of the world today, a “re-localization” trend has been observed, in which companies move back into central areas.

This study aims to analyze how many potential customers e-commerce companies can reach within different time intervals, review factors that could impact the choice of location and identify necessary changes to manage faster deliveries. A mixed method approach has been applied. Quantitative data in form of localization of e-commerce companies have been collected and qualitative data in the form of interviews have been executed to get a deeper understanding of strategies behind warehouse localization.

The quantitative data results showed that a central location in Stockholm municipality provides the highest population reach within the shortest time interval due to proximity to residential areas. A geographical shift was observed when analyzing the longer time intervals, making Eskilstuna in the region of Stockholm-Mälardalen the location with the largest potential to reach many customers.

The qualitative data results showed that some companies manage same-day delivery to some parts of the country, but the large majority of the customers receives its order within one to three business days. All respondents valued proximity to transport infrastructure as an important characteristic of a suitable location of a warehouse. Swedish e-commerce customers do not seem to be willing to pay for even shorter deliveries. The conclusions of these findings are that even faster deliveries are possible, but not realistic in terms of costs and the additional environmental impacts it contributes to.

Keywords: e-commerce, warehouse localization, last mile delivery, end-customer, transports, express delivery

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1 Introduction

This section aims to give the reader a brief introduction to the subject of the thesis. It consists of a background description, followed by a problem discussion which explains why the topic is relevant and needs to be studied. The problem discussion is followed by the thesis' purpose, three research questions and scope of the study.

1.1 Background

The e-commerce sales, primarily the business to consumer sales, has rapidly increased during the last years, challenging the traditional sales channels and has changed the business environment towards becoming more consumer-driven with higher competition among companies (Cárdenas, Beckers & Vanelslander, 2017). The rapid increase in e-commerce depends on several different factors. According to Al-Mulali Sheau-Ting and Ozturk (2015), the main factor is that more companies and people have access to Internet and smartphones. Easy and fast solutions for payments and deliveries are also factors that contribute to increased e-commerce. The effects of digitalization are an increase in innovations, competition among businesses and convenience for customers. The continuous urbanization, with more than half of the worlds' population living in cities, impacts the distribution of goods from warehouses to end-consumers (Schliwa, Armitage, Aziz, Evans & Rhoades, 2015).

For many companies, the digitalization has had a significant effect on how to conduct business (Verhoef, Kannan & Inman, 2015). Today, there are many different retailing channels or methods to sell products to customers (Al-Mulali et al.,2015). Retailing ranges from traditional shops with one sales channel, to omni channel retailing in which several different sales channels are used. An example of a company applying an omni-channel approach is H&M, that sells products both in physical stores and online. Zalando is an example of a pure online retailer, that only sell products over the Internet. The increased e-commerce sales have for many companies resulted in increased costs due to failed delivery issues, large reverse logistics flows and last-mile issues (Cárdenas et al., 2017). The last-mile issues refer to the costly last part of the transportation to the receiver of the parcel and the issues and negative impacts with the last-mile transportation have engaged many researchers from different fields within logistics as well as public decision-makers (ibid.).

Buldeo Rai, Verlinde and Macharis (2018) stated that the last mile transport is inevitable. Free delivery, free returns, delivery time and delivery windows are means to influence customers to choose a certain delivery option (ibid.). In order to reach high efficiency in the last-mile deliveries, Cárdenas et al. (2017) claimed that a high customer density is necessary. Home delivery of sold goods through e-commerce in rural areas with low customer density would be both costly and inefficient, but the preconditions are different in highly dense urban areas.

The growth within e-commerce and last mile deliveries is currently leading to negative impacts on the environment, since it for example increases the number of freight movements (Heitz, Dablanc, Olsson, Sanchez-Diaz & Woxenius, 2018). A study conducted by Zhao and Zhang (2018) in China showed that urban transports are contributing to a significant larger share of emissions than other forms of transport. Solutions for sustainable city logistics are needed and e-commerce and urbanization challenges general trends (Amling & Daugherty, 2018). Traditional methods of last mile deliveries are unsustainable, as they are based on sending large shipments to one customer whilst e-commerce shipments instead consist of small

packages to numerous customers (ibid.). Congestion in cities in combination with the increased number of shipments further complicate e-commerce shipments to end-customers (ibid.).

Al-Mulali et al. (2015) implied that when e-commerce is replacing more than three and half personal trips for shopping or that more than 25 deliveries can be made in one trip and to the same address, e-commerce will affect the environment positively. Therefore, e-commerce is not to be considered as a sustainable solution today. Van Loon, Deketele, Dewaele, Mckinnon and Rutherford (2015) argued that depending on how the goods are delivered to the end-customer, e-commerce will affect the environment differently. Delivery option, basket size, trip chaining, choice of travel mode when collecting packages at pick-up point, failed deliveries, returns and types of packaging are all factors that have an effect on the environmental footprint an online order has (ibid.).

Logistics sprawl

Logistics companies, with terminals and warehouses, require in general a large amount of land (Dablanc, 2014). In the past, warehouses were often located in central areas and close to railway connections (Chinitz, 1960, see Dablanc, 2014). Between the 1970s and 1990s, many logistics companies fled from central locations towards the hinterland, due to high costs of land in the city centers (Dablanc, 2014). The movement of warehouses from central areas towards more peripheral areas is referred to as “logistics sprawl” (Heitz et al., 2018; Dablanc, 2014; Aljohani & Thompson, 2016). The logistics sprawl has impacted the land consumption, increased the travelled distances for goods and resulted in changes of the logistics system (Aljohani & Thompson, 2016).

For many industries, transportation costs represent a fraction of the total costs and Glaeser and Kohlhase (2004, see Dablanc, 2014) claimed that transportation costs often are trivial. The low freight transportation costs have according to Rodrigue (2004, see Dablanc, 2014) enabled an increased distance between warehouse location and densely populated cities.

The relative costs for freight transportation have decreased during the last decades, as a result of advancements in technology, infrastructural improvements and low oil costs (Hall et al., 2006, see Dablanc, 2014). Many changes have occurred that have impacted freight movement and the location of warehouses. According to Ogden (1992, see Heitz et al., 2018), a change in production and consumption patterns has occurred, which has impacted freight transports in terms of volumes, traffic flows, frequency and time of freight movements. Hesse and Rodrigue (2004, see Dablanc, 2014) argued that the “new distribution economy” has contributed to increased globalization and just-in-time operations which have resulted in lower inventory levels and an increase in numbers of distribution centers.

Re-localization trend

Previous research has according to Heitz and Beziat (2016) illustrated the presence of logistics sprawl in both Europe and the United States. Another ongoing trend that has been identified is the “re-localization” of logistics activities in city center areas (Heitz & Beziat, 2016). The authors argue that these are contradictory trends and makes the geographic location of warehouses interesting and important (ibid.).

Today, localization of distribution centers, warehouses and terminals are affected by continuous urbanization and the growth in e-commerce (Selko, 2016). It is stated that reducing the cost for the last mile of the transportation is becoming increasingly more important since the last mile costs can stand for a large portion of the transportation costs (ibid.). One way to reduce the last mile cost is to locate logistics facilities in proximity of urban areas. By relocating or establishing a warehouse close to the customer market, a reduction in the last mile cost can be achieved as well as a possibility to better meet customers' demands of faster deliveries (ibid.). Selko (2016) argued that even though the rental costs are higher in urban areas compared to hinterland areas, a reduction in last mile cost still could result in a lower total cost. A central warehouse location often provides proximity to customers, accessibility and availability of well-developed transport infrastructure (Heitz et al., 2018). However, Kang (2017) argued that the optimal location differs depending on whether the warehouse is supposed to serve a local or non-local market. According to Kang (2017), a warehouse that serves a non-local market is best located close to an airport, seaport or near major highways whereas a warehouse that is to serve a local market is best located as close to the customers as possible.

1.2 Problem discussion

The development of the e-commerce sector has according to Burnson (2016) and Tompkins (2016) impacted companies' logistics operations and supply chains. It has also contributed to an increased number of freight movements (Cárdenas et al., 2017). This development has changed the perceptions of the optimal location of warehouses, as e-commerce has transformed customers' purchasing behavior and increased the demand of delivery services (Morganti, Seidel, Blanquart, Dablanc & Lenz, 2014). The development has also impacted logistics operations with more last-mile issues to manage. E-commerce and home deliveries are problematic from an urban logistics standpoint, as it contributes to increased "last-mile" problems (Morganti et al., 2014).

Customers demand more and faster deliveries and according to Lee and Whang (2001), the ability to deliver on time determines the success of an online retailer. In essence, a company that offers short delivery times could have a greater chance to win the order, compared to its competitors. Gangeshwer (2013) agreed with Lee and Whang (2001) and stated that one of the motivators to shop online is fast deliveries. The case study in India showed that there are especially five motivators for shopping online - cash back guarantee; cash on delivery; access to branded products; large discounts compared to retail and as mentioned; and fast deliveries. Urban logistics operations are challenged by the combination of the large growth in e-commerce sales and the increased demand of faster deliveries, which could lead to large operational challenges for companies (Boudoin, Morel & Gardat, 2014).

According to Tompkins (2016), one factor that impacts the success of an e-commerce company is the ability to meet consumer expectations. Today, next-day deliveries are more commonly requested by customers than before (Morganti et al., 2014). Consumer expectations can be divided in four different categories - price; selection; convenience; and experience (ibid.). The convenience aspect refers to the faster deliveries, the more satisfied customers. In order for companies to meet the increasing demand for faster transports, well developed processes for order handling and efficient distribution are vital (Lee & Whang, 2001). According to the European Commission (2013, see Morganti et al., 2014), companies that sell goods via

e-commerce claim that delivery service options have a large impact on the consumer's purchasing decision.

Burnson (2016) argued that one large challenge is determining the optimal distribution network with the cost-service trade-off in consideration. An important aspect is the geographical locations of companies' warehouses, which could have a large impact on the delivery time. If a facility is located in a rural area with a long distance to important transportation links, the possibilities to delivery customer orders within a couple of hours are quite limited. In order to manage fast transports, companies are highly dependent of the geographical location of their warehouses, land use patterns and trade imbalances (Allen, Browne & Cherrett, 2012).

Selko (2016) argued that companies are likely to locate warehouses in urban areas in order to manage the high-speed deliveries in the near future. In order to succeed with such short delivery windows, such as delivery within a couple of hours from order placement, there is a need for distributions centers to be located in proximity to the customers (ibid.). An urban geographical location provides quick access and short transportation time to many customers but could also be costly and not optimal, as warehouses in general allocate large land areas (Heitz et al., 2018). To meet customers demand, e-commerce companies must increase handling and delivery speed as well as manage last-mile deliveries (Ewedairo, Chhetri & Jie, 2018).

In Sweden, there are some geographical challenges for companies that promise fast deliveries needs to consider. Sweden is a large country in terms of land area, but in terms of population size Sweden is a sparsely populated country, illustrated in figure 1. The average number of inhabitants per square kilometer (km^2) was 24,8 the year of 2017 (SCB, 2019). Figure 1 shows that there are many areas in Sweden with none or low population density and only a few areas or municipalities with high density (in this figure defined as over 200 inhabitants per km^2). The combination of low population density and long distances compose a challenge for fast deliveries, especially for municipalities in the northern areas and for the largest island Gotland, which lacks road infrastructure connection to the mainland (NE, Sweden).

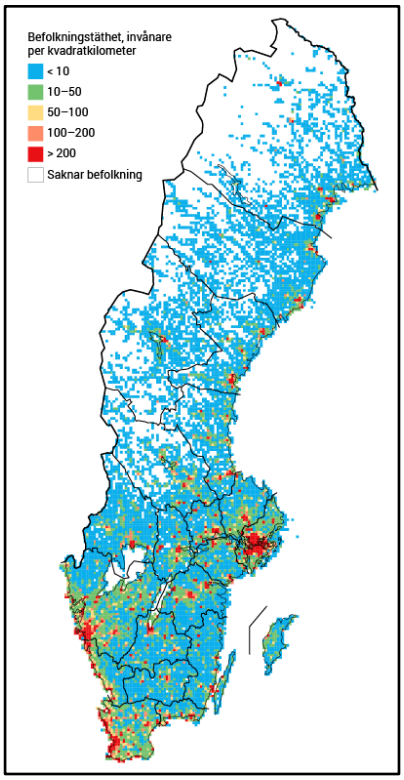

Figure 1.1 Population reach in Sweden (SCB, 2019)

As previously mentioned, the geographical location of a company's warehouse could have a large impact on the delivery time. Considering the geographical challenges, the question whether Swedish e-commerce companies can deliver according to the increasing demand for faster transportation or not arises. How short delivery times can e-commerce companies promise with their current location of warehouses - and what happens if the demanded delivery time decreases to a few hours in the future? How that would impact the built environment, logistics operations and the society are questions that remain to be answered.

1.3 Purpose

The purpose with the thesis is to analyze how many potential customers e-commerce companies can reach within different time intervals and to understand which factors that impact the choice of warehouse location. To fulfill the purpose, the geographical location of warehouses will be compared with population density in Sweden in a geographical information system (GIS) and different strategies regarding warehouse localization will be analyzed.

1.4 Research questions

- How large share of the population can Swedish e-commerce companies reach within different time intervals and which similarities between the warehouses with the highest reach can be identified?
- Which geographical aspects are important for e-commerce companies when deciding where to locate a warehouse?
- What changes are necessary for e-commerce companies to manage same-day deliveries?

1.5 Scope

The scope of the study is limited to the delivery from e-commerce companies' warehouses to end-customers. The study is reviewing the delivery potential between warehouses and citizens' home addresses, which eliminates deliveries that are transported to pick-up points. Drop-shipping, transports from a company's supplier directly to end-customers, and the suppliers' delivery capability will not be included in the study. The study is based on the largest business-to-consumers e-commerce companies in Sweden. E-commerce companies in this study are defined as companies that sells the majority of their products online. Companies with other or multiple sales channels will not be included.

2 Literature review

In the literature review, some of the previous research within the field is presented and some definitions and concepts are included in order to increase the reader's' knowledge and understanding.

2.1 E-commerce challenges traditional channels

E-commerce is according to Suzuki, Kawai and Wakabayashi (2016) defined as a transaction of goods over the Internet, where the purchased item is delivered directly from the selling company to the end-customer. The rapid increase in e-commerce sales has challenged traditional sales channels, due to its different characteristics (ibid). In traditional business to consumer (B2C) sales, customers travel to physical stores to purchase items (Cárdenas, Beckers & Vanelslander, 2017; Joong-Kun Cho, Ozment & Sink, 2008). Within e-commerce, the companies arrange for the transportation of the parcels to the customers instead. Omni- and multi channels refers to providing more than one sales channel, for example having both physical stores and a platform for e-commerce sales (Verhoef et al., 2015). B2C e-commerce is characterized by small consignments to numerous end-customers, which differs from traditional business to business (B2B) sales (Al-Mulali et al., 2015; Rushton, Croucher & Baker, 2014). Rushton et al. (2014) stated that B2B sales are characterized by large volumes to a few customers and that increased B2C e-commerce has resulted in an increased number of required vehicles to be able to manage the last-mile deliveries effectively and within a small delivery window.

Joong-Kun Cho et al. (2008) argued that more aspects than only a product that meets customers' demand are necessary to become successful as an e-commerce company. Complementary services and logistics skills are claimed to be as important as the product itself (ibid.). Supply chain management and logistics have according to Yu, Wang, Zhong and Huang (2017) been highly affected by the rapid increase in e-commerce. Within e-commerce, logistics costs make a considerable part of the total costs of a product as it can be as much as 40 percent of the price of the product (ibid.). Replenishment from suppliers or manufacturers, sorting, picking and packing orders and delivery to end-customers is what the logistics chain mainly consists of. Since the logistics costs are a large part of an e-commerce business total costs, many companies involved in e-commerce put a lot emphasis in finding less costly and more efficient logistical solutions, for example automated warehouses (ibid.)

2.2 Impact on freight transportation system and the built environment

Road transports dominate the market share when it comes to short distance freight transportation, as the transportation mode provides high relative speed, high flexibility and low investment costs (Rodrigue, Comtois & Slack, 2013). In e-commerce sales, road transportation is by far the transport mode that dominates (ibid.). One challenge with e-commerce is the limited time windows for deliveries and as e-commerce continues to increase, the supply chain of businesses involved in e-commerce becomes more complex (Rushton et al., 2014). The complexity stems from customers demand for convenient deliveries and the lack of willingness to pay for deliveries (ibid.).

E-commerce effects on urban areas and last-mile challenges

Modern logistics have according to Hesse (2008) reshaped the urban development and urban land-use. New means of transportation and new technologies are continuously changing the structure of cities and impacts the land-usage in central areas (ibid.). Allen et al. (2012) claimed that there are mainly three trends that impact the land-use in urban areas: de-industrialization; spatial centralization of stockholding; and rising land-prices in urban areas combined with increasing congestion in urban areas.

The term “Last mile” is used when describing the end part of a transportation chain to the end-customer, which often is a costly and time-consuming activity (Rodrigue et al., 2013). The last mile transportation is often considered to be a logistic challenge and Yu et al. (2017) claimed that the ability to manage the last mile transportation is crucial to successfully run an e-commerce business. The last mile transport can be responsible for up to 75 percent of the total supply chain costs (Buldeo Rai et al., 2018). Some challenges with last mile transportation are managing variations in the demand peaks and satisfying the customers’ demand for fast deliveries (Allen et al., 2018). Liu, He, Gao and Xie (2008) argued that although fast deliveries are important, it is more important to deliver within the promised time to fulfil the customers’ expectations.

Ewedairo et al. (2018) argued that the last-mile transportation also could be challenging for urban planning, due to the heterogeneity in products and reduced product life cycles. The increased e-commerce sales have according to Allen et al. (2018) resulted in an increased presence of smaller freight distribution vehicles in cities. Smaller distribution vehicles have a higher flexibility and can drive in areas with limited space compared to larger vehicles (ibid.) A contributing factor for increased demand for flexible deliveries is the limited space for stockholding in urban areas (ibid.). It is stated that freight transports within urban areas are less efficient than freight transportation to and from urban areas, which adds on to the complexity of urban freight transports. E-commerce sales are forecasted to continue to grow as well as the demand for receiving consignments just-in-time, which will further challenge transportations in urban areas (Ewedairo et al., 2018).

E-commerce and sustainability impacts

The last mile transportation is rarely sustainable, due to high delivery failure rates and in general low filling rates (Buldeo Rai et al., 2018). The last leg of the transport is often classified as the least sustainable. Companies that offer fast deliveries, for example next-day delivery, have lower possibilities to consolidate consignments and achieve effective route planning which results in more vehicle kilometers driven per parcel (ibid.). It is difficult to find a solution that is both attractive to the end-customer but still is economically and environmentally sustainable (ibid.). Al-Mulali et al. (2015) showed that last-mile distribution of e-commerce sales will have a negative environmental impact until better efficiency in the distribution of parcels can be achieved.

Road transports are responsible for a large share of the emissions from the transport sector that contributes to both short-lived gases and long-lived greenhouse gases (Uherek et al., 2010). The short-lived gases from road transports impact the air quality with primary and secondary pollutants and the main problem is the small particles and ozone, which could seriously affect the human health (Uherek et al., 2010). Road transports also generate

unpleasant sounds and could affect and disturb the human health in the long-term (Rodrigue et al., 2013). Noise stemming from road transports is mainly a local issue and especially problematic in urban areas. In the long perspective, noise could have a negative effect, both physically and mentally, resulting in high levels of stress, fatigue or even cardiovascular diseases (Rodrigue et al., 2013; Björklund, 2012).

Another issue that stems from increased road freight transports is congestion that occurs when the number of vehicles exceeds the road network capacity (Björklund, 2012). The trend of receiving goods just-in-time has generated smaller, more frequent consignments, resulting in additional vehicles using the road network (Olsson & Woxenius, 2014). Congestion on the road network equals vehicles in standstill and idling, releasing emissions without producing any transportation work (Björklund, 2012). Besides the emissions, congestion limits the accessibility on the transport network and is costly for companies, as it affects the delivery times, especially in urban areas (Olsson & Woxenius, 2014).

Decision-makers and urban planners need to balance the demand for accessibility for freight transport operators and to provide a pleasant and safe living environment for the inhabitants (Rodrigue et al., 2013; Uherek et al., 2010). To minimize the risk of sacrificing human health, regulations could play an important role (Rodrigue et al., 2013). An example of a regulation that could restrict urban freight transports is delivery-time windows, only allowing freight deliveries under a certain time period of the day. Other regulations could ban certain vehicle types or restrict weight or length of the vehicles.

E-commerce impact on warehouse localization

Today, two trends regarding e-commerce have been observed. The logistics sprawl and urbanization of warehouses are two different strategies regarding warehouse localization. Logistics sprawl is the trend of warehouses moving further away from city centers due to high land prices, no available land and traffic congestion in urban areas (Sakai, Kawamura & Hyodo, 2018). According to Hall and Hesse (2013), reasons for locating warehouses outside of cities are mainly because of the increasing size of warehouses. The need for larger warehouses is derived from the larger flow of goods and within cities there are no available land for large warehouses.

The other trend is the increased presence of urban warehouses. The presence of urban warehouses and freight movements in cities have increased over the last twenty to thirty years, something Hall and Hesse (2013) described as “persistent urbanization of freight” (see Heitz et al., 2018). Some reasons for moving warehouses and logistics facilities towards more central areas are proximity to customers, access to transport infrastructure and greater accessibility (ibid.). However, an urban warehouse could face challenges regarding deliveries, due to congestions and limited available storage space (Hall & Hesse, 2013). Some aspects that impacts the sizing and location of urban warehouses are levels of congestion, size and density of the city, the possibilities for multimodality, costs for land and the presence of logistics services suppliers (Diziain, Ripert & Dablanc, 2012).

Warehouse location could also have sustainability implications. The trend of logistics sprawl has according to Diziain et al. (2012) resulted in substantial negative environmental impacts. The movement of warehouses towards the hinterland has increased the total number of vehicle

kilometers, emissions and contributed to congestion on the road network. Khalid (2016) also stated that even as the number warehouses are decreasing in urban areas, freight movements in cities increase as well as the total number of vehicle kilometers. All mentioned aspects contribute to increased costs, both direct and indirect, for the society (Diziain et al., 2012). To reduce the negative impacts, it is not enough to slow down the logistics sprawl and Diziain et al. (2012) suggested that logistics operations should be moved back into the city in order to minimize the negative environmental effects.

2.3 Observed trends of warehouse localization around the globe

The previous sections presented how the development of e-commerce has challenged traditional ways of transportations and the society. The demand for faster deliveries could challenge e-commerce companies' logistics operations, but also contribute to the strategic question of warehouse localization (Jakubicek & Woudsma, 2011; Heitz, Launay & Beziat, 2019). The geographical location of a warehouse could play an important role in terms of the possibilities to reach customers within a short period of time, which could be the reality in customer demand in the near future (Allen et al., 2012). Different trends regarding warehouse localization have been identified in different parts of the world and the following sections will review some of the ongoing trends that have been observed in different parts around the globe. The three locations presented in the following sections have different characteristics and different possibilities for last-mile deliveries. USA is a geographically large country and there are large variations in population density. France is located in central Europe and the capital city has a high population density, which is necessary to reach high efficiency in last mile deliveries (Cárdenas et al., 2017). The geographical characteristics of USA and France are quite different than Sweden, which is as previously mentioned sparsely populated. The intention with this chapter is to show differences and similarities in localization trends.

United States of America - North America

Between 2003 and 2013, some parts in USA have had an increase number of warehouses in metropolitan areas (Kang, 2017). One observed trend is the increase of decentralization in terms of employment of warehouse workers in decentralized areas. But in terms of the number of built warehouses there are no trends of decentralization. Kang (2017) argued that different trends can be seen in different parts of USA. In Los Angeles, there are many warehouses built in urban areas and close to highways. In San Francisco, warehouses are clustered around the San Francisco Bay area and north of the city. Many cities on the west coast of USA have several clusters of warehouses. In Sacramento, a trend can be seen that warehouses are clustered in the central business district area as well as along the highway corridors. In San Diego, warehouses are mostly located along the coast. San Diego was the only city on the west coast in USA that did not have an increase of warehouses in urban areas (Kang, 2017).

France - Europe

In the Ile-de-France region, including the capital city Paris, the logistics sprawl is obvious (Diziain et al., 2012). The authors analyzed different warehouses and categorized them in five different categories based on regional patterns. Large peripheral multimodal warehouses were classified as level 1. Level 2 warehouses included medium-sized facilities, often located in logistics clusters. Urban gateways, often located within a range of 5 to 10 kilometers from the city center, were defined as Level 3 warehouses. Urban warehouses within the city center,

approximately sizing 7,000 to 20,000 m^2, were classified as level 4. Finally, level 5 warehouses are for small last-mile deliveries with a size of 500 to 5,000 m^2, located on central buildings' ground-floor or underground. In the studied region, the authors found warehouses in four out of the five categories - no level 4 warehouses could be identified (Diziain et al., 2012).

The different levels of warehouses face different challenges. Smaller, urban facilities often face challenges with operating within a dense and well-balanced network, meanwhile the urban gateways struggle with successful consolidation and maintaining current locations and sites, which are threatened by future urban growth (Diziain et al., 2012). In general, urban warehouses have low priority and e-commerce companies cannot afford as high rental costs or land costs as other industries, due to low margins and low profitability (ibid.). Another challenge logistics operators face is resistance from public authorities and decision-makers in the region. According to Diziain et al. (2012), regional authorities are resistant to the development of new warehouses in urban areas and eager to limit the road freight movements, in order to decrease negative environmental impacts and congestion stemming from freight transportation.

Sweden - Europe

Sweden's second largest city, Gothenburg, is an important logistics hub for both the region and the country (Heitz el al., 2018). Gothenburg is a medium-sized city with quite low density, but both the largest port in Scandinavia and many other large logistics operators are located in the region (ibid.). Heitz et al. (2018) studied the development of warehouses in the Gothenburg metropolitan area, comparing and analyzing locational data of warehouses between 2000 and 2014. One of the findings was an increase in the number of warehouses, 57 percent increase in the metropolitan area and 45 percent increase in the region (Heitz et al., 2018). According to the authors, this development is in line with other case studies in different parts of the world and illustrate that the supply chains nowadays require a larger number of urban facilities (ibid.)

Another finding in the case study of Gothenburg is the locational change over time. The general trend of logistics sprawl was observed, as the mean distance between warehouses and the city center has increased, both in the metropolitan area and the region (Heitz et al., 2018). The authors argue that this medium to high level of urban sprawl indicates that cities with similar characteristics as Gothenburg may continue facing the phenomenon of logistics sprawl (ibid.).

Summary of geographical trends

The previous sections have shown different geographical trends regarding warehouse localization in different parts of the world. Both logistics sprawl and urbanization of warehouses have been identified in previous research, but the studies from different regions mainly show that logistics sprawl continues to dominate. Next chapter will review different specific factors that impact the choice of warehouse location, identified by researchers within the field.

2.4 Identified factors that impact warehouse localization

Many factors impact the choice of location of warehouses and logistics operators have to make trade-offs regarding these aspects (Heitz et al., 2019). According to Kang (2017), different characteristics and features in different areas affect the choice of location. What is prioritized

when deciding on an optimal location of a warehouse according to Kang (2017) is freight volume and land price distribution. Jakubicek and Woudsma (2011) explored the relationship between importance and satisfaction regarding facility location within the logistics industry. As illustrated in figure 2.1, there were both negative factors that tend to push companies away from the location, and positive factors that made companies stay, that was identified in the study. Depending on the level of satisfaction and level of importance the different factors have it has different effects on choice of location.

	LOW SATISFACTION	**HIGH SATISFACTION**
LOW IMPORTANCE	NEUTRAL EFFECTS	SLIGHTLY RETAIN
HIGH IMPORTANCE	PUSH FACTORS	RETAIN FACTORS

Figure 2.1 The relationship between importance and satisfaction (from Jakubicek & Woudsma, 2011)

Heitz et al. (2019) claimed that previous research has analyzed different warehouses from a holistic point of view and argue that there is missing a diversification in the heterogeneous warehouses. It is argued that the facilities are different in their preferences and needs and generate different spatial trends (ibid.). The following sections will review different factors that could impact the choice of warehouse location that has been identified in previous research.

Space requirements and costs for land

In a study conducted by Jakubicek and Woudsma (2011), most respondents replied that costs for land and tax rates were the most important location factors. In agreement, Kang (2017) stated that in many regions in USA after the year of 2000, low land prices are higher prioritized than proximity to customer market and access to labor force when choosing location.

An ongoing trend is the increasing size of warehouses, due to more integration of operations, improved pooling of logistical flows and increased e-commerce (Heitz & Beziat, 2016). Aljohani and Thompson (2016) stated that new operational requirements, due to rapid growth in global trade, e-commerce development and new methods such as Just-in-time, have changed the logistics industry. The restructuring of supply chains and the globalization of supply chains have also led to a need of larger and automated warehouses which has then led to a need of re-localizing warehouses (Kang, 2017). With the new operational requirements, logistics companies demand fewer, but larger facilities within 10,000 to 100,000 square meters (Hesse, 2004; Cidell, 2010; Leight & Hoelzel, 2012, see Aljohani & Thompson, 2016). As a result of these trends, many warehouses require large areas of land as normal facilities are sizing over 50,000 square meters (Dablanc, 2014). Aljohani and Thompson (2016) emphasized that land costs in urban areas have become too expensive to allocate warehouses on and show that suburban locations can compete with substantially lower costs for land.

Access to transport infrastructure

Jakubicek and Woudsma (2011) found that proximity to highways was highly valued in their study. The proximity to highways received the third highest average score of importance in the

researcher's' study and it was explained by the large usage of trucks as mode of transport by the respondents (ibid.). Dablanc (2007) argued that companies within the logistics industry tend to locate their facilities as close to highway networks as possible, but also in proximity to airports. In the study by Jakubicek and Woudsma (2011), it was found that proximity to airports was not a very important feature among their respondents. Proximity to seaports or intermodal yards for railway transportation was also not considered as an important location factor (ibid). However, Kang (2017) argued that the growth in international trade is one reason for decentralization. For international trade, it is more important for companies to have warehouses in proximity to seaports or airports, compared to distribution companies serving the local market (ibid.).

Access to employees

Besides the physical characteristics of the geographical location, Heitz and Beziat (2016) stated that access to a low-skilled job market is important for companies when locating warehouses. Although a remote location might result in low costs for the land, it might be troublesome with the staffing of the warehouse. In the study by Jakubicek and Woudsma (2011), the results showed that the access to skilled workers was prioritized in comparison to the access to unskilled workers, which differs from the results of Heitz and Beizat (2016). The authors suggest that the movement towards more automation in warehouses and warehouses could be the reason for a changed demand in the labor force (ibid.). The availability of skilled labor was highly valued and the lack of access to skilled workforce was defined as a likely push factor.

Access to customer market

Access to major customers or important customer markets are considered to be important factors for logistics operators (Jakubicek & Woudsma, 2011). Further, Hesse (2008, see Jakubicek & Woudsma, 2011) argued that there is a trend towards locating facilities close to customers in order to ensure quick deliveries, but simultaneously as far away from expensive areas to minimize the costs for land.

Which market the warehouse is supposed to serve is another factor that impacts the choice of location (Kang, 2017). The author states that if the warehouse serves a local market proximity to customers becomes more important. If the warehouse serves a non-local market other factors such as low land prices or proximity to road infrastructure becomes more important than proximity to customers (ibid.).

The role of public stakeholders

Companies in the logistics industry cannot choose to locate their facilities anywhere, as they are dependent on available land and zoning of commercial and industrial land, regulated by local or regional authorities (Aljohani & Thompson, 2016). Very small parts of urban areas are available or suitable for logistics operations, as they tend to be too costly (ibid.). Aljohani and Thompson (2016) argued that improved understanding of the impacts of logistics sprawl would result in more policies and urban planning to re-integrate warehouses in central areas, as the freight movements in urban areas have rapidly and substantially increased.

Other factors

Another factor that could impact the choice of location for companies in the logistics industry is the possibilities to operate around the clock, without any restriction for nighttime operations (Jakubicek & Woudsma, 2011). This ability was viewed as “Extremely important” by most of the respondents in a study conducted by Jakubicek and Woudsma (2011). The municipality’s views and priorities regarding logistics operations are also aspects to consider when choosing location, as Gordon (2005, see Jakubicek & Woudsma, 2011) claimed that municipalities tend to restrict and regulate instead of understanding the needs.

Besides rules and regulations, physical characteristics of the location were also found to impact the choice of location (Jakubicek & Woudsma, 2011). Available land for future expansion, number of dock doors, trailer parking areas and truck staging areas are features that companies could assess before choosing the location (ibid.). Another aspect is the last mile cost, which could be of large importance when deciding on location of a warehouse (Kang, 2017). A more rural location could lead to higher transportation costs and especially higher last mile costs (ibid.).

2.5 Summary of the literature review

E-commerce as a sales channel is quite different than traditional sales channels due to its complexity with small consignments to many different addresses with limited time windows for delivery. This complexity makes the normally inefficient last-mile deliveries highly important (Yu et al., 2017). The combination of increased volumes and demand for faster deliveries make the geographical location of warehouses important in order to maintain high service level to the customers.

Previous research has shown that many different factors are important to consider when locating logistics facilities. Costs for land, distance to transport infrastructure, distance to customer market, access to employees and possibilities for operations around the clock are some of the found factors of importance. For e-commerce companies, distance to customer market could be one of the most important factors, to manage fast deliveries.

Road transports impacts the environment negatively as it contributes to emissions, pollution, congestion and noise to mention a few aspects. Increased volumes of sold goods through e-commerce generate an increase in vehicle kilometers and number of trips. Some researchers, there among Al-Mulali et al. (2015) argued that the negative externalities that e-commerce contributes to will continue to have a negative impact until distribution of parcels reach higher efficiency and replaces personal shopping trips to a larger extent.

3 Methodology

The purpose with this section is to describe the formation of the study and the methodology choices that are the foundation of the study. The data collection process, both quantitative and qualitative data, is described in detail and the execution of the interviews are presented. The process of the literature study that was performed in the initial stage of the creation of the thesis is also described. Finally, the chapter is wrapped up by some methodology criticism, analyzing aspects as validity, reliability and generalizability.

The initial chapter in this thesis provides the reader with an introduction to the topic, the study is motivated by a problem discussion which is followed by the thesis purpose, research questions and scope. In the second chapter, the executed literature review is summarized and relevant theories presented. This chapter, chapter three, describes the formation of the study, methodology choices and criticism. The fourth chapter presents the findings from the quantitative and the qualitative study. This chapter includes many figures and graphs. The results are followed by an analytical discussion in chapter five, based on the findings of this study and previous research. In the sixth and final chapter, conclusions and suggestions for future research is presented. Besides the six main chapters, the thesis also includes an abstract, acknowledgements, table of content, list of figures, list of tables, reference list and three appendices.

3.1 Formation of the study

Currently, there are several trends and changes that can have an impact on where online retailers choose to locate their warehouses. To find out what trends and changes that have an impact on where to locate warehouses a study of where online retailers have chosen to locate them was made. What was also studied is how many customers that can be reached within different time horizons from the warehouses. Furthermore, it has also been studied why companies have chosen to locate their warehouses on a specific location. Firstly, a literature review was made to get an understanding of which factors could impact the choice of location today. Secondly, the study's purpose was determined and three research questions were formulated.

After the literature review and the formulation of purpose and research questions, data collection of the largest e-commerce companies in Sweden was initiated. E-handel.se (2018) provided a list of the 100 largest e-commerce companies in Sweden by the year of 2017 in terms of revenue. Warehouse coordinates, distance to transportation infrastructure, size of warehouse and turnover of the companies on the list were collected. The companies were categorized in different commodity categories based on the type of products the company sells.

To obtain a deeper understanding of what trends and changes that have an impact of online retailer's location of warehouses, four interviews with representatives from large e-commerce companies was executed. The purpose with the interviews was to understand why online retailers have chosen to locate their warehouses or distribution centers in a specific area. When the data was collected and interviews had been held, all relevant data and information were compiled in the thesis' fourth chapter. After summarizing the findings, the compiled data and information were compared with the literature review and elaborated on in the analysis chapter. Finally, conclusions based on the analysis are presented in section five, in which the research questions are being answered and therewith the purpose fulfilled.

3.2 Method choices

In order to fulfill the purpose and to be able to answer the previously formulated research questions, this thesis is built upon both quantitative and qualitative method choices. Research question one will be answered by quantitative data analysis and research questions two and three will be answered by qualitative interviews.

Mixed method

To fulfill the purpose of the study and answer the research questions a mixed method has been used, a quantitative study and a qualitative study have jointly been conducted. The reason a mixed method was chosen was to both study what ongoing trends regarding warehouse localization there are in Sweden as well as understand the underlying reasons for why these trends have occurred. Bryman and Bell (2013) argued that a mixed method can be used to strengthen the positive aspects and avoid the negative aspects of each method. However, even though mixed method studies are becoming increasingly more common, many researchers remain critical to this method and claim that the mixed method is not better than a strict qualitative or quantitative approach (ibid.). Bryman and Bell (2013) argued that a mixed method is a suitable choice when neither a qualitative nor a quantitative study can fulfil the study's purpose. This thesis purpose is to understand where and why e-commerce companies locate their warehouses, which requires a mixed method approach.

Quantitative approach

In the quantitative method part of this study, data of the 100 largest e-commerce companies' warehouses in Sweden were collected. The companies that were chosen are listed as the largest e-commerce companies of 2017 by the website ehandel.se. Some of the companies on the list sell goods through other channels, such as showrooms or pop-up stores, but the majority of their sales stems from the e-commerce sector.

Secondary data in the form of geographical location of warehouses have been retrieved mainly from Google Maps and relevant articles about the e-commerce companies. Other ways of collecting data of the geographical location and size of online retailers' warehouses have been to use the search engine Google as well as searching for addresses on online retailers' web pages. If the data could not be retrieved by using different search engines, customer service of the different companies was contacted either by phone, e-mail or companies web pages. To find the data needed for the study, articles about the e-commerce businesses have also been used. The search engine Retriever Business has also been used to collect relevant data. Retriever Business is a search engine that provides data from Swedish companies in the form of for example annual reports (Gothenburg University Library, Retriever Business, 2019).

The choice to use different search engines to collect the needed data could have a negative impact on the validity of the data. However, using different search engines and comparing results was considered as the most valid and accurate way of collecting the needed data. The option of contacting all companies and retrieve the data from an employee at the company was also an option but considered as too time consuming and a high risk of a low answer frequency. Therefore, the choice to mainly use different search engines for collecting quantitative data was made.

The sample consists of warehouses belonging to the 100 largest e-commerce businesses in Sweden. The sample size is considered as a large sample size since you need minimum 30 samples to get a sample that can be generalized across the population (Collis & Hussey, 2013). The population in the study is e-commerce companies with warehouses in Sweden. To collect data from all companies in Sweden that are involved in e-commerce is impossible since it is changing daily. The choice to use the hundred largest companies was made on the basis that it would provide the most relevant answers. E-commerce companies can range from global companies with enormous warehouses to smaller companies with minimal warehouses. This could be exemplified in the long-tail distribution phenomenon (Cortinhas & Black, 2014), meaning there are some large actors and a large number of smaller firms. In general, the larger the company the more sales and customer orders, which result in a higher need of strategically located warehouses.

To fulfill the purpose of the study, an assortment of the dataset was run through a Geographical Information System (GIS), which is a cartography system were maps with different data are compared (Gold, 2006). In this study, Trafikverket's map of the road network in Sweden was compared with a map of the population in Sweden. Combining these maps, data of what share of the population that could be reached within different time intervals were extracted. As the transportation time between a warehouse and an end-customer only is fraction of the total lead time, the time intervals chosen are short. The total lead time from order placement to delivery include several different activities, for example picking, packing, loading and unloading operations. This means that short transportation time increases the probability to manage same-day delivery. The chosen time intervals are 15, 30, 45, 60 and 90 minutes. The output from GIS was analyzed with the other variables in the dataset.

Qualitative approach

In general, qualitative data is considered to have high validity and reliability (Collis & Hussey, 2013). Interviews can be executed in different ways; in person, via telephone or via web-based methods online (ibid.). Some negative aspects with collecting qualitative data and interviews are that it tends to be costly and time-consuming, especially when interviewing face-to-face, but is the preferred method when the data is complex or of sensitive character (ibid.). Using web-based methods could reduce travelling costs but there is a risk of losing the personal contact. Based on the suggestions by Collis and Hussey (2013), this study includes qualitative data in form of in person interviews with four representatives from large e-commerce companies.

To keep the interviews within the topic, warehouse localization, but also giving the respondents a chance to elaborate on the questions semi-structured interviews were held. There are different ways to prepare and execute interviews and interviews can have unstructured, semi-structured and structured character (Collis & Hussey, 2013). While unstructured interviews do not include any formed questions prior to the interview, structured interviews are the opposite and the interviews follow a strict list of questions with no deviations (Collis & Hussey, 2013). Semi-structured interviews are in-between, meaning that the respondent is allowed to speak freely, but the interviewer has some questions prepared in order to keep the conversation within the topic (ibid.). The semi-structured approach gives the interviewer some flexibility and opportunities to ask follow-up questions when the respondent shares an interesting idea or concept, in which the interviewer wishes deeper elaboration. Challenges with unstructured

interviews are that there is a risk of being time consuming and a risk for deviating from the subject but could be to prefer when the subject is commercial sensitive, or the purpose is to understand personal concepts or ideas (ibid.). In the held interviews of this study, the semi-structured approach was used and an interview guide was created as a framework prior to each interview, which is further described in section 3.4.

Prior to the interview an interview guide was formulated. The prepared questions in the interview guide aimed to be formulated as open questions. The interview guide was also sent on beforehand to the respondents to allow them to prepare and understand what information that was wanted. Open questions cannot be answered by a yes or a no and require longer, more elaborated answers (Collis & Hussey, 2013) and the reason for formulating open questions was that those questions are more meaningful and interesting. The opposite, closed questions, can be answered by a yes or no answer, and more suitable when the purpose is to confirm facts rather than to understand a deeper context. In the interview guides, the pre-written down questions were formulated as open questions and closed questions were only used to gather specific facts or information.

3.3 Quantitative data collection - geographical data

The list of the largest e-commerce companies in 2017 from e-handel.se was submitted in a spreadsheet and the collection of other data begun. Relevant data that was collected was geographical information of the warehouses, size of the facility as well as main commodity type of the companies' sales and turnover. The commodities were divided into eight categories: Clothing & footwear, Electronics & computers, Furniture & homeware, Groceries, Health & beauty, Machinery & raw materials etc., Sports & leisure and Others. Commodities that cannot be classified in one of the seven first categories or have sales from many different categories were placed in the "Others" category. The reason for dividing the commodities into different categories was to see if there are any differences between the categories in terms of localization and warehouse size.

Initially, the idea was to collect other types of data, such as establishing year of the facility, usage of third-party logistics operator, ownership of terminal and company characteristics (manufacturing, non-manufacturing). However, these data were difficult to find with the time and resources available for the majority of the companies and were therefore eliminated. Some of the studied companies have more than one warehouse and in those cases, data from each warehouse was collected in separate rows in the spreadsheet.

The geographical data that was used in this study are mainly collected from Google Maps. The geographical data includes the coordinates, the mentioned distances and the facilities' areas, which were measured on the computer screens, using the satellite image and the measuring tool in Google Maps. Warehouses are in general squared shaped or rectangular, which makes it possible to calculate the facility's area. The measuring method gives an estimate over the size and the measured area was rounded off to the closest hundred square meters. Additionally, searches about the companies' warehouses were made and newspaper articles with information about the size of the warehouses were found for the largest companies. This information was also noted in the spreadsheet and compared to the measurement method. If there was a large difference between the observed area and the area stated in an article, further investigation was made to determine which area that was the most accurate. In an

attempt to divide the warehouses by size, it was also noted in which of the following size category the facility belonged: [1] 0 to 2,499 m^2, [2] 2,500 to 4,999 m^2, [3] 5,000 to 7,499 m^2, [4] 7,500 to 9,999 m^2 and [5] 10,000 or larger m^2.

Other, non-geographical data, such as company revenue were presented in the initial list by E-handel.se. The revenue was verified by checking the companies' annual reports from 2017, which were retrieved from the database Business Retriever. Initially, the idea was also to collect data about number of warehouse employees, in order to investigate the potential output for the specific warehouses. However, financial information and other company reports only indicate the total number of employees, including headquarter staff and other functions not directly related to the warehouse operations. Furthermore, some warehouses are fully automated, with only robots operating instead of humans. The presence of robots and other diversities in warehouses contributes to making this aspect more complex. The information about a company's total number of employees is not relevant for this study and therefore deliberately left out. A sample of the data that was collected is illustrated in table 3.1 and the full list of the gathered data can be found in appendix 1.

Size (1-100)	**Company name**	**Main commodity (category)**	**Coordinates**	**Size category of warehouse, m^2**	**Proximity to… E4 (<5km) 0 or 1**
1	Dustin	Electronics & computers	59.571919, 17.876209	[5] 10,000+	1
2	Cdon.com	Electronics & computers	56.818187, 13.901006	[5] 10,000+	1
...					
100	Däck365	Machinery, raw materials etc.	56.500246, 13.021211	[1] 0-2,499	0

Table 3.1 Illustration of the quantitative data collection

Out of the 100 largest e-commerce companies, data of 95 warehouses belonging to 84 companies were included in the sample. Eight companies have more than one warehouse and 16 companies were excluded from the sample. Reasons for the exclusions as presented in the following section. The companies with more than one warehouse are Mathem, Jollyroom, Linas matkasse, Mat.se, CarpetVista/Rugvista, Ellos, Jotex and Stayhard. The study will be based on the capacity of each warehouse and not per company. Some of the mentioned companies' warehouses are located in proximity to each other, which makes it difficult to calculate the company's total population reach, as these areas are likely to overlap. Only the warehouses of Mathem and Mat.se are located with large enough distances to avoid overlapping of population reach. Considering this challenge, analyzing the warehouses separately gives the most valid result with the limited time and resources. Ellos Group have five warehouses, all located in proximity to each other, and the warehouse area is shared by Ellos, Jotex and Stayhard. Due to the small distance between the warehouses, the coordinates belonging to the main warehouse is used for Ellos, Jotex and Stayhard. The population reach would not differ if the five warehouse coordinates would have been used.

Companies were excluded by various reasons. One company uses multiple sales channels, including several physical stores, which the majority of the sales stems from. This led to exclusion. There were other companies with more than one sales channel, for example

temporary pop-up stores. Those companies have the majority of their sales stemming from e-commerce and were considered to be relevant for this study. Four companies do not have a warehouse or only uses drop-shipping, which led to exclusion. Additional four companies were excluded from the sample as the location of the warehouses could not be identified. Five companies have warehouses located outside of Sweden, which led to exclusion as this study focus on warehouses within Sweden. One company has its warehouse located far north in Sweden, which makes it an outlier and was therefore excluded. Finally, one company on the list could not be identified.

For three warehouses, the facility size could not be identified and when inserted in GIS, the warehouse size was set to 0. These three warehouses will be included in the data in the same category as the smallest warehouses, 0 to 2,499 m^2. The exact coordinates for one warehouse could not be identified, but the approximate area of location was found through articles and the coordinates that were chosen for the company is an estimate. However, the discrepancy between the estimated location and the real location is not likely to have a large impact on the results as the transport time between the two locations is considered not to be significant.

After completing the data set, it was possible to make a geographical analysis of the warehouses. Two geographical variables in the dataset, coordinates and warehouse size, were run through GIS together with an ID number for each warehouse. The GIS output was a table that showed all warehouses population reach within different time intervals: 15, 30, 45, 60 and 90 minutes. 24 of the 95 warehouses showed a population reach of zero or the same population reach for all time intervals, which is not accurate. In these cases, the GIS system lacks complete data over the road network and some roads are missing and not connected in the data system. For these warehouses without correct data, the data from the geographically closest warehouse in the sample were used.

3.4 Qualitative data collection - interviews

To be able to answer research questions two and three, deeper understanding and elaboration of the aspects that impact the choice of location among Sweden's largest e-commerce companies were considered to be vital. Qualitative interviews were chosen as the most suitable method to achieve higher understanding of the reasons behind companies' localization and thoughts about the future, as a complement to the quantitative data collection described in section 3.3. Suitable representatives from large e-commerce companies were contacted by e-mail and asked about their willingness to participate in the study. In the email, the purpose with the study was briefly described and the duration of the interview was estimated. The intention in the beginning of this study was to execute as many in-person interviews as possible instead of other types of interviews. The idea was to limit the geographical area of the respondents to the region of Västra Götaland, due to time and resources limitations. The intention was revised as the willingness to participation was low as well as the reply rate. Therefore, interviews with all companies that were willing to participate in the study were held, both via telephone and in person. Telephone interviews were held when the respondents were located in a different region than Västra Götaland or when the respondents specifically asked for a telephone interview due to time limitations. After one week from the first e-mail request, a reminding email was sent out to each company contacted the first time. 21 inquiries were sent out and representatives from four companies choose to participate in the study, which is a participation rate of 19 percent.

If the candidate responded favorable, time and place for the interview were decided. The interviews were semi-structured and an interview guide was created prior to the interviews. If the respondents would have represented different stakeholders or actors within the urban logistics, different interview guides for each interview would have been necessary. However, due to the respondents' homogeneity, one interview guide was considered to be sufficient. The interview guide can be found in appendix 3. The purpose with using a semi-structured approach was to give the respondent some flexibility to discuss or elaborate on certain topics that could enlighten interesting approaches that otherwise would be missed, but still maintain a certain structure to avoid a complete deviation from the topic.

The interview guide was sent to the respondent before the interview in order to ensure that the respondent was well prepared and ready to answer questions and share ideas within the main topic. Before the interviews started, the respondents were asked if they accepted that the interview was recorded. The purpose with recording the interviews is to have the possibility to listen through the interview afterwards if there is need for any clarifications on what the respondent stated. Additionally, before the interviews started the respondents were informed of the possibility of responding anonymous. The choice of responding anonymous was considered to be more important than losing important data or information. All respondents consented to having the interview recorded and to participate with their full name and position at their company. Table 3.2 summarizes the held interviews.

Interview No.	**Name of respondent and position**	**Company**	**Commodity category**	**Date & duration (Location)**	**Type of interview**
1	Anton Hellström, Supply chain manager	Bokus	Others	2019.03.14 30 minutes	Telephone
2	Niklas Venhagen, Logistics developer	Ellos	Clothing & footwear	2019.03.20 60 minutes (Borås)	In person
3	Pär Svärdson, CEO	Apotea	Health & beauty	2019.03.27 45 minutes	Telephone
4	Niels Hemmingsen, COO & Veronica Sundström, Distribution and Logistics Manager	Boozt	Clothing & footwear	2019.04.02 30 minutes	Telephone

Table 3.2 Summary of held interviews.

The companies that were interviewed represent three of the eight categories regarding commodity type: Clothing & footwear, Health & beauty and Others. Ellos, Boozt and Apotea are among the ten largest e-commerce companies in terms of turnover and Bokus is the 26th largest. The representatives from the companies have plenty of working experience and knowledge within logistics and e-commerce, which makes them suitable interviewees.

3.5 Construction of literature review

In the beginning of this research process, previous research within the field was reviewed in order to increase the understanding of relevant phenomenon, trends, concepts and ideas. The search engine “Supersearch” provided by Gothenburg University Library was primary used to find peer-reviewed articles, as those are regarded as trustworthy sources of information. Another search engine that was used to find relevant information about the topic was Google Scholar. Encyclopedias like the Swedish NE was also used to find distinct definitions of certain important words and terms. Many different words and combination of the words were used to gather information and some examples of word combination that were used were “urban sprawl + logistics”, “city logistics + freight transports”, “e-commerce + challenges + logistics”, “environmental impacts + urban freight transports”.

The literature review is based on relevant articles and books. To ensure the validity of the articles and books many different articles and books about the same subject have been compared and used in the literature review. Recently written and peer reviewed articles have mainly been used. When possible, more recent articles were chosen over older articles because the study is focused on finding current trends of location of warehouses. Trends can change quite rapidly over time, which gives recently published articles higher importance and relevance to the subject. Firstly, the abstract and conclusion was read in order to determine the article’s relevance for this thesis. If the article passed the first examination, the full article was studied. When interesting data or information was emphasized in an article and referred to a previous study, an attempt to find the original source of information was made to ensure the rightful interpretation.

3.6 Methodology criticism

This thesis aims to analyze the location of Swedish e-commerce companies’ warehouses and one aspect that could impact the study’s validity negatively is the fact that the chosen interviewees are very few. There is a risk that the interviewed companies have certain preferences or restrictions that does not account for the entire population. Therefore, the sample might not be completely representative for all e-commerce companies in all regions of Sweden or for all different line of businesses in e-commerce. The reasons behind this limitation is as mentioned previously due to limitations in time and resources.

What further could impact the validity of the data is that a large share of the quantitative data collected is from secondary sources, for example addresses from Google Maps and company information from newspaper articles. However, Google Maps is one of the most used free to access and web-based mapping tools (Cipeluch, Jacob, Winstanley & Mooney, 2010) and in general seen as an accurate tool as it is frequently updated. The choice to use secondary sources to collect the quantitative data was made because it was the only option where all required data could be collected within the time frame of the master’s degree project and did not result in any costs.

Since the study is based on a limited geographical area, the results of the study can only be generalized to geographical areas with the same features. By comparing the results of the study with the literature review an understanding of what parts of the result of the study can be generalized across other geographical areas. The focus of the study is on the specific e-

commerce industry, which differs from traditional retailing multi-channel and omni-channel retailing. There are different challenges, needs and preferences which means that the results will not be generalizable for companies with different sales channel approaches. However, high generalizability across different sales channels is not the aim of this thesis as the focus is rather on studying a specific phenomenon within geographical localization in a specific context.

The quantitative sample is considered large enough to represent the e-commerce company industry's population. However, a sample with more than 30 warehouses in each of the reviewed aspects that could impact warehouse location would have been preferable. It would have made it possible to draw conclusions on the effects the variables would have on population reach. Warehouse size, commodity type and closeness to transport infrastructure are divided into several sub-categories. Although this would have been desired, the possibilities to do this are limited since it would have required a much larger sample. To collect a larger sample, it would have been required to increase the scope of the study to a larger geographical area and include e-commerce companies in other countries.

In the qualitative part of this study, four large companies were interviewed. The interviewed companies represent three of the eight different categories of commodities and are located in different parts of Sweden. Preferably, additional interviews should have been held to further increase the study's validity, for example with representatives from all commodity categories. However, 21 inquiries were sent out, but only four companies choose to participate, but the participation rate of 19 percent is regarded as sufficient. In the small sample of companies, there is a good geographical spread, located from Ängelholm in south to Falun in mid-Sweden, in Borås close to the Gothenburg area and in Morgongåva, close to the region of Stockholm-Mälardalen. The four representatives have many years of experience working with logistics and e-commerce and the knowledge and insights made them suitable candidates to interview and it also contributed to improving the study's validity.

Out of the four interviews, three interviews were telephone interviews and one was a personal interview. Bryman and Bell (2013) stated that there are both advantages and disadvantages with each type of interview. Telephone interviews are in general more time efficient, less costly and could also make it easier to ask and answer sensitive questions (ibid). However, by conducting telephone interviews, the possibility to notice and interpret body language and mimics is eliminated and this could according to Bryman and Bell (2013) have a negative impact on the communication. Additionally, technical difficulties and disturbances were also mentioned as disadvantages. In this study, telephone interviews were the only feasible option for three of the interviews due to long distances and other limitations. To minimize the risk of technical disturbance, the telephone interviews were conducted in a location with good cell phone reception.

There is always a risk of receiving biased information when collecting qualitative data from respondents with different interests (Collis & Hussey, 2013). In this case, companies might not be willing to share information about negative aspects, such as weaknesses and challenges. If the data asked for is sensitive, for example data or information about customer market, companies might not be willing to share this with the researchers due to the risk of competitors taking advantage of this information. To minimize the risk for not receiving data or receiving false data due to sensitivity aspects, the respondents were informed of the possibility to anonymity. To minimize the risk of having biased information representatives from several

different companies have been interviewed and the questions were formulated with neutrality. In question 4C, the respondents could not see the variables they were asked to rank on beforehand when the interview guide was sent to them. The interviewees first received the options during the question at the interview. The purpose with masking the variables in question 4C was to avoid providing the respondents with aspects that they might not would have mentioned themselves in the previous questions 4A and 4B.

Another aspect that could impact the study's results is the time aspect. The e-commerce industry is changing rapidly and to capture all changes that occurs on the market in real-time is not possible in the frame of this study. The quantitative data used captures the momentary situation of the largest e-commerce companies in Sweden during 2017, which was the latest available data at the time of the data collection process. Reliability refers to the study's consistency and the possibilities to replicate the study and to achieve the same results (Collis & Hussey, 2013). As the methodology section is thoroughly described, the reliability of this study should be considered high. If the study is replicated in accordance to what is described, the same results are likely to be achieved.

4 Results

In this section, the results from the data collection are presented, starting with the quantitative data and continued with the qualitative data. The results from the quantitative data are visualized in figures and tables and described more thoroughly in text. The qualitative sections contain the findings from the held interviews, which are presented for each company separately.

4.1 Quantitative data results

The quantitative results are based on a sample of 95 warehouses. Figure 4.1 illustrates the share of warehouses in different size categories. Three percent of the warehouses have an unknown size, marked N/A in grey, 17 percent of the warehouses are within the size category 0 to 2,499 m^2, in yellow. 22 percent of the warehouses sizing between 2,500 and 4,999 m^2 are marked in orange and 16 percent of the warehouses within the range of 5,000 to 7,499 m^2 are visualized in pink. 8 percent of the sample are within the size category of 7,500 to 9,999 m^2 and illustrated in a purple color. The category of the largest warehouses represents 34 percent of the sample, all sizing over 10,000 m^2 and visualized in a dark blue color.

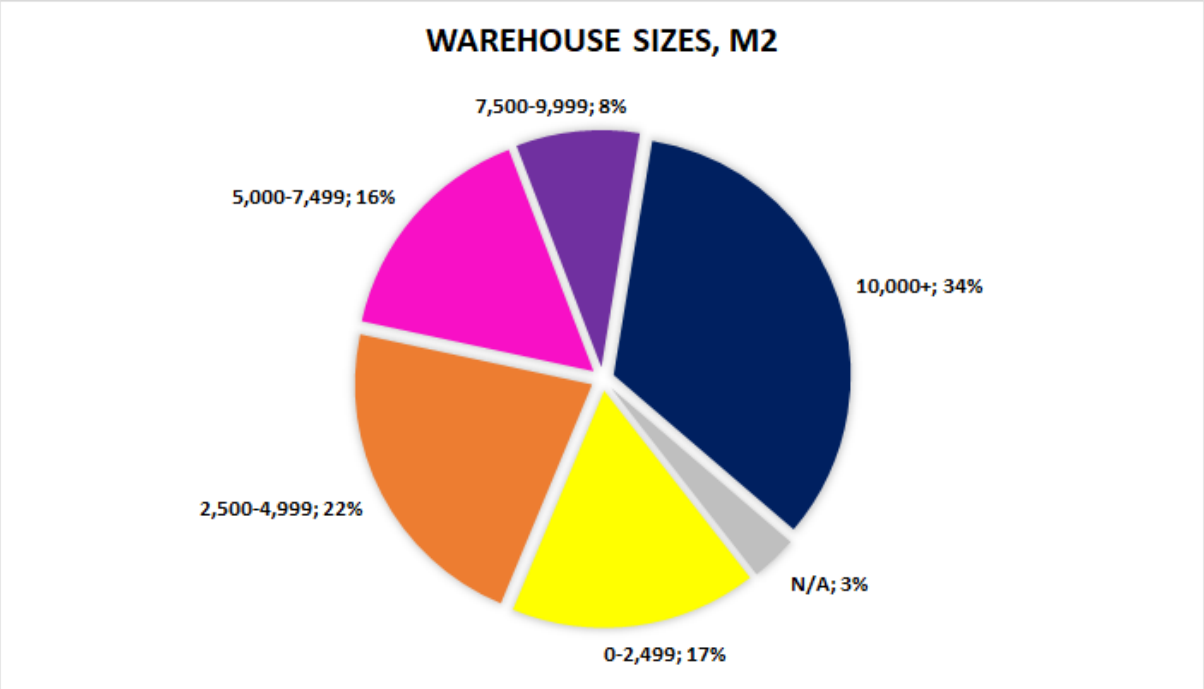

Figure 4.1 Size of each warehouse in the sample

The 95 warehouses were categorized in eight different categories, based on the main area of business, and are visualized in figure 4.2. “Clothing & footwear” was the largest category, together with “Others”, both representing 17 percent of the sample. Companies classified as “Others” have their main sales of products that do not fit into one of the other categories, for example books, children’s items, broderies and wrapping materials. “Health & beauty” and “Furniture & homeware” each represents 14 percent of the warehouses. Health and beauty includes sales of pharmaceuticals, supplements, make-up and similar items. 13 percent of the warehouses are categorized as “Sports & leisure”. 9 percent of the warehouses are within the category “Machinery, raw materials etc.”, which includes sales of building material, machines

and spare parts to vehicles. The categories “Electronics & computers” and “Groceries” are each represented by 8 percent.

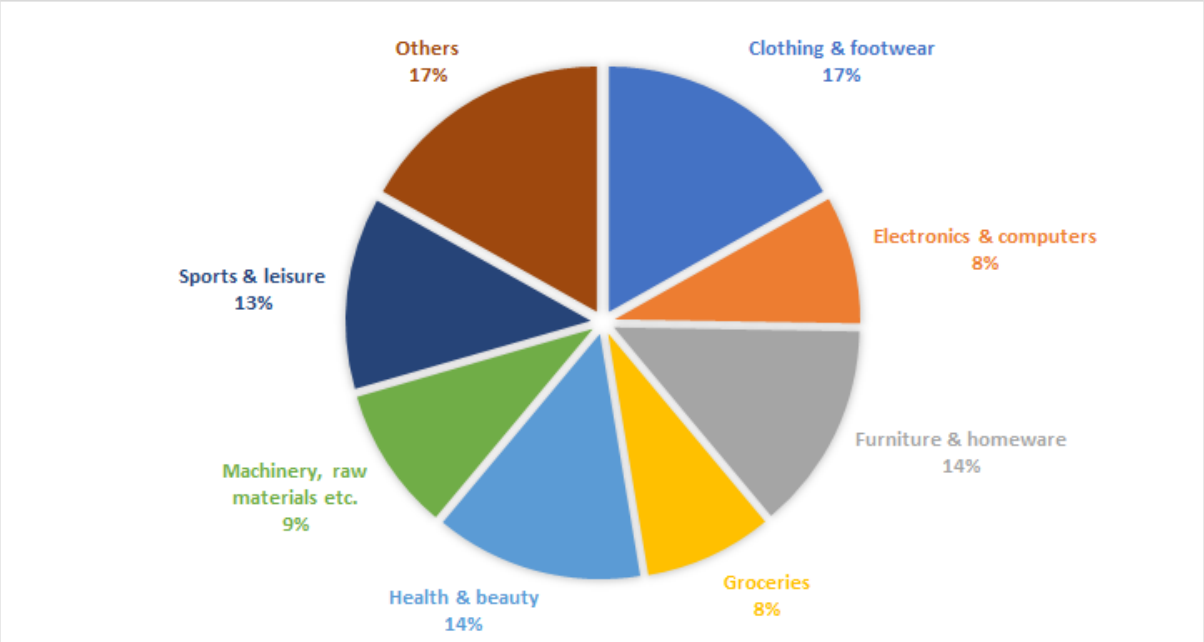

Figure 4.2 The warehouses in the sample divided into categories based on the company’s main sales

The geographical information system visualized the location of the warehouses in the sample, which can be found in figure 4.3. The 95 warehouses are illustrated by squares and marked with the different colors based on the facility size.

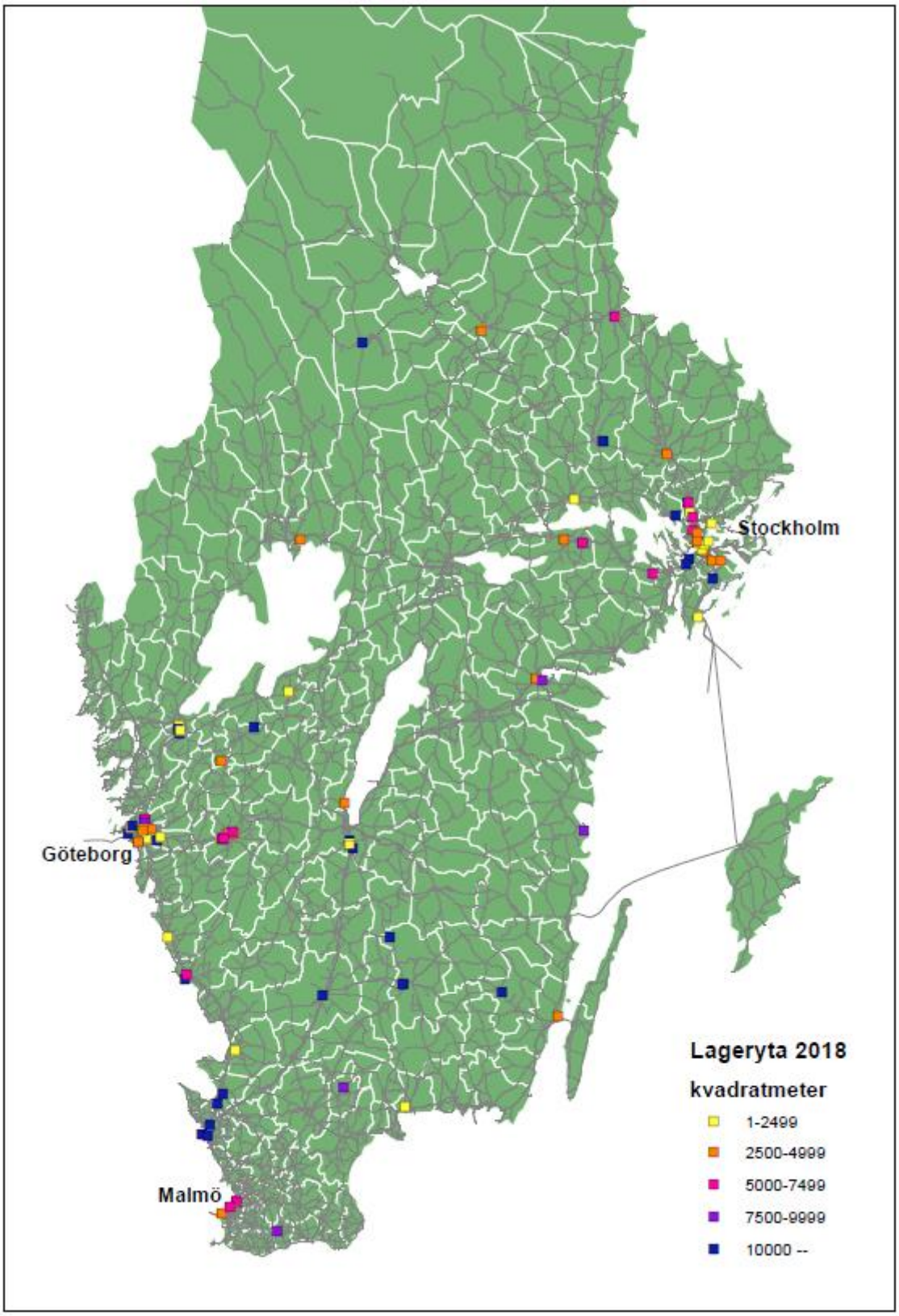

Figure 4.3 Location of the warehouses in the sample, showing different size categories

The visualization of the warehouses' location shows some primary areas of location. 15 percent of the companies in the sample are located within the municipality of Stockholm and if the area is expanded to include Stockholm-Mälardalen, 29 percent of the sample are located

within this region. This includes the nearby areas of Uppsala, Västerås and Eskilstuna. 25 percent of the sample are located within the large Gothenburg region, including nearby municipalities Borås and Mölndal. 13 percent of the warehouses are located within the Greater Copenhagen region, which includes Skåne. Table 4.1 shows the number of warehouses in the three areas with the highest density and how many of the warehouses in the sample that are located elsewhere.

Primary region	Number of warehouses	Percentage of sample
Gothenburg region, Including Borås and Mölndal	24	25%
Greater Copenhagen region	12	13%
Stockholm-Mälardalen region, Including Uppsala, Västerås, Eskilstuna	29	30%
(Stockholm municipality)	(14)	(15%)
Other areas	30	32 %

Table 4.1 The warehouses in the sample, divided in primary regions.

In different parts of the inland of Småland, a few larger warehouses are located. More than 170 kilometers north of Stockholm, three warehouses in the sample are located. The geographical location of the warehouses in relation to customers and transportation infrastructure will be presented in the following sections.

Distance to customers

Figure 4.4 shows the number of warehouses that can reach different percentages of the population within different time intervals. The population reach was divided into percentage intervals of 5, 10, 15, 20 and 25 percent. 89 percent of the warehouses can reach 5 percent of the population and 11 percent of the warehouses can reach 10 percent of the population within 15 minutes. Within a time interval of 90 minutes, 86 percent of the warehouses can reach 5 percent of the population and 77 percent of the warehouses can reach 10 percent. 42 percent of the companies can reach 15 percent of the population, 31 percent of the companies can reach 20 percent and 25 percent of the companies can reach 25 percent of the population.

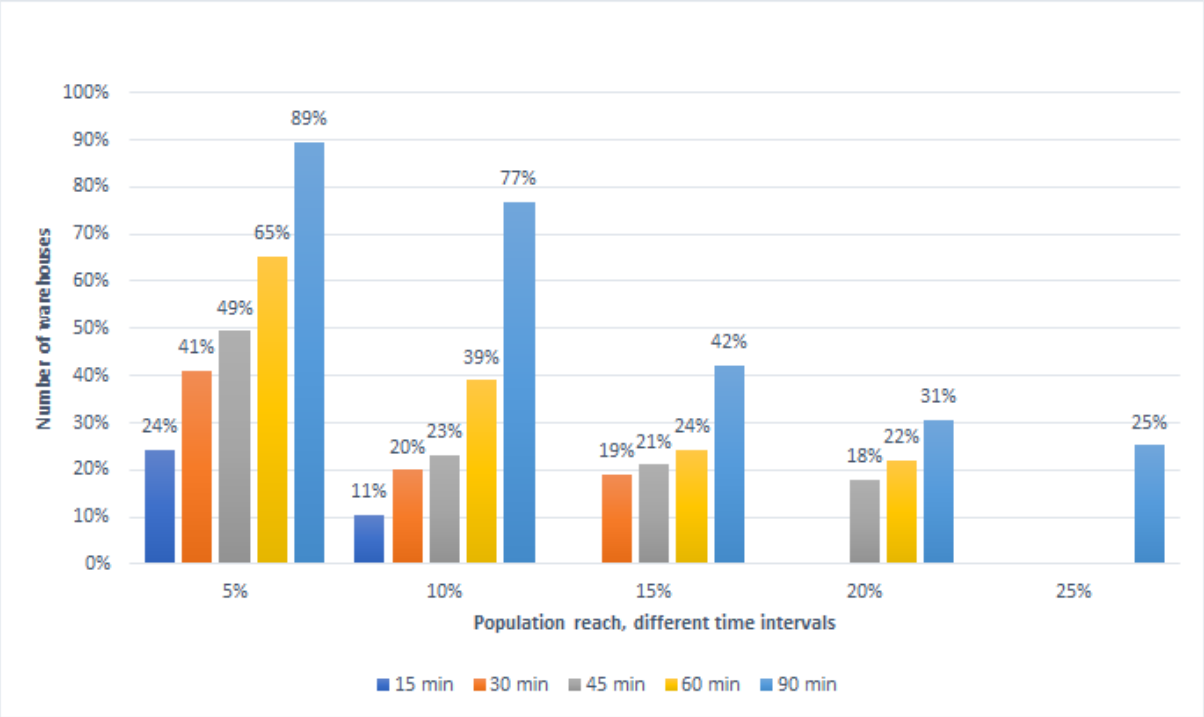

Figure 4.4 Population reach of the warehouses in the sample

The average population reach of the warehouses in the sample is 3,19 percent within 15 minutes, 5,84 percent within 30 minutes, 7,70 percent within 45 minutes, 10,01 percent within 60 minutes and 15,76 percent within 90 minutes as illustrated in table 4.2. The table also shows how the median value changes between the different time intervals and the largest reach for each time interval.

Time interval	Average reach	Median reach	Maximum reach
15 min	3,19%	0,94%	14,50%
30 min	5,84%	1,68%	19,47%
45 min	7,70%	3,97%	22,17%
60 min	10,01%	7,91%	24,01%
90 min	15,76%	15%	28,67%

Table 4.2 Mean, median and maximum population reach in the sample within different time intervals

Table 4.3 specifies the location of the warehouses and figure 4.5 geographically illustrates the location of the ten warehouses with the highest reach for different time intervals. The companies with the highest reach differ between the different time intervals, especially between 15 and 90 minutes. The companies that can deliver to the highest share of the

population within 15 and 30 minutes are located in close proximity to central Stockholm. All ten warehouses are located within 10 kilometers of the city center of Stockholm. Within 15 minutes, the ten companies can each reach between 11 to 15 percent of the population and within 30 minutes, the companies can reach between 18 to 20 percent of the population. Within 45 minutes, the ten warehouses with the best reach can reach between 21 and 22 percent of the population. In 60 minutes, the warehouses can reach around 24 percent of the population. Within 90 minutes, the ten warehouses with the best reach can reach approximately 28 percent of the population.

Largest reach	15 min	30 min	45 min	60 min	90 min
1	Stockholm	Stockholm	Sollentuna (Stockholm County)	Stockholm	Eskilstuna
2	Stockholm	Stockholm	Stockholm	Stockholm	Eskilstuna
3	Stockholm	Stockholm	Upplands-Väsby (Stockholm County)	Stockholm	Eskilstuna
4	Stockholm	Stockholm	Stockholm	Stockholm	Stockholm
5	Stockholm	Stockholm	Stockholm	Stockholm	Stockholm
6	Stockholm	Stockholm	Stockholm	Stockholm	Stockholm
7	Stockholm	Stockholm	Stockholm	Sollentuna (Stockholm County)	Stockholm
8	Stockholm	Stockholm	Stockholm	Stockholm	Stockholm
9	Stockholm	Stockholm	Stockholm	Upplands-Väsby (Stockholm County)	Uppsala
10	Stockholm	Stockholm	Stockholm	Stockholm	Stockholm

Table 4.3 The location of the warehouses with the 10 largest population reach within different time intervals

Within table 4.3, all locations within the municipality of Stockholm are defined as “Stockholm”. Warehouses located outside of Stockholm municipality, but within Stockholm county are marked by “(Stockholm County)”.

In Figure 4.5, the different marks visualize the geographical location of the warehouses with the highest reach within the different time intervals. The smallest marking shows the location of the warehouses with the best reach within 15 and 30 minutes, which are the same warehouses. The second largest marking shows the location of the warehouses with best reach within 45 and 60 minutes. There are some changes on these top lists, but the companies

located in the same geographical area, which explains the same marking in figure 4.5. The largest marking in figure 4.5 shows the geographical location of warehouses with the largest reach within 90 minutes.

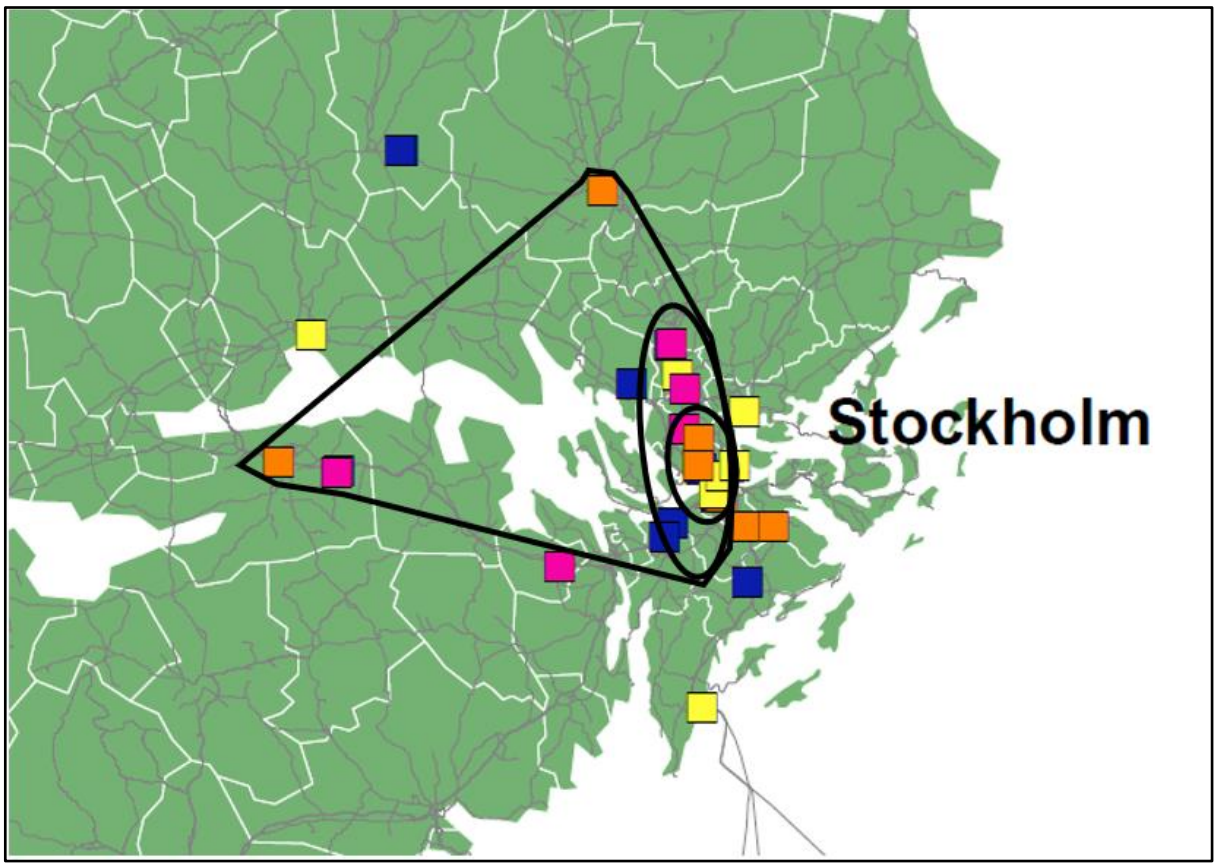

Figure 4.5 The geographical location of the ten warehouses with the largest reach

Warehouse sizes

68 percent of the warehouses in the sample are located within the three primary regions Gothenburg, Greater Copenhagen and Stockholm-Mälardalen. Figure 4.6 shows that some of the size categories are more common in some parts of Sweden than others. Comparing with the sample average, the Gothenburg region has a large presence of warehouses sizing between 5,000 to 7,499 m^2 and a lower share of warehouses sizing over 10,000 m^2. Within the Greater Copenhagen region, there are a substantial larger presence of warehouses sizing over 7,500 m^2 and no warehouses within the smallest size category. The Stockholm-Mälardalen region is quite similar to the sample average but has some additional warehouses within the smaller warehouse categories, below 5,000 m^2. For the warehouses located outside of the primary regions, in figure 4.6 shown as “Other”, there are a larger presence of facilities sizing over 10,000 m^2 and less medium-sized warehouses.

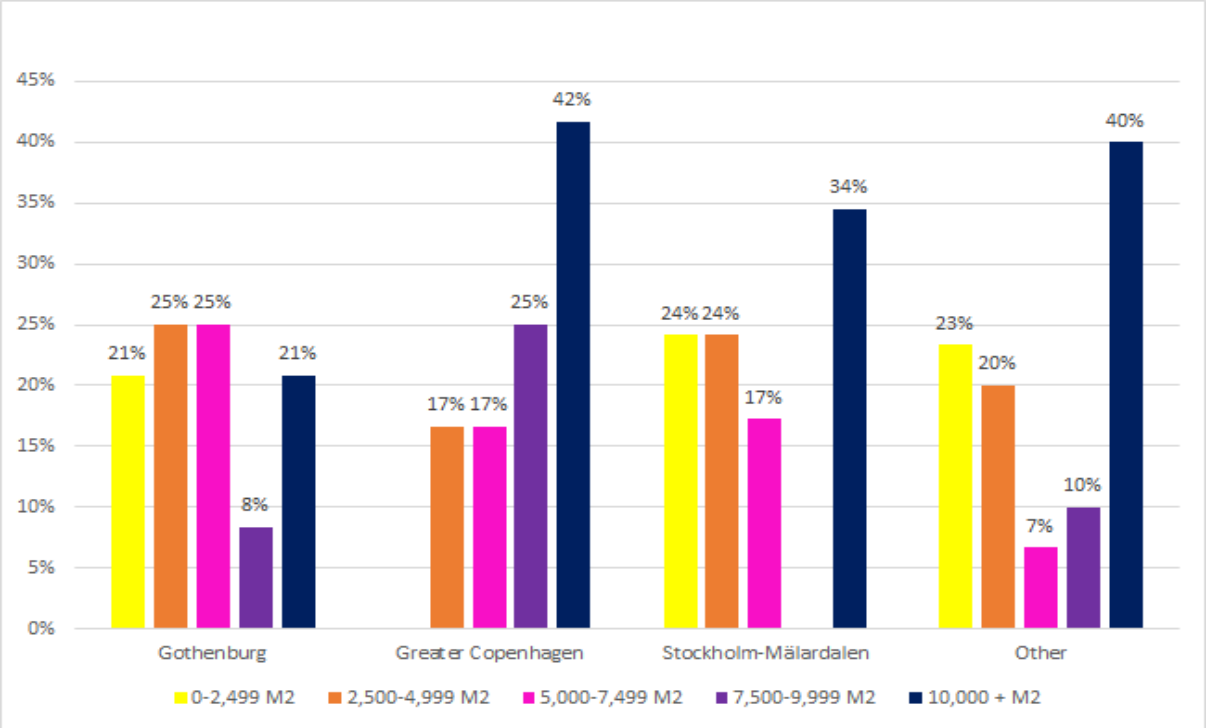

Figure 4.6 Warehouse sizes in different regions

As illustrated in figure 4.4, none of the warehouses in the sample can reach over 15 percent of the population within 15 minutes. The following graphs will show how the population reach is varies between different warehouse sizes. Figure 4.7 shows that within a time period of 15 minutes, 32 percent of the smallest warehouses and 38 percent of the warehouses sizing between 2,500 to 4,999 m^2 can reach 5 percent of the population, which is above the sample average. Warehouses in the third size category, measuring between 5,000 to 7,499 m^2, also have a higher reach than average within the shortest time period, but only for 5 percent of the population. The larger warehouses, sizing over 7,500 m^2, have a lower reach than the sample average.

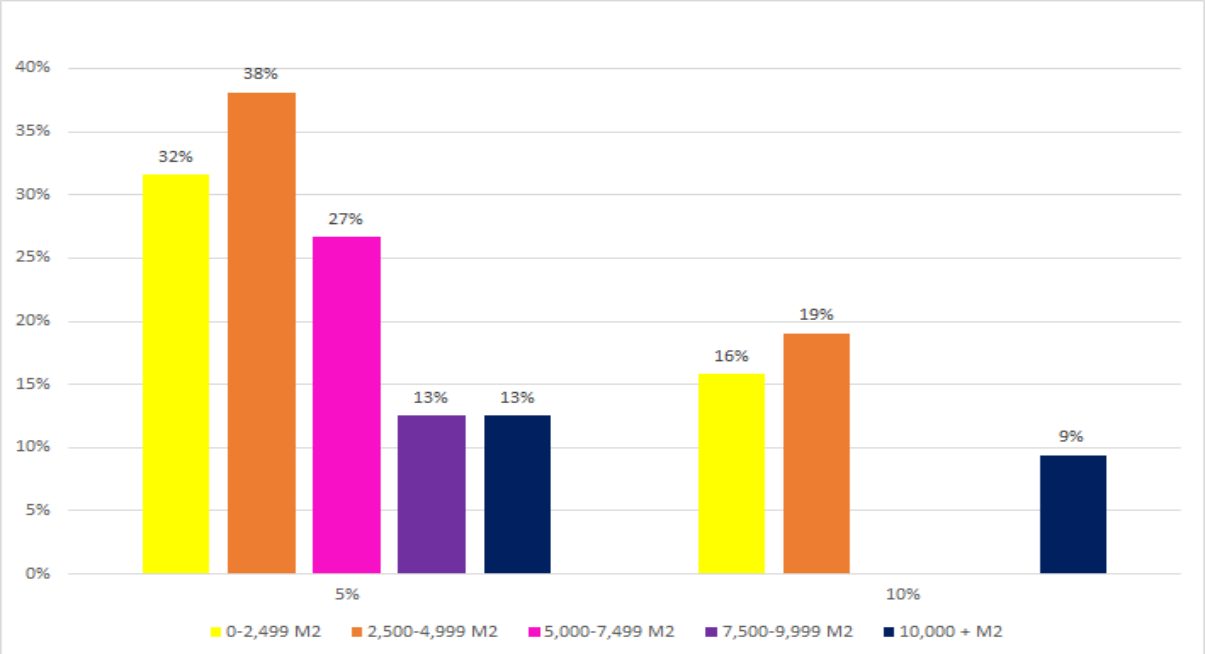

Figure 4.7 Different warehouse sizes and population reach within 15 minutes

The population reach within a time interval of 90 minutes is shown in figure 4.8, divided by warehouse size category. All warehouses within the smallest warehouse category, 0 to 2,499 m^2, can reach 5 percent of the population. Medium-sized warehouses, within the category 5,000 to 7,499 m^2, have the highest capability to reach 10 percent of the population. The percentage of warehouses that can reach 15, 20 and 25 percent of the population within 90 minutes is quite similar between the different categories, except for warehouses sizing 7,500 to 9,999 m^2.

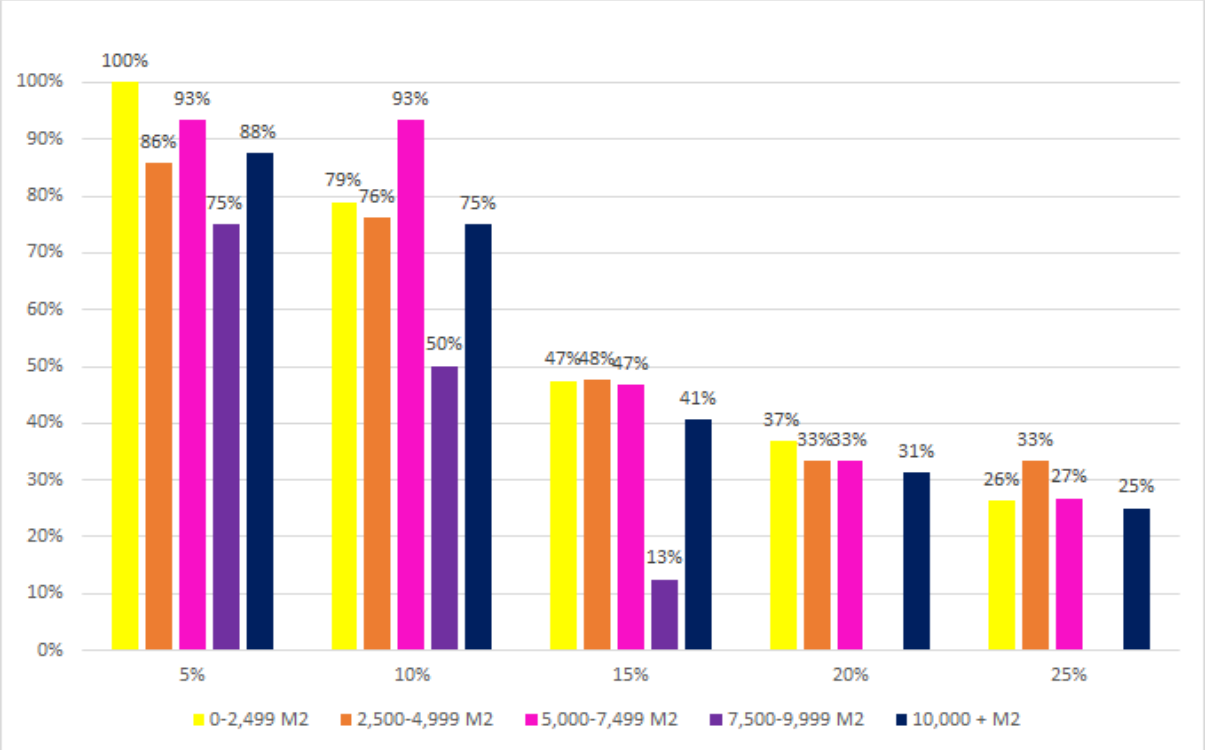

Figure 4.8 Different warehouse sizes and the possibility to reach different percentage of the population within 90 minutes

Distance to transport infrastructure

Besides the warehouses, figure 4.9 shows the main roads, E4, E6, E18, E20 and RV40, the five largest container ports and the two main airports. The ports are located in Gothenburg, Helsingborg, Halmstad, Norrköping and Gävle and the airports are located in Härryda and Sigtuna municipality.

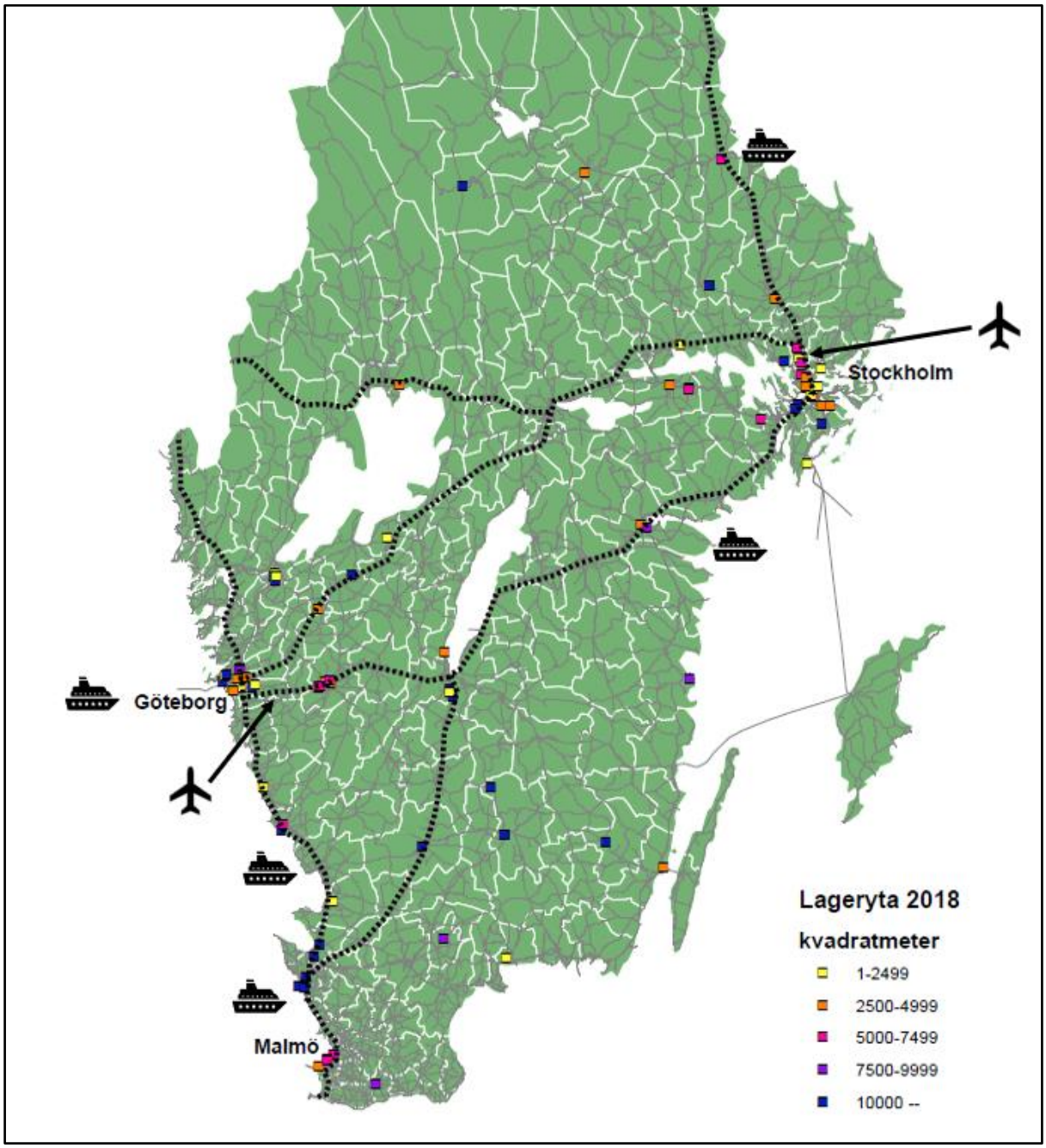

Figure 4.9 Geographical overview of warehouse location in relation to transport infrastructure

Figure 4.10 shows the percentage of the warehouses located in close proximity to large container ports, large airports and the main roads E4, E6, E18, E20 and RV40. Warehouses in the municipalities with one of the five largest ports are considered to be located in proximity to a large container port. Warehouses in the same municipality as either Härryda or Sigtuna are considered to be close to a large airport. 68 percent of the warehouses are located within five kilometers to at least one of the specified main roads. 18 percent of the warehouses are located in the same municipality as one of the largest container ports and 4 percent of the warehouses are located in the same municipality as one of the two largest airports.

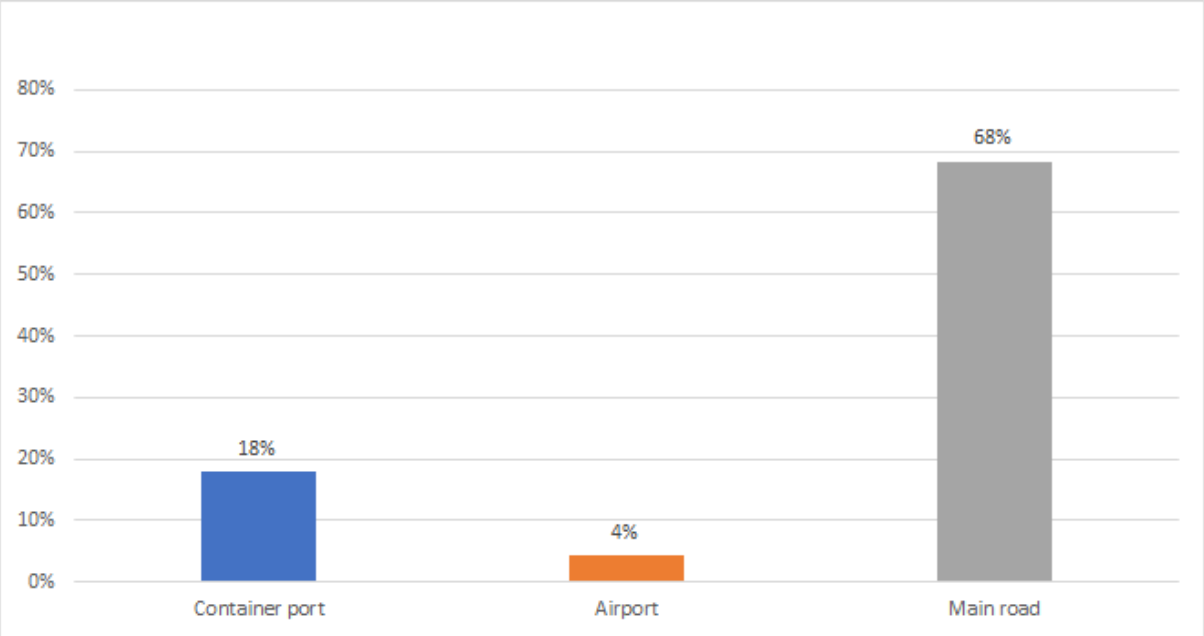

Figure 4.10 Percentage of warehouses located in proximity to transport infrastructure

Figure 4.11 illustrates the share of warehouses that can reach different percentages of the population within 90 minutes. The blue bars show the warehouses located within the same municipality as one of the five largest container ports, the orange bars show the warehouses located in the same municipality as one of the largest airports and grey bars shows the warehouses located within five kilometers to one of the five main roads. A large share of the warehouses located close to a container port can reach up to 10 percent of the population within 90 minutes but cannot reach a higher percentage within the given time interval. 32 percent of the companies located close to a main road can reach 25 percent of the population within 90 minutes and two of the four companies located close to the airports can reach 25 percent of the population.

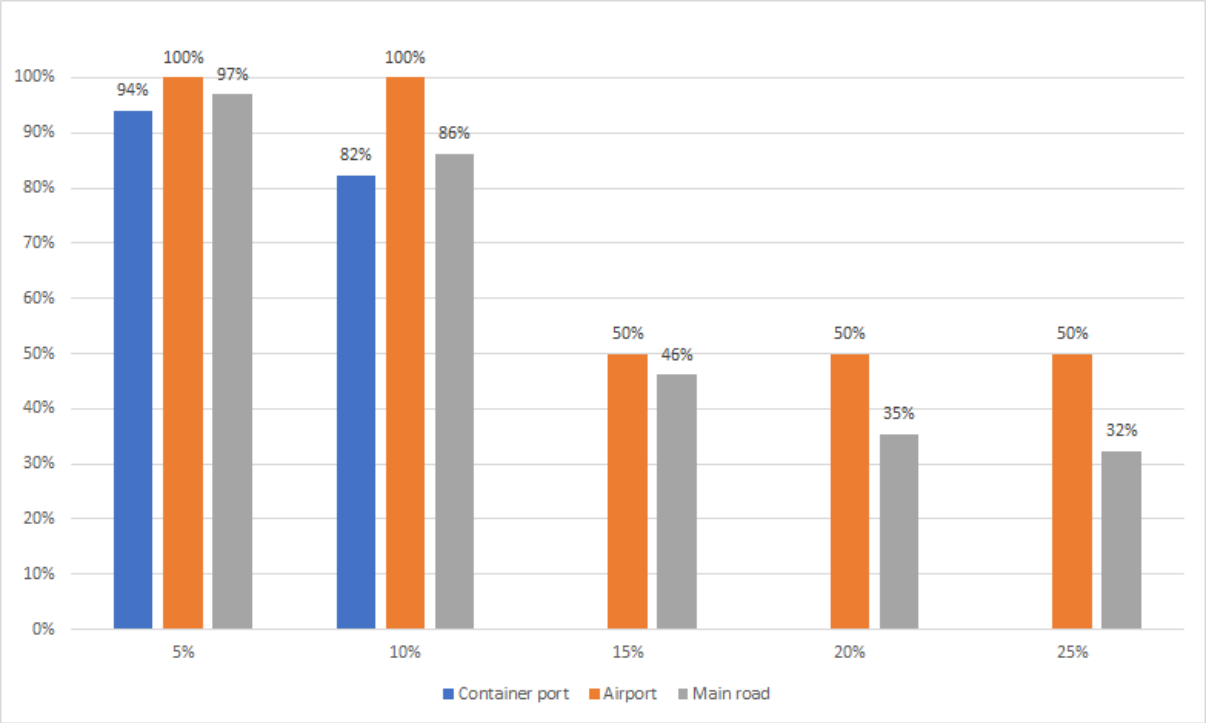

Figure 4.11 Warehouses in proximity to transportation infrastructure and population reach within 90 minutes

Figure 4.12 shows the percentage of warehouses located in proximity to one of the specified main roads. A warehouse could be located to more than one of the main roads. 22 percent of the warehouses are in proximity to E4, 18 percent are in proximity to E6, eight percent are in proximity to E18, 35 percent are in proximity to E20 and 15 percent are in proximity to RV40.

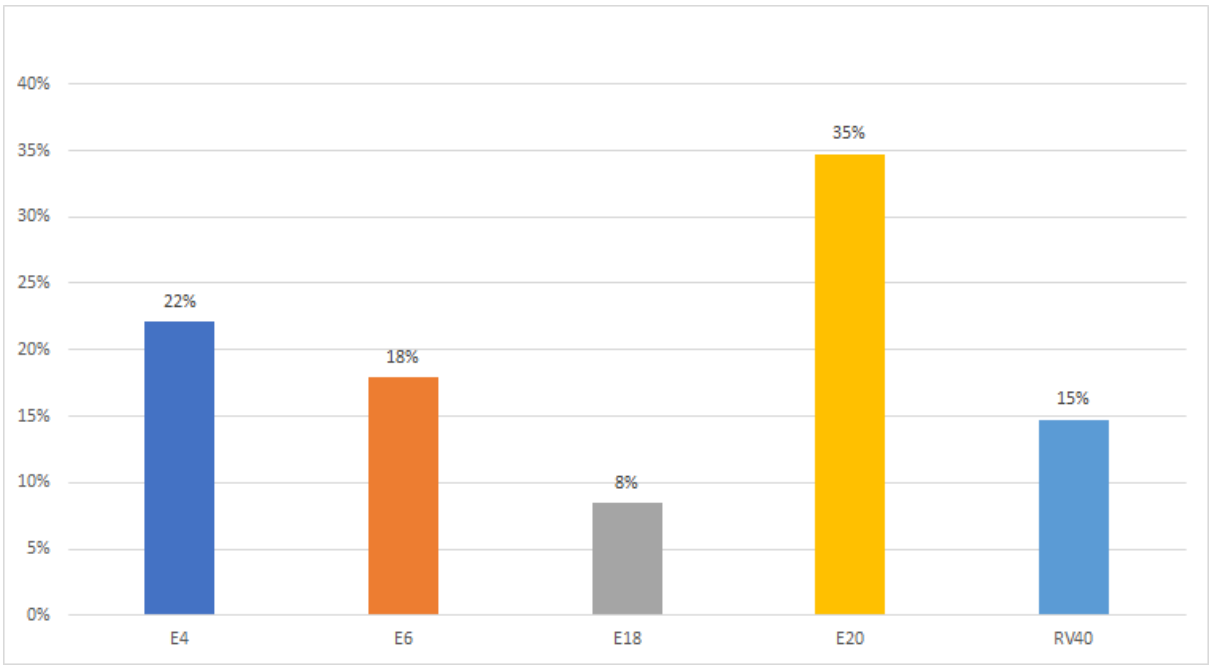

Figure 4.12 Percent of warehouses located in proximity to different main roads

The percentage of warehouses that can reach different percentage of the population within 15 minutes, based on proximity to the different main roads are shown in figure 4.13. The figure shows that 59 percent of the warehouses located close the E6 can reach 5 percent of the

population within 15 minutes, but when comparing with a 10 percent reach of the population, none of the warehouses close to E6 have the possibility.

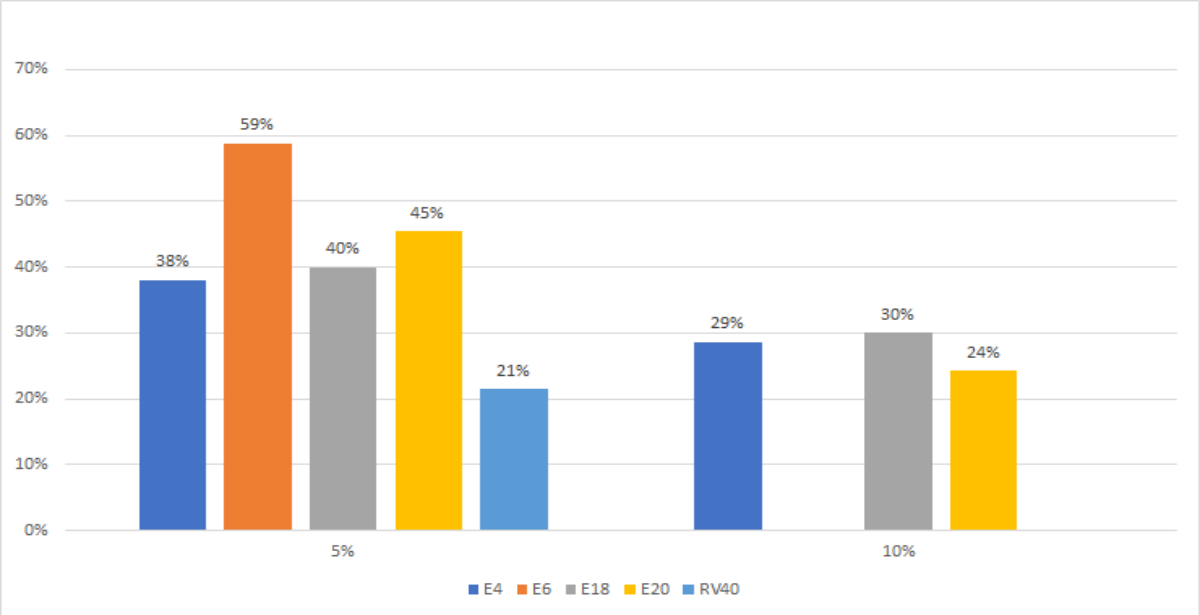

Figure 4.13 Warehouses in proximity to main roads and population reach within 15 minutes

The share of warehouses that can reach different percentage of the population within 90 minutes, based on the proximity to different main roads is illustrated in figure 4.14. Within a time interval of 90 minutes, almost all warehouses located close to E6, E20 and RV40 can reach up to 10 percent of the population. The share of warehouses located close to E18 that can reach 5 percent respectively 20 percent of the population within 90 minutes is exactly the same and only a small drop can be seen when comparing the reach to 25 percent of the population.

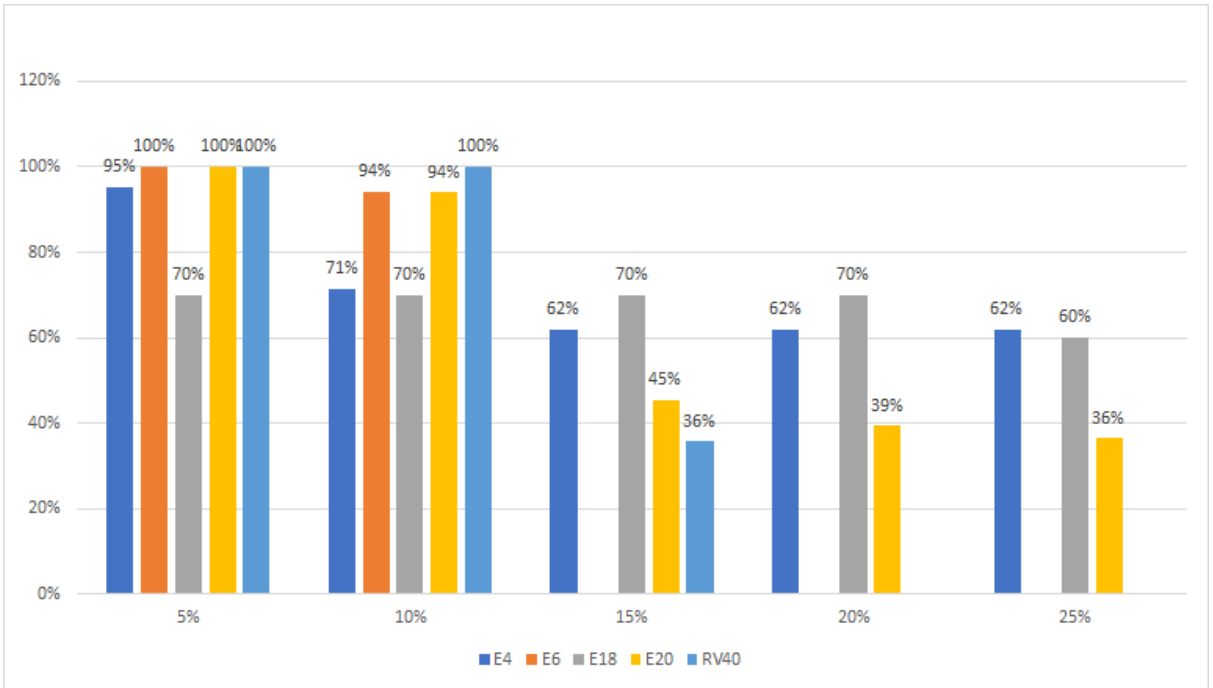

Figure 4.14 Warehouses in proximity to main roads and population reach within 90 minutes

Commodity category

The companies in the sample were divided into eight different categories based on the main sales commodity. To identify if the population reach differs between the different commodity categories, the reach for each commodity group will be compared with the sample average. Figure 4.15 shows the percentage of warehouses with different population reach within 15 minutes, divided by commodity categories. The sample average showed that 24 percent of the warehouses can reach 5 percent of the population respectively 11 percent of the warehouses could reach 10 percent of the population within the time interval.

The commodity group Groceries stands out in the sample, showing that 63 percent of the warehouses can reach 5 percent of the population within 15 minutes. Regarding a population reach of 10 percent, the percentage of companies within the category decreases drastically, but are still substantially above the sample average. Warehouses within the category Clothing & footwear have the second largest reach within 15 minutes and a smaller decrease when expanding the population reach to 10 percent. The categories Furniture & homeware and Sports & leisure also stands out, with only 8 percent of the warehouses reaching 5 percent of the population within the time interval. When expanding the population reach to 10 percent, none of the warehouses within the Furniture & homeware category have the possibility. However, the warehouses within Sports & leisure remains the same, as the warehouses that can reach 5 percent of the population within a time interval of 15 minutes can also reach 10 percent.

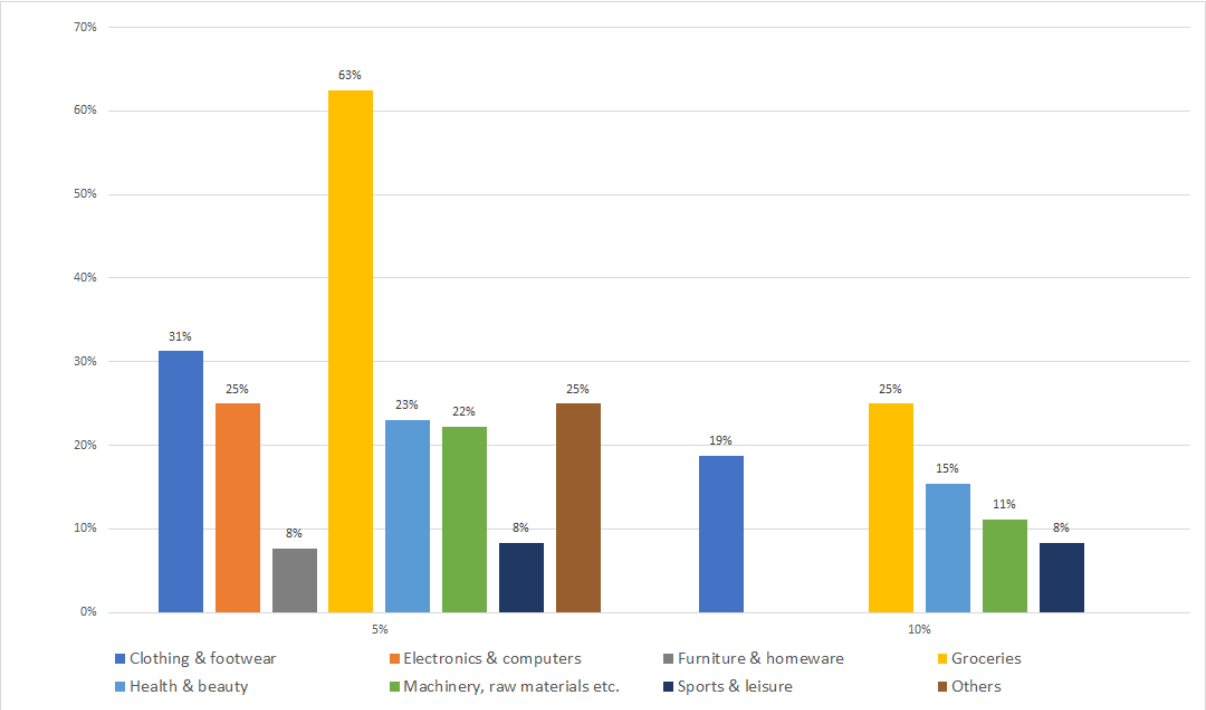

Figure 4.15 Population reach within 15 minutes between different commodity groups

Within the time interval of 90 minutes, the population reach among the different commodities has changed, illustrated in figure 4.16. All warehouses within three commodity categories, Clothing & footwear, Groceries and Sports & leisure, can reach 5 percent of the population within the time interval. All companies within the categories Clothing & footwear and Groceries can reach 10 percent of the population within the given time interval.

All warehouses within the commodity category Groceries can reach up to 10 percent of the population within 90 minutes. The percentage of warehouses drastically decreases for a population reach over 15 percent and stagnates. 25 percent of the warehouses within the Grocery category can reach up to 25 percent of the population. All warehouses within the Clothing & footwear category can also reach up to 10 percent of the population within 90 minutes. 63 percent of the warehouses can reach 15 percent of the population, which is well above the sample average of 42 percent.

In the commodity category Sports & leisure, all warehouses can reach 5 percent of the population within 90 minutes and the category has higher reach than the sample average. Within the commodity category Health & beauty, less warehouses than the sample average can reach up to 10 percent of the population. However, more warehouses within the category reach 15 percent of the population or higher, compared to the sample average.

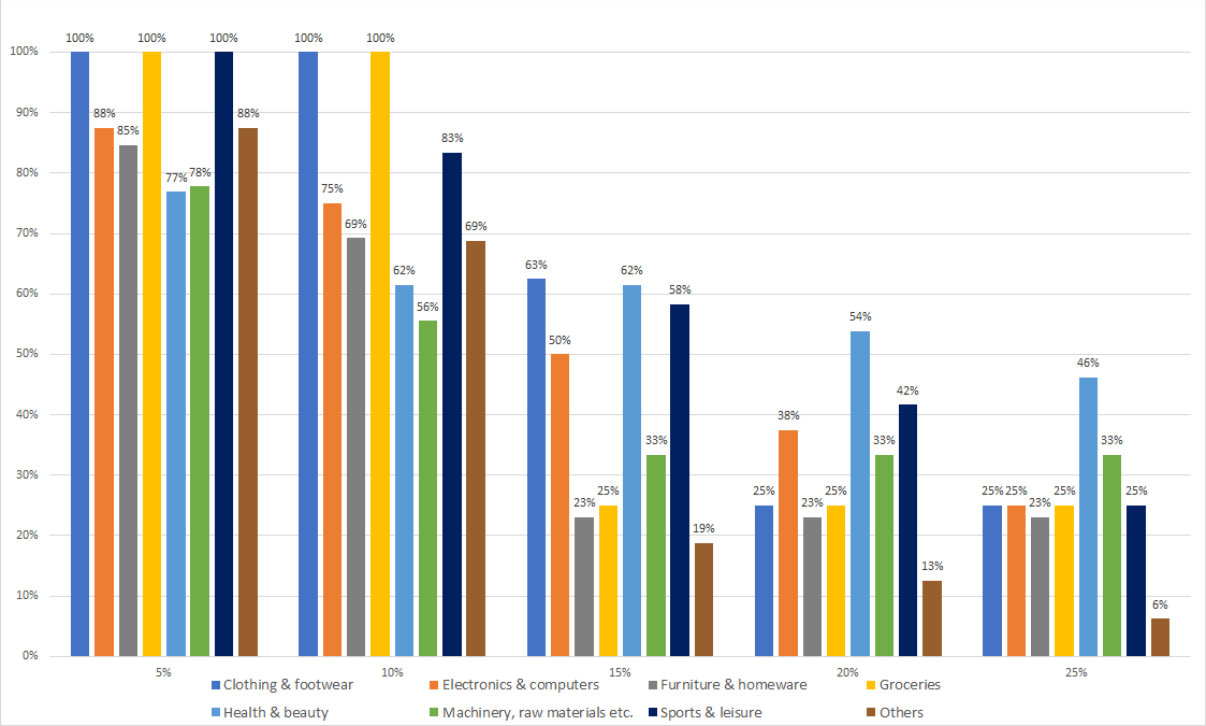

Figure 4.16 Delivery capacity within 90 minutes to different percentage of the population

Turnover

The companies operating the warehouses in the sample have both similarities and differences. The firms are all on the list of the top 100 largest e-commerce companies in Sweden in 2017, but the companies' turnover varies to a large extent. The largest company on the list has a turnover of over eight billion SEK and the smallest company has a turnover of approximately 75 MSEK. The average turnover in the sample is approximately 450 million SEK and the median turnover is approximately 190 million SEK. The company with the largest annual turnover stands out in the sample, as the second largest company have an annual turnover of approximately 1,7 billion SEK. No significant relationship between turnover and population reach could be identified and regarding the time intervals of 15 and 90 minutes, the correlation was low, less than 0,10. However, all companies with over 600 MSEK in turnover have

warehouses with a population reach over 10 percent within the time interval of 90 minutes. There is a large variation in the population reach among the companies with less turnover, having both the highest and the lowest reach.

4.2 Qualitative data results

The result of the interviews with Bokus, Ellos, Apotea and Boozt is presented in this section and the respondents are briefly described. How the companies adapt to the demand of faster deliveries, how they manage deliveries to end-customers today and necessary changes to manage faster deliveries in the future will be presented. The companies' locations are further discussed in terms of advantages and disadvantages. Unless stated otherwise, all data, information, ideas and concepts stem from the respondents.

Bokus, Bokhandelsgruppen

Bokus is a company owned by Bokhandelsgruppen that sells books online, with approximately 16 million books available for purchasing. The millions of books that is offered to customers are not stock kept in a mega-warehouse, but instead ordered from the suppliers once the customer order has been placed. Therefore, the central warehouse should be viewed more as a consolidation center rather than a traditional warehouse for inventory. However, some books that are forecasted to generate many orders, are ordered from the suppliers in advance and stored in the warehouse, ready for dispatchment once the customer order has been placed.

The target customers for Bokus are people living in Sweden who reads books. Students are one large customer category for Bokus. Customers can choose between standard delivery or express delivery. Standard delivery is normally two to five working days and the faster deliveries normally means next-day delivery, but it requires that the products have arrived from the suppliers. Deliveries to customers in the northern, rural parts of Sweden and customers living on the island Gotland cannot be guaranteed next-day delivery. Bokus has observed a higher demand for faster deliveries, as more customers tend to choose express deliveries than before. Bokus have also noted an increased demand for control over the delivery, meaning that customers want to know where in the transportation chain their package is. Today the company uses Postnord, Schenker and CityMail to send their packages to end-customers.

Bokus has a 2,500 m^2 large central warehouse located in Falun, illustrated in figure 4.17. Bokus moved into the facility in 2010 and the primary reason for the location is the proximity to the suppliers. The largest supplier of Bokus is located in the same facility as the warehouse, meaning that the lead time from the supplier to the warehouse is minimized. As Bokus does not have a large inventory of books, the proximity to the customers is not considered as important as the proximity to the suppliers. The lead time from the suppliers to Bokus is considered to be the bottleneck and the most important lead time to minimize. The supplier proximity is also considered to be the largest advantage compared to their competitors.

Another important aspect that impacted on the choice of location was access of employees, as the capability to manage the seasonal fluctuations is vital. During holidays such as "Black Friday" and Christmas, Bokus could face a sales increase of 300 to 400 percent and the possibility to have access to a solution that could manage such a high peak is important. Today, Bokus can fulfill next-day deliveries with their current system setup and warehouse location.

To manage shorter delivery times, such as same-day deliveries, well-developed IT infrastructure and omni-channel operations are a solution.

Figure 4.17 Geographical location of Bokus
Coordinates: 60.577994, 15.597628 (Google Maps)

Ellos Group AB

In Ellos Group AB, there are three companies that are included on the top 100 list of the largest e-commerce companies in Sweden - Ellos, Jotex and Stayhard. Ellos is a company that primary sells clothing articles, home articles and beauty articles, with a broad range of products. The typical customers of Ellos and target customers are women with family and children who purchase products not only to themselves, but also to other family members. The company was founded in the 1970s, long before e-commerce sales existed, and then the business was selling products via mail order. The transformation, from a mail ordering company to an e-commerce company, occurred five years ago and has had great impact on the organization.

Ellos Group currently has five warehouses, all located in Borås within close range of the headquarter. In total, Ellos Group has approximately 100,000 m^2 of floor space in five warehouses. The warehouse allocation between the different companies within Ellos Group is roughly estimated to Ellos disposing 60 percent (60,000 m^2), Jotex 35 percent (35,000 m^2) and Stayhard 5 percent (5,000 m^2). The main warehouse, sizing 67,000 m^2, was built in the late 1970s and the location is shown in figure 4.18. The warehouses were not built for the e-commerce market and there was no strategic decision behind the choice of warehouse localization in Borås. However, as Ellos Group have customers in the Nordic countries, Borås is close to the center according to the center of gravity method, which makes it a suitable localization for the organization. Several larger metropolitan areas and with that many customers can be reached in an effective way.

Besides the main warehouse, Ellos Group has three smaller warehouses which in total measures approximately 20,000 m^2 as well as one additional warehouse for buffer stock, estimated to 13,000 m^2. Ellos Group is currently building a new warehouse which is intended to replace the three smaller warehouses. There was no strategic decision behind the choice of location of the new warehouse, but rather an outcome of an opportunity that occurred. There is a limitation of available land for industrial usage in the region of Västra Götaland and according to Ellos, companies can rarely choose freely between different locations and once an opportunity of available land occurs, the decision-makers in the firms need to act quite fast.

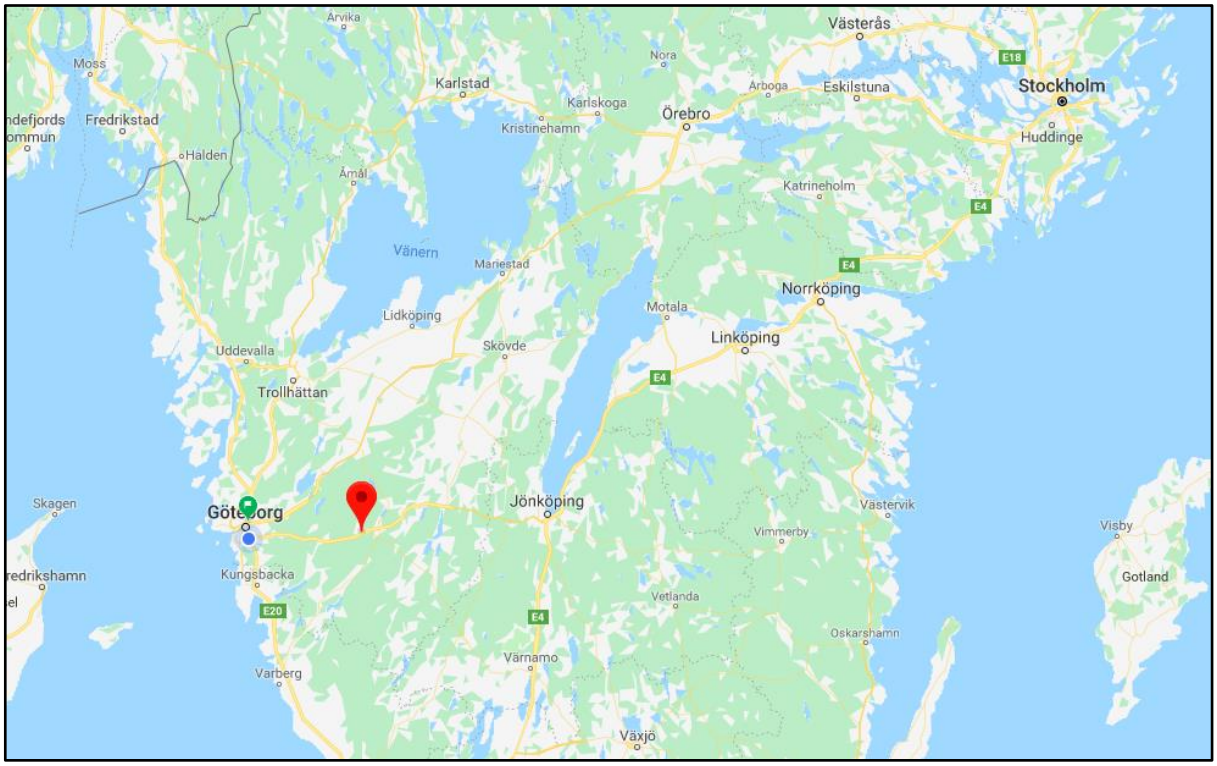

Figure 4.18 Geographical location of Ellos Group central warehouse
Coordinates: 57.693629, 12.820468 (Google Maps)

The new warehouse, also located in Borås, is scheduled to be completed by the end of 2019. The decision whether to use a third-party logistics operator or manage the new warehouse in-house was discussed, but in-house operations was chosen as the proximity to the headquarter and the internal knowledge were highly valued. When deciding on the new location, some aspects were considered to be of higher importance than other and the aspect “distance to transport infrastructure” was ranked as the most important. Distance to customers followed as the second most important, but Ellos argued that it was closely related to the first aspect. The possibility of operations around the clock was ranked as the least important aspect, due to the low relevance for Ellos Group. Ellos Group’s large warehouses are located in industrial areas, far away from residential areas that might be one reason for restrictions in operations around the clock.

Ellos Group offers two main delivery options to customers order, standard and express delivery. Ellos Group uses distribution services from Postnord and DHL, which picks up the orders once the orders are ready for transportation. Standard deliveries usually take between two and four days and is the most common choice. Approximately 10 percent of the customers choose to pay extra for the express delivery services to receive the order the next working day.

Ellos Group is regularly analyzing the market development to pick up new trends and demands of the customers. In the future, Ellos Group believes that their customers will demand faster deliveries than what is possible today. With the current setup and locations, reaching some larger cities, for example Gothenburg, within the same day is possible. The large geographical distance to Stockholm and Copenhagen makes it difficult to manage same-day deliveries to these areas. In the future, additional small warehouses in larger metropolitan areas could be one solution to manage same day deliveries to other areas or regions than Gothenburg. Another possible solution could be drop-shipping, meaning that the suppliers delivers the ordered products directly to the customers, without Ellos Group's involvement in the physical products.

Apotea AB

Apotea AB is by far the largest e-commerce company that sells pharmacy products and prescription medicine in Sweden. Apotea uses eleven different methods to deliver customer's orders to customers across the country. Customers cannot choose freely between the eleven delivery methods, as some freight transport companies or delivery methods only are available in certain regions. For example, Bussgods is a company that sends packages together with scheduled passenger buses and operates in less densely populated areas in the northern parts of Sweden. The delivery options that are available for the customers depend on their locations and are based on the option that provides the shortest delivery time. In general, the customers expect as short delivery time as possible, but how fast the order can be delivered depends on the customer's location. According to Apotea, many customers can receive the products the same day and almost everyone can receive the goods the next day. Apotea's warehouse, sizing 38,000 m^2, is located in Morgongåva, around 40 kilometers north-west of Uppsala (see figure 4.19).

Figure 4.19 Geographical location of Apotea
Coordinates: 59.938205, 16.948473 (Google Maps)

Pär Svärdson, CEO of Apotea, was the founder of Adlibris, one of the largest e-commerce companies that sells books. Adlibris was located in Morgongåva because of a large book wholesaler's presence in Morgongåva. When Svärdson sold Adlibris and founded Apotea, he chose to stay close to Adlibris, as it enabled beneficial contracts with freight transport companies. Adlibris is a large and important customer for some of the transportation companies and by locating Apotea as their neighbor, the company did not need to "start over" as it did not result in new routes nor increased vehicle-kilometers for the pick-up of goods.

One important aspect for Apotea regarding warehouse location is the access of employees. Morgongåva provides a good access to a low-skilled job market, as there are many young adults, highly motivated and with high work ethics living in the area. Working in the warehouse, picking and packing orders, does not require a higher education. Apotea states that it sometimes could be a challenge to recruit employees with a higher education, for example pharmaceutics. Other aspects that Apotea values are the proximity to freight terminals, transport infrastructure and the total costs for warehouse operations.

A customer delivery time of two hours is not possible to offer with the current warehouse location in Morgongåva. Apotea claimed that even with a location closer to densely populated areas, problems with congested roads and profitability would make it impossible to fulfill such fast deliveries. Small, emergency warehouses close to larger metropolitan areas are not suitable for Apotea's business, as the company has a broad range of products. An emergency warehouse would only be able to serve a small fraction of the customer orders and is not likely to be profitable. According to Apotea, delivering customer orders within very short time periods would result in a courier service and would not be sustainable. An omni-channel solution is not on the agenda today and is unlikely to occur in the future.

Apotea believes that customers are likely to want faster deliveries, but simultaneously unwilling to pay a higher charge for it. Moving the business from Morgongåva to another location is unlikely to happen in the near future, as the CEO stated that "Nothing will make us move, unless there is an earthquake or a similar natural catastrophe".

Boozt Fashion AB

Boozt offers clothing, shoes, cosmetics and sports apparel as well as a small assortment of homeware to customers in Scandinavia and other parts of Europe. Boozt's main sales categories are Scandinavian clothing brands as well as large international clothing brands. Today, the company can deliver the ordered products within 24 hours to the majority of its customers. The customers that Boozt cannot deliver to within 24 hours are located in the northern parts of Norway and northern parts of Finland. According to Hemmingsen, the northern parts of Scandinavia cannot be reached within the same-day and simultaneously be economically and environmentally sustainable, as there are a limited number of customers in these regions. Therefore, the choice of warehouse location is not impacted by the limited delivery capacity to these customers.

Boozt sells products to all EU-membership countries, but the main customers are located in Sweden, Denmark, Norway and Finland. For Boozt, it is more important to have short distances to the Greater Copenhagen Region, in which the largest share of the customers is located.

The Greater Copenhagen region includes the areas, besides Copenhagen, eastern Denmark and Skåne County in Sweden.

Boozt's warehouse is located in Ängelholm, as shown in figure 4.20, within a close distance to highway E6 and Ängelholm's airport. The warehouse is 43,500 m^2 and was established in 2011. The reasons behind the location choice were the proximity to many of Boozt's customers and the short distance to transportation infrastructure. Another reason was the regional development and the decision-makers' willingness to support companies operating in the municipality. An aspect that Hemmingsen did not think was of importance was proximity to customers in other parts of Europe than Scandinavia, as the majority of the customers are located in Scandinavia.

Figure 4.20 Geographical location of Boozt
Coordinates: 56.190844, 12.851474 (Google Maps)

Boozt believes that fast deliveries are important, but more important is the capability to deliver within promised time. About 90 percent of the orders are transported by air to end-customers to manage the promised delivery time. Boozt argue that using air freight does not result in higher costs than road freight transportation. The airports Boozt uses for transport to end-customers are the airport in Ängelholm, Kastrup in Copenhagen and Landvetter in Härryda. Depending on where the customer lives, different delivery methods are used. Budbee, Postnord, Bring, Åland Post, Posti and Posten are examples of freight transport companies that Boozt uses for last-mile deliveries.

5 Analysis

The literature review and findings from the study are compared and discussed in this chapter. The quantitative data is analyzed and the capacity of the Swedish e-commerce companies is reviewed. The analysis of the companies is based on different aspects as commodity type and warehouse size. Differences and similarities between different parts of the region are also reviewed. The second part of this chapter analyzes the qualitative data and compares factors that impact warehouse localization, identified by previous research, with the findings from the interviews. Finally, challenges to manage even shorter delivery times in the future are discussed.

5.1 Population reach within different time intervals

In the previous chapter, different variables in comparison to population reach within different time intervals from the warehouses' coordinates by road transport have been described. The population reach varies among the warehouses in the sample. Naturally, the longer time interval the greater share of the population can be reached. The warehouses that have the highest population reach within 15 minutes are not the same warehouses that have the highest population reach within 90 minutes. It should be emphasized again that the findings are based on the 95 warehouses in the sample and not based on the companies' total population reach when operating several warehouses. If the result would be based on each company's total reach, by adding up the population reach for each warehouse, the result would be different. Mat.se and MatHem have three warehouses each, all located in the densely populated regions Stockholm, Gothenburg and Malmö. The combined reach of these companies are over 55 percent of the population within 90 minutes.

Location in Stockholm is required to reach many customers within 30 minutes

Within the shortest time interval of 15 minutes, one of four companies can reach 5 percent of the population and the ten warehouses with the highest reach within both 15 and 30 minutes are located within the municipality of Stockholm. Among the 20 warehouses with the highest population reach within 15 minutes, the 13 largest are located in Stockholm municipality and the others are located in the region of Gothenburg. All warehouses have relatively central locations, located close to many residential addresses. Hall and Hesse (2013) argued that by locating a warehouse close to large cities, the access to customers and employees increases. As figure 1.1 illustrates, there are three main areas in Sweden, Stockholm-Mälardalen, Gothenburg and the Greater Copenhagen Region, that are more densely populated than the Sweden's average population density. Figure 4.3 also illustrates that the majority of the warehouses are located in these regions. Stockholm is the most densely populated area in Sweden and within 15 minutes, the warehouses with the highest population reach are located in proximity to the city center. Additionally, a location in Stockholm or any other densely populated area, increases the access of employees.

By locating a warehouse close to or within an urban area, the last mile transportation becomes shorter to a larger share of the population than if the warehouse would be located in the hinterland. The possibility to decrease the length of the last mile transportation could result in less negative external impacts and lower delivery costs while still managing fast deliveries within a limited time window to many customers (Diziain et al., 2012).

Congestion is a large issue with urban transports and can have a large impact on the transportation time (Björklund, 2012). Hall and Hesse (2013) also stated that a warehouse located in an urban area could face severe challenges to deliver within a short time frame due to congestion. Since the warehouses with the highest population reach within 15 and 30 minutes are located in an urban area there is a considerable risk of congested roads which could impact the transport time greatly. During peak hours with heavily congested roads the delivery capacity of the warehouses in urban areas is instead likely to be close to zero within a short time span, such as 15 or 30 minutes. This adds on to the complexity of urban deliveries, locating a warehouse in an urban area enables short distances to many customers but the short distance does not necessarily result in a short delivery time. Despite the complexity of urban logistics, Diziain et al. (2012) argued that logistics operations should be moved back into the city in order to minimize negative environmental effects. In the sample, 15 percent of the warehouses are located within the municipality of Stockholm, which could be regarded as an urban location. This could be compared to 32 percent of the warehouses that are located in the hinterland, outside of the primary regions. The two trends that have been observed, logistics sprawl and re-localization to urban areas, by Sakai et al. (2018) and Hall and Hesse (2013) are both present in the sample. Therefore, the choice of localization could be a result of other factors.

Olsson and Woxenius (2014) stated that the trend of just-in-time deliveries has resulted in faster transports, lower filling rates and a larger presence of small vehicles on the road network. This, in combination with centrally located warehouses, could contribute to an increase in negative externalities in urban areas due to additional freight movements and congestion (Buldeo Rai et al., 2018; Rodrigue et al., 2013; Uherek et al., 2010). However, if the distribution of parcels becomes more efficient and substitutes personal shopping trips to a larger extent than today, the negative impacts could decrease (Al-Mulali et al., 2015). The challenge the e-commerce companies are facing today is the trade-off between faster deliveries and consolidation of consignments to reach the higher efficiency, which is also confirmed by the respondents in the qualitative part of this study.

Stockholm county dominates the customer reach within 60 minutes

The ten warehouses with the highest population reach within both 45 and 60 minutes are all located in Stockholm county. Eight warehouses are located in the municipality of Stockholm and two companies are located in Stockholm county, outside of the municipality. Compared with the shortest time intervals, the warehouses with the best population reach are located both north and south of the city center. Within the shortest time intervals, the warehouses are located within five kilometers from the city center and within time interval of 60 minutes, the warehouses with the highest reach are located up to 30 kilometers from the center.

Land costs in urban areas are most often considerably higher than in the hinterland (Diziain et al., 2012). Although it could enable better accessibility to many more customers, the land or rental costs could be expensive and it could be problematic with limited space in urban areas (Hall & Hesse, 2013). In the sample, 15 percent of the warehouses are located in Stockholm municipality and these warehouses have the highest population reach. However, 32 percent of the warehouses are located in other areas than the densely populated regions Stockholm-Mälardalen, Gothenburg and the Greater Copenhagen region. This could be an indication that although fast deliveries are important, land or rental costs in urban areas could be too

expensive or there might not be available land or warehouses in urban areas. Furthermore, even though the localization in proximity to Stockholm gives the highest population reach within 45 and 60 minutes, there is no possibility to reach the majority of the population within this time span. Within 60 minutes, less than a quarter of the population can be reached.

No clear relationship between turnover and population reach was found in this study. Companies with high turnover could have larger capability to manage high costs for land or rental costs for warehouses compared to smaller companies. There are large variations in both turnover and population reach. Figure 4.18 showed that companies with the highest turnover in the sample, over 600 MSEK, all have a population reach around the sample average or higher. Among the companies with the lowest turnover, both the highest and the lowest population reach were observed. Out of the ten companies with the highest turnover, only two companies have warehouses in Stockholm. Two of the ten companies with the highest turnover are located in Gothenburg, three companies are located in the Greater Copenhagen region and three companies are located in other areas of Sweden. These findings indicate that other factors are more likely to have a larger impact on the choice of location than turnover.

Eskilstuna provides the highest population reach within 90 minutes

Warehouses located in the most densely populated areas have the highest reach within the shortest intervals but are also competitive within the longest time interval. More than half of the 20 warehouses with the highest reach within 15 minutes are also among the highest population reach within 90 minutes. However, with the largest time interval, new geographical areas have larger reach than the locations in central Stockholm. Three warehouses in Eskilstuna, located approximately 110 kilometers west of Stockholm, could reach the largest share of the population within the given time interval. Uppsala, located approximately 70 kilometers north-west of Stockholm, also entered the top list of the warehouses with the highest reach. As both Eskilstuna and Uppsala are included in Stockholm-Mälardalen, all companies on the top list of the largest reach within 90 minutes located in this region.

Stockholm-Mälardalen region dominates the customer reach within a time interval of 90 minutes. The 29 warehouses with the highest population reach are all located in this region and can reach over 20 percent of the population within the time interval. The warehouse with the highest population reach located in the Gothenburg region is ranked as number 30 and have a population reach of 17 percent. The warehouse with the highest reach located within the Greater Copenhagen region has a population reach of 13 percent and is ranked as number 60. These results show that there is a large difference in reach between the different primary regions. Locating a warehouse close to the customers is only possible when serving a local market (Kang, 2017). This means that companies that strives towards reaching plenty of customers within a short period of time could consider locating their warehouses within Stockholm-Mälardalen. Additionally, a location within the region of Stockholm-Mälardalen makes it possible to reach the other primary regions within the same day, as the distances are relatively short. Only regions that cannot be reached within the same day is far north, where there is a low population density.

Within an interval of 90 minutes, warehouses in Eskilstuna can reach central parts of Stockholm, which increases the population reach substantially. Within 60 minutes, the population reach is approximately 5 percent which could be compared to a population reach

of close to 30 percent within the time interval of 90 minutes. Eskilstuna is geographically located within 90 minutes of several densely populated areas, which is a precondition to manage fast deliveries to a large share of the customers. The choice of location in a suburban area could be based on costs aspects, availability of land and accessibility on the road network, as Hall and Hesse (2013) suggests drives the logistics sprawl. The warehouses in Eskilstuna are located within a reasonable short distance from large customer markets but can still benefit from the hinterland locational characteristics. However, even though the location in Eskilstuna has the largest population reach within the time interval, less than a third of the Swedish population can be reached. This shows one challenge with logistics and last-mile customer deliveries within countries with relatively long distances between densely populated areas.

5.2 Aspects that impact population reach

Previous research (Kang, 2017; Heitz et al., 2019) have shown that different geographical features and location-wise characteristics are differently prioritized by companies and could impact the choice of warehouse localization. Hesse (2008) mentioned that modern logistics and developments in technology have changed logistical patterns and use of land in urban areas. Today, an urban location provides proximity to customer markets and could result in greater accesses to transport infrastructure compared to the hinterland (Heitz et al., 2018). A location in the hinterland could on the other hand provide more available land to a low cost and less congested roads (Sakai et al., 2018). There are advantages and disadvantages with all locations and companies have to make prioritizations and trade-offs. The relationship matrix by Jakubicek and Woudsma (2011) divided features based on their importance and the companies' satisfaction level and noted that the factors with high importance are either considered to push companies away from the location or retain companies at the present location. The following sections will analyze the companies' population reach in relation to some of the previously reviewed features, in order to identify if the geographical features have an impact on the population reach and the possibility to manage same-day deliveries in the future.

Transportation infrastructure

The data shows that more than two thirds of the warehouses are located close to a main road, but a low share of the warehouses is located close to a large container port or a large airport. The warehouses located close to an airport are either located close to Gothenburg or Stockholm county, which gives the warehouses a good access to many customers within 90 minutes. However, only four percent of the largest e-commerce companies in Sweden have located their warehouse close to one of the largest airports. This indicate that proximity to airports are not highly prioritized, which is in line with the findings in the study by Jakubicek and Woudsma (2011). Dablanc (2007) agrees with the importance of short distance to the road network but argues that logistics companies tend to locate their warehouses close to airports. In the sample of 95 warehouses only four percent were located close to a large airport. With the small number of warehouses close to airports, it cannot be determined whether it is the proximity to the airport that impacts the population reach or the fact that these warehouses are in densely populated regions of Stockholm-Mälardalen or Gothenburg. Besides the two main airports in Sweden, there are several small airports located in proximity to other cities. If these would have been included, the result may have been different.

Less than 20 percent of the warehouses were located close to a large container port. A large share of these warehouses can reach up to 10 percent of the population within a time interval of 90 minutes, but none have a reach of 15 percent. None of the container ports are located within Stockholm municipality, county or even in the densely populated region Stockholm-Mälardalen, which could be the explaining factor behind the limited population reach. Dablanc (2007) stated that proximity to seaports are not considered to be of high importance, which could be verified in these data with less than 20 percent of the warehouses located close to a container port. As Kang (2017) noted, seaports are vital for international trade and sales, but less important for companies serving the national market. Furthermore, the warehouses that are located in Gothenburg and in proximity to the large container port, could have other reasons and strategies for choosing their location than proximity to the port.

In contrast to other transportation infrastructure, many warehouses in the sample are located close to a main road. Jakubicek and Woudsma (2011) found proximity to the highway network to be of high value because of the derived demand of road transports to deliver parcels. With the low share of warehouses located in proximity to other transport infrastructure than main roads in the sample, in combination with previous studies (Rodrigue et al., 2013; Rushton et al., 2014) that showed that road transports dominates when it comes to shorter distances, the road network is likely to be highly utilized by the warehouses in the sample. E20 showed to be the road where most warehouses were located in proximity to and E18 was the road with the least warehouses located in proximity to. E20 intersects several areas with high population density, for example the Greater Copenhagen region, Gothenburg and Stockholm-Mälardalen and it shares some sections with other main roads. Within the shortest time interval, warehouses located close to E20 do not have a specifically high reach. A larger share of the warehouses located in proximity to other roads can reach 5 and 10 percent of the population within the given time. The results are quite similar when the time interval is expanded to 90 minutes.

Warehouse size and commodity

The ongoing trend of increasing warehouse sizes could result in high land or rental costs for companies (Dablanc, 2007; Heitz & Beziat, 2016). Large warehouses and logistic facilities require major amount of land, which in combination with expensive land result in high costs. The location factor “costs for land” were claimed to be one of the most important factors in previous studies (Jakubicek & Woudsma, 2011; Kang, 2017). In the warehouse sample, 58 percent of the warehouses are sizing over 5,000 m^2 and more than one third of the warehouses are over 10,000 m^2. The high presence of large warehouses in the sample is expected, as previous studies (Aljohani & Thompson, 2016) have pointed out the trend towards larger warehouses and logistics facilities. Kang (2017) suggested that new technology and higher usage of automated warehouses to manage increasing amounts of parcels explain the need for larger warehouses.

In the primary regions, Gothenburg; Greater Copenhagen and Stockholm-Mälardalen, some differences in terms of warehouse size have been identified. No warehouse from the smallest size category is located in Greater Copenhagen region and 84 percent of the warehouses are sizing over 5,000 m^2. The lowest share of warehouses larger than 10,000 m^2 is located in the region of Gothenburg, but it is the region with the most even distribution in terms of warehouse sizes. Outside of these primary regions, half of the warehouses are sizing over 7,500 m^2, with

a large emphasis on warehouses sizing over 10,000 m^2. Although there is a wide spread in the sample, the findings indicate that larger warehouses seem to be located in less dense areas. Previous research explained this by costs aspects and limited land space in urban areas (Kang, 2017; Aljohani & Thompson, 2016).

70 percent of the warehouses with the highest population reach within 15 minutes are sizing below 5,000 m^2. This could be compared with the entire sample, in which 42 percent of the warehouses are sizing below 5,000 m^2. Among the warehouses with the highest population reach within 90 minutes, the distribution differs. Approximately half the warehouses with the highest reach size over 5,000 m^2 and half of the warehouses are smaller. This shows that the smaller warehouses tend to be located closer to densely populated areas, as the population reach is high. Warehouses sizing between 500 to 5,000 m^2 were defined by Diziain et al. (2012) as smaller facilities suitable to be located in central areas, close to the customer market.

Different commodities could require different handling and storage. For example, groceries with fresh and frozen food have quite different characteristics than furniture or raw materials. Furniture and other larger, bulky items could require larger warehouses than other smaller commodity types. The 20 warehouses with the highest reach within 15 minutes are represented by all commodity categories. However, the category distribution on the top 20 list differs from the entire sample. Two categories, Clothing & footwear and Groceries, have a larger presence on the top list and three categories, Furniture & homeware, Sports & leisure and Others, have a lower representation on the top list compared to the complete sample. 25 percent of the warehouses on the top list are represented by Clothing & footwear which could be compared to 17 percent representation in the entire sample. The second largest representation is the commodity group Groceries with 20 percent of the warehouses on the top list, which could be compared to only 8 percent representation in the entire sample. These results show that warehouses that handles food and groceries tend to be located in proximity to urban areas. The warehouses in the sample within the commodity category are all located within one of the primary regions Gothenburg, Greater Copenhagen and Stockholm-Mälardalen.

5.3 Valued characteristics of a location

The respondents in the qualitative study are similar in terms of type of commodity. Boozt and Ellos both sell clothing and footwear products. Apotea represents pharmaceutical products, categorized as “Health and beauty” and Bokus sells books and similar items. The commodities that the respondents sell do not require any special handling, such as refrigerated storage that would be necessary for groceries for example. Ewedairo et al. (2018) noted a general reduction in product life cycles, which further contributes to the already challenging last-mile deliveries. Products with very short life cycles, for example newspapers or flowers, require efficient logistics and last-mile deliveries to not decrease in value. The commodities that the respondents sell do not have a specifically short life cycle and could be stored as inventory without losing significant amount of value.

Strategies behind warehouse location

Ellos’ location in Borås does not stem from a strategic decision as the location was chosen based on the founder’s connections to the area. Even if it were no strategic reasons behind

the choice of location back in 1978, Ellos is satisfied with the good access of transport infrastructure and a good access of employees. Additionally, Ellos is satisfied with its location in relation to customer market, with possibilities to reach large regions, mentioning the Gothenburg region and the Greater Copenhagen region. Several previous studies (Cárdenas et al., 2007; Suzuki et al, 2016; Verhoef et al., 2015) stated that e-commerce sales have challenged traditional sales channels, but Ellos has not been using traditional sales channels due to its background as a mail order company. The transformation from a mail order company to an e-commerce company has according to Ellos had a great impact on the company's internal structure. However, the mail order industry and the e-commerce industry are quite similar in terms of distribution to the end-customers. The two industries have according to Ellos differences in terms of speed, volumes and seasonal fluctuations. A transition from a traditional sales channel approach to a pure e-commerce approach would likely have changed the needs and preferences of a facility localization, due to larger operational differences in the distribution.

Bokus, Boozt and Apotea elaborated in detail on the strategic benefits of their location. The main reason for Bokus' location in Falun is the minimal distance to its largest supplier. Bokus moved in next door to one of the largest wholesalers of books in 2012 and stated that they are satisfied with the location. Instead of locating the warehouse close to customers, Bokus chose to think in the opposite direction by minimizing the transport time from the largest supplier.

One reason behind Bokus' choice of location was the impossibility to be close to all customers from only one warehouse, as their customers are located all over the country. As Sweden is a sparsely populated country, which additionally challenges already inefficient last mile transportations (Rodrigue et al., 2013), Bokus' strategic decisions behind the localization could be the optimal solution to minimize the company's total order time, from placed order to delivery. The fact that Bokus based the decision on where to locate their warehouse depending on where their largest supplier is located is interesting, since most of previous research rather focuses on the proximity to customers. In previous literature, there is a larger focus on proximity to transport infrastructure to be able to easily receive goods from suppliers and send packages to end-customers. Bokus' strategy is possible to apply when there is one or a few suppliers within the country, but would have been difficult for Ellos, as their suppliers mainly are located in other countries.

Boozt chose their current location in Ängelholm due to the location's proximity to the road network and the smaller airport in the area, which is frequently used by the company. The location in Ängelholm has advantages and provides good access to the Scandinavian market. The distance to the Greater Copenhagen region is short and the company can easily access the transport infrastructure. Rodrigue et al. (2013) stated that road transports dominate for e-commerce sales due to relative high speed and flexibility, but Boozt differs with its high usage of air freight for customers deliveries. Although Boozt's customer deliveries primarily are transported by air, Boozt still claims that the road network is of great importance for the firm.

The decision to locate Apotea in Morgongåva was based on the CEO's connections to the location. The specific geographical location itself is not unique but is was beneficial for Apotea that another large e-commerce business was established next door, as it made the freight negotiations with the transport companies easier. The transport companies could easily collect and transport the customer orders from Apotea in the company's start-up phase, without generating additional vehicle kilometers. Due to the presence of the large e-commerce

company next door, daily departures and routes were already established. In the start-up phase of Apotea, the customer orders were loaded in the same vehicles that transported goods from the neighboring company.

All respondents are located outside central areas for different reasons, but the logistics sprawl trend can clearly be identified, which is one of the main trends that impacts land-use (Allen et al., 2012; Sakai et al., 2018; Dablanc, 2014). All of the respondents, expect Bokus, have large warehouses and locating these warehouses in urban areas would result in unreasonably high costs in relation to low margins, which are common for e-commerce companies in general (Diziain et al., 2012).

Target customers

Joong-Kun Cho et al. (2008) stated that an online retailers' success much depends on the capability to adapt to its target customers' demand. All respondents are successful companies within their line of business and are well aware of their customers' demand and preferences of delivery time and options. Jakubicek and Woudsma (2011) argued that companies choose to locate their warehouses depending on where their target customers are located. All of the respondents, except Bokus, have warehouses located in proximity to a large share of the customers. Bokus chose to locate close to its largest supplier, in order to minimize the supply chain's bottleneck. The majority of Boozt's customers are located in the Greater Copenhagen region, within a short distance from their warehouse by using the road network. Ellos has customers evenly distributed all over Scandinavia and according to the company, the warehouses in Borås are almost equally as close to Stockholm as to Copenhagen. Apotea's target customers are people living all over Sweden, which makes it difficult to be located close to the customers. However, Apotea's location in Stockholm-Mälardalen should be considered as a good location to be able to reach many potential customers within a short time interval. Additionally, the location in Morgongåva provides access to both the northern and southern parts of Sweden within less than 24 hours.

Kang (2017) argued that the locational choice of warehouses depends on whether the warehouse primarily serves the local or a non-local market. If Sweden or Scandinavia is considered to be the local market, all respondents have located their warehouses in the approximate center of their customer markets. Boozt and Ellos primary markets are several countries in Scandinavia, meanwhile Bokus and Apotea focus on the Swedish market. Does having several countries as target markets make Boozt and Ellos serving a non-local market? Boozt emphasizes that proximity to transport infrastructure and airports are important, which is congruent with the theory and findings in the study by Kang (2017).

Both Boozt and Ellos argued that their warehouses are located at the center of their main customer markets. Ellos' proximity to Gothenburg and fairly short distance to both the Greater Copenhagen region and Stockholm-Mälarden gives them a high reach of potential customers. Boozt's location within the Greater Copenhagen region and the proximity to airports enables the company to reach many customers within a short time. Apotea's location in Stockholm-Mälardalen gives high access to many potential customers in the region, without facing large issues with congestion on the road network. Bokus' approach differs from the other respondents, as the warehouse is not located in proximity to one of the larger primary regions.

Distance to transport infrastructure

Two of the four respondents, Ellos and Boozt, have a warehouse located within five kilometers to a main road. Apotea and Bokus are located in more rural areas and do not have one of the specified main roads nearby. Ellos ranked “Distance to infrastructure” as the most important aspect and emphasized the great accessibility that RV40 provides. Boozt also mentioned that the proximity to E6/E20 is highly important for the company, which is in line with the results in the study of Jakubicek and Woudsma (2011).

Dablanc (2007) argued that both the proximity to highways and airports are important to manage the logistics. None of the respondents are located close to one of the largest airports in Sigtuna or Härryda. Boozt is located close to a smaller airport that is frequently used in order to manage fast deliveries to customers. Approximately 90 percent of all Boozt’s consignments are sent as air freight and only 10 percent are transported by road vehicles. This transportation approach or strategy is different than the other companies’, which transports all or the majority of the customer orders by road. For Boozt, proximity to the airport is one of the most important aspects of their warehouse localization. Air freight transportation enable fast deliveries to many customers all over Scandinavia and even same-day delivery to some locations. The possibility to fast deliveries is considered to be a competitive advantage and therefore of high importance. The other companies stated that the distance to a large airport had little or none impact on the decision regarding warehouse localization. This study’s findings are in line with the study of Jakubicek and Woudsma (2011), which showed that almost 30 percent of the companies claimed that the proximity to the airport was not important at all.

None of the respondents are located in the same municipality as one of the largest five container ports in Sweden. All respondents stated that this aspect had no impact on the warehouse location and Apotea and Bokus said that it was not relevant for the company at all. None of the respondents uses seaports to transport customer orders, which explains the factor’s low importance. Jakubicek and Woudsma (2011) showed that a short distance to a seaport is not considered to be highly important. For companies that are more engaged in international trade, the relative importance of seaports increases compared to companies focusing on the local or national market (Kang, 2017). Apotea and Bokus are not engaged in international trade in the same extent as Boozt and Ellos, which serves customers all over Scandinavia. However, the Scandinavian market is geographically small and sea transports are not used for customer deliveries. With a relatively small geographical international market, it could be discussed if Boozt and Ellos should be considered to be engaged in international trade, or if they serve an extended local market. The port of Gothenburg is important for Ellos, as the majority of the products are delivered from the foreign suppliers to Ellos via long-distance ocean transportation. However, as the products from the suppliers have been transported during a long period of time before reaching the port of Gothenburg, the final leg of the transport to the warehouse composes a very small share of the total transport time. Therefore, Ellos argues that it does not matter greatly if the transport time between the port of Gothenburg and the warehouse is half an hour, one hour or two hours.

In the case of Apotea, it could be argued that the company took advantage of the short distance to transport infrastructure. Not transport infrastructure in terms of large roads or ports, but transport infrastructure in terms of current freight transportation routes. New routes were not required to be negotiated with the freight transportation companies in the startup phase of the company, which resulted in cost-savings and possibilities to invest in other areas. As

companies in the startup phase, in general, lacks negotiation power compared to large freight transportation company, they could benefit from locating in clustered areas with other large companies with a high demand for freight transportation.

Warehouse costs

Ellos, Boozt and Apotea have large warehouses, sizing between 32,000 m^2 to 60,000 m^2. Bokus differs with its small warehouse of only 2,500 m^2 and should according to the company be regarded more as a consolidation center. The size of the warehouse has according to Heitz and Beziat (2016) an effect on were the optimal warehouse localization is. The authors mean that the larger the warehouse, the larger effect land price has on choice of localization. The larger warehouse size, the greater costs of land or warehouse rental costs. For companies with large warehouses, the cost of the warehouse could have a large impact on overall costs. However, none of the respondents ranked the costs of land or rental costs as the most important aspect or the least important aspect during the interviews. The costs of land or rental costs were considered to be of medium-importance. All respondents stated that costs are important to consider, but other factors are of higher importance. According to Ellos, the costs of land are only a small part of the total costs and to make a good decision, all costs should be included when deciding where to locate a new warehouse. The relative low importance of costs differs from the findings of Jakubicek and Woudsma (2011), which showed that costs for land and tax rates are among one of the most important factors. The statements by Kang (2017) regarding costs' relative importance compared to proximity to customer market, business clusters and access to employees, can neither be verified by this study's findings.

Kang (2017) reflected on the fact that land costs sometimes are lower prioritized than other aspects, such as proximity to customers. It is more likely that companies located in central areas are less sensitive to high costs for land, than companies located in more rural areas. Companies located in central areas most likely have other motives for their location other than costs, for example proximity to customers. None of the four respondents are located in an urban area and three of the companies are located in suburban areas or in the hinterland within fairly short distance to larger customer markets. Only Bokus' location could be considered to be rurally located. The three other companies are located in areas that likely are carefully evaluated in terms of the trade-off between costs for land and proximity to customer markets.

Several studies (Hesse, 2004; Cidell, 2010; Leight & Hoelzel, 2012, see Aljohani & Thompson, 2016) have observed warehouse centralizing, the movement of using few, large warehouses instead of several small warehouses. This movement was also identified among this study's respondents. Ellos is currently building a new, larger warehouse that will replace three of the smaller warehouses, decreasing the number of warehouses from five to three facilities. Larger warehouses require access to large areas of available land, which could be both costly and difficult to access. Three of the respondents have large warehouses and Bokus has a smaller facility. Bokus' facility is the only warehouse that has the potential to be located in a central area based on its size, as the other companies' warehouses require enormous areas of land. Despite the possibilities, the smallest warehouse among the respondents is the warehouse located in the most rural area. However, the locational decision of Bokus stems from other reason as previously described. To date, none of the respondents are interested to be located in more central areas in order to manage faster deliveries.

Access to employees

Apotea values the access to employees high and their location in Morgongåva provides the company with a good access to a "low-skilled job market", employees that did not pursue higher education. In the same time, Apotea faces challenges when it comes to recruiting employees with a higher education, as workers with higher degrees tend to live in more central areas. Employees that work in Apotea's warehouse do not require a higher education, but job positions that involve working with prescribed medicines or similar tasks require pharmaceutical education. Apotea argues that by being located in a small town such as Morgongåva tends to result in motivated and loyal employees with high work ethics. Apotea argued that it differs from more urban areas, in which there are more job opportunities for the low-skilled job market and easier to switch between different employers.

The large majority of the employees in Morgongåva works in the warehouse, which makes the access to a low-skilled job market more important than a high-skilled job market. These results comply with the study of Heitz and Beziat (2016), which showed that the access to low-skilled employees are valued higher when it comes to warehouse employees. Simultaneously, these findings are not in line with the study of Jakubicek and Woudsma (2011), which showed that their studied companies prioritized high-skilled employees. The later study explained that the shift towards a higher demand for high-skilled workforce stems from warehouses becoming automated in a larger extent. Kang (2017) suggested that the changes in supply chains, stemming from increased globalization, have contributed to an increased presence of automated warehouses which could impact the optimal warehouse localization. A fully automated warehouse does not require as many low-skilled workers as traditional warehouses, as new technologies and machines replace manual labor. To date, the warehouse of Apotea is not automated and it could explain the discrepancy between this study's findings and the study of Jakubicek and Woudsma (2011). None of the respondents has a fully automated warehouse and therefore also a need to access low-skilled employees.

For Bokus, access to temporary employees is vital in order to manage the seasonal fluctuations. Certain holidays during the year could result in a 400 percent order increase, which challenges the company and the ordinary employees. Ellos and Boozt do not prioritize access to employees specifically high and do not consider it to be a strategic question. The management of Ellos views access of employees as highly important but cannot identify the direct connection between warehouse localization and access of employees. Ellos location in Borås provides high access to a large job market within a short geographical distance, having Sweden's next largest city within commuting distance. Ellos has no issues with recruiting employees today and cannot see how it would be any different with the new warehouse, located in the proximity of current facilities. The recruitment of employees and access to workers are viewed as important aspects that will solve themselves, rather than strategic questions for the top management.

Other location aspects

All respondents are located in industrial areas, far away from residential areas. This means that the companies are not restricted in their operations in terms of noise regulations or other similar regulations, exemplified in the literature by Rodrigue et al. (2013) and Uherek et al. (2010). Due to the respondents' presence in industrial areas, no company claimed that operations around the clock was of high importance. These results differ from the findings of

the study by Jakubicek and Woudsma (2011), which showed that the studied companies valued a restriction-free location. Apotea even stated that it is laws and regulations regarding working hours that restrict the possibilities for operations around the clock, rather than the geographical location of the warehouse.

All respondents were satisfied with the municipality in which the warehouses are located within, but only Bokus and Apotea argued for the importance of the public stakeholders and municipality. None of the respondents agreed with the view of Gordon (2005, see Jakubicek & Woudsma, 2011), who claimed that the decision-makers tend to restrict companies and prioritize other needs in the society. In smaller municipalities, which is the case for both Apotea and Bokus, a large company could be the most important employer in the region. The relative importance of Apotea and Bokus is high in their municipalities and the decision-makers are likely to be eager to collaborate with the companies, to ensure that they stay in the region. For larger municipalities and regions, in which both Ellos and Boozt operate within, the individual companies could be less important as there are more companies present in the area. If a large company moves from a municipality, the impact will be larger for smaller municipalities.

Importance and satisfaction matrix

The previous sections described the respondents' views of some characteristics of a geographical location and the following sections aim to categorize some of these factors in the importance-satisfaction matrix, adapted from Jakubicek and Woudsma (2011), which were illustrated in the literature review as figure 2.1. If the respondents classified or ranked a characteristic as low or medium-important, they are classified as "lower importance". Only characteristics that specifically were described as "highly important" received this classification. Characteristics with non or little relevance and of low or medium-importance were classified as neutral effects.

There were some similarities but also some differences between the four respondents. All companies claimed that they were satisfied with their current location and could not forecast a movement in the near future. As no respondent was unsatisfied with aspects of high importance, no push factors could be identified. All companies claimed that proximity to the road network was of high importance and no company claimed that they were unsatisfied, which makes the proximity to highways a retain factor. Another retain factor for Boozt, who uses air freight transportation in a great extent, is the proximity to airports. Proximity to seaports are not of high importance for any of the respondents and not relevant at all for Apotea and Bokus. Ellos is satisfied with the company's location in relation to the seaport and do not find any need to be located closer, as it does not impact the transportation time to end-customers.

A good access to employees and available workforce is highly valued and regarded as a retain factor for Apotea and Bokus. Even if Ellos claims that it is important, it is not a considered to be a strategic issue and something that "solves itself", and therefore classified as lower importance in this matrix, becoming a slightly retain factor. For Apotea and Boozt, a good business environment and an enterprise-friendly municipality are considered to be of high importance. Both companies are satisfied with the municipality they operate within and it is therefore classified as a retain factor. Both Ellos and Bokus are satisfied with the support from its municipality, but the companies do not consider this aspect to be as important as other aspects. The possibilities to operate around the clock are not applicable or relevant for any of

the respondents, as the respondents are located in industrial areas without such restrictions nor even apply operations around the clock nowadays. All companies classified warehouse costs as “medium-importance” and no company stated that they were directly unsatisfied with its current costs.

	LOWER SATISFACTION	**HIGHER SATISFACTION**
LOWER IMPORTANCE	*NEUTRAL EFFECTS* PROXIMITY TO SEAPORTS (BOOZT, APOTEA, BOKUS) PROXIMITY TO AIRPORTS (ELLOS, APOTEA, BOKUS) 24/7 OPERATIONS (ALL)	*SLIGHTLY RETAIN* PROXIMITY TO SEAPORT (ELLOS) ACCESS OF EMPLOYEES (BOOZT, ELLOS) WAREHOUSE COSTS (ALL) THE ROLE OF MUNICIPALITY (BOKUS, ELLOS)
HIGHER IMPORTANCE	*PUSH FACTORS* NO FACTORS IDENTIFIED	*RETAIN FACTORS* PROXIMITY TO AIRPORT (BOOZT) PROXIMITY TO ROAD NETWORK (ALL) ACCESS OF EMPLOYEES (APOTEA, BOKUS) THE ROLE OF MUNICIPALITY (APOTEA, BOOZT)

Figure 5.1 The relationship between importance and satisfaction for the respondents (based on Jakubicek & Woudsma, 2011).

5.4 Challenges and opportunities

All the respondents stated that keeping the promised delivery time is important, since customer’s satisfaction often reflects upon the company’s performance in relation to the expectations. This means that it is better for a company to promise delivery within three days and deliver after two days, than the opposite. In order to manage the short delivery times that is promised, both Apotea and Boozt use plenty of different delivery options to customers. Apotea stands out in the sample, with its eleven delivery possibilities within Sweden. Boozt on the other hand manages the short delivery time by using air transport for the majority of their deliveries. Boozt also uses several different freight companies for deliveries to end-customers but not as many as Apotea. Ellos only uses Postnord and DHL and Bokus uses Postnord, Schenker and CityMail.

The difference between “wanting” and “willingness to pay” for it

One aspect to consider before relocating to an urban area is the customer demand. When all respondents were asked what delivery time their customers expect, they all answered similarly that the customers demand as fast deliveries as possible. Ellos stated that they follow the market development and acts on changes on the demand regarding transportation time but chooses not to lead any changes. Ellos further argued that customers easily adapt their expectations based on new standards. For example, if customers receive their orders the next-

day or the same day for other commodities and from other companies, there will most likely be a shift and a higher request or demand regarding the products from Ellos.

The respondents stated that their customers are demanding faster deliveries but very few of the customers were willing to pay an extra fee to receive their package faster. What was the most important aspect to consider is according to all of the respondents to deliver within the promised delivery time. Liu et al. (2008) also stated that fast deliveries are important, but most important is to achieve what is promised in regards of delivery time. Both Apotea and Ellos elaborated on the difference between demand and the willingness to pay for what is demanded. Buldeo Rai et al. (2018) mentioned that there is a challenge to find a solution that is optimal for both the end-customers and still economically sustainable for the companies. Ellos customers can choose express delivery to receive the orders next-day, but only 10 percent of the customers are willing to pay for this service.

The respondent from Bokus stated that the majority of their customers thought it was more important to be able to trace their package from order until delivery than faster deliveries. There is a difference between wishing for fast deliveries and the reality that somebody needs to pay for the transport. The low share of express deliveries could indicate that Ellos' customers might not be mature or willing to pay for even faster deliveries than next-day. Possible explanations could be the commodity type or the customer group. The main customer of Ellos is a woman who orders products, not only to herself, but also to other family members. Normally, clothing and footwear items do not stem from an immediate need, which could indicate that customers are willing to wait longer than for other commodities with a more urgent need. One reason for customers to choose e-commerce over traditional retailers is the possibility to purchase the demanded product to a lower cost (Gangeshwer, 2013). The strive for buying products to lowest possible price could be an explanation to the unwillingness to pay for faster deliveries. Apotea cannot see that their customers are willing to pay for even faster deliveries than the company offers today. Many of the products are not directly linked to the company or the brand Apotea. If there would be an urgent need for any of the products that Apotea sells the products or substitutes could be purchased in physical stores. Instead, Apotea's competitive advantage is the large number of different products to a low cost. Therefore, it is difficult to offer ultra-fast deliveries, for example within a couple of hours, as it today is connected with high costs. Apotea has a broad variety of items and a micro warehouse in an inner-city area would not be able to serve many customer orders, as such a small warehouse would not be able to store many of the available items. Only a limited range of the orders could be served by a micro warehouse and would therefore not be economically sustainable.

Feasible - but is it worth the costs?

Some of the respondents, Apotea and Boozt, offers same-day deliveries to some locations. All of the respondents, expect Apotea, said that a delivery time of two hours or less is impossible today with the current company setup. Apotea suggests that it is theoretically possible, but not realistic. Deliver parcels to customers within a very limited time frame would almost result in a "courier service". This view is in line with challenges mentioned in previous research by for example Rodrigue et al. (2013) and Allen et al. (2018) who argue that managing fast deliveries within limited time windows is difficult to do sustainably. The CEO of Apotea stated that it could be executed to certain regions, but at what cost? Last-mile transportation is considered to be inefficient and transporting single parcels to one or few addresses, similar to a taxi service,

would both generate significantly higher transportation costs and a more negative impact on the environment. Morganti et al. (2014) argued that e-commerce companies are adapting to the demand of faster and faster deliveries and some companies even offer delivery within 90 minutes from placed order. The question is what effect this have on economical or environmental sustainability for the companies who offers this type of delivery service?

Yu et al. (2017) argued that the logistics costs for an e-commerce company make up for a considerable part of an e-commerce company's costs. Therefore, the localization of the warehouse becomes a strategic choice, which is the case for three of the respondents. Selko (2016) stated that there is a large demand for faster deliveries and one way to respond to this demand without increasing the last mile costs is to locate the company's warehouse close to the target customers. However, traffic congestion during peak hours in large metropolitan areas needs to be considered. A short transport distance is not a guarantee for a fast delivery. Apotea argued that even if the company's warehouse was located closer to a large city, for example Stockholm, it could still take the vehicle two hours to drive across the city during certain time periods.

Environmental and social challenges

Another cost for the society is the environmental impact that transporting parcels contributes to. One way to lower the environmental impact on e-commerce deliveries to end-customers, while still managing the demand of faster deliveries, is to locate a warehouse in close proximity to large cities or even in cities (Heitz & Beziat, 2016). None of respondents thought this was a feasible solution. The respondent from Apotea argued that, even though Apotea manages next day deliveries to the majority of their customers, customers purchased products from Apotea because of their low prices, not fast deliveries.

Amling and Daugherty (2018) argued that the traditional way of distributing goods is not sustainable when distributing parcels to end-customers. The large number of parcels to the many different addresses together with urbanization and increased congestion challenge how to distribute the parcels. Both the respondents from Apotea and Boozt stated that from a cost or environmental perspective, shorter delivery times do not make sense. The respondent from Apotea also questioned the point of receiving parcels even faster - and continued with claiming that if there was an urgent need, many of the products the company sells can be bought in a physical store.

Buldeo Rai et al. (2018) also questioned the degree of sustainability that can be reached with current delivery methods in e-commerce. Last mile transportation is rarely efficient or sustainable as it is today, as it generates additional trips and adds pressure on an already strained road network (ibid.). If even shorter delivery times resulted in lower filling rates in vehicles, generate extra trips and added number of vehicles, it would contribute to more negative impacts on both local, regional and global level (Blinge, 1996, see Lumsden, 2012). Additional vehicles on the roads, especially in central areas, contribute to more congestion if the vehicles are using the road network during peak hours. The respondent from Ellos stated that to manage faster deliveries, other distribution methods are required. All respondents claim that the current last-mile transports cannot be both sustainable and as fast as the customers likely are to demand in the future. To be both sustainable and fast, new developments in technology or other transport solutions are necessary.

6 Concluding remarks and future research

This final chapter summarizes the findings and provides the concluding remarks of this study. The research questions are answered and some ideas for future research are suggested.

This study has provided an overview of the geographical location of warehouses belonging to the largest e-commerce companies in Sweden. The capacity in terms of delivery time has been analyzed and preferences regarding geographical features of locations have been reviewed. Challenges and barriers towards faster deliveries have been identified and the final conclusions of this study are presented in following sections.

6.1 Conclusions

The growth of e-commerce sales combined with the demand for faster deliveries challenge the possibilities to achieve efficient last-mile deliveries. Sweden is a geographically large country that is sparsely populated which could contribute to less efficient transports and impact the operations of the e-commerce companies. The choice of warehouse localization could be vital to manage short transportation times the end-customers. In this thesis, the transport time between warehouses and residential addresses were analyzed and the result showed that the closer a warehouse is located to a densely populated area, the higher possibility to reach potential customers within the shortest time intervals. This is explained by the proximity to many residential addresses in urban areas. In this sample, warehouses located within the region of Stockholm-Mälardalen have the highest population reach given all time intervals. Locations in the inner city of Stockholm give the largest reach within the shortest time intervals and locations in suburban areas of Stockholm have higher reach regarding the longer intervals. Within the longest transportation time of 90 minutes, warehouses located close to more than one densely populated region showed to have the highest potential customer reach. In this study, the optimal location within a time interval of 90 minutes showed to be Eskilstuna.

The maximum share of population that a warehouse can reach within 15 minutes is close to 15 percent. Within 30 minutes, the maximum reach is almost 20 percent. Given a transport time of 45 minutes, the maximum reach is 22 percent and within one hour, 24 percent of the Swedish population can be reached. The largest reach in the sample is close to 29 percent, which requires a time interval of 90 minutes. The results show large variations in population reach among the warehouses. The average reach within 15 minutes are 3,2 percent, 5,8 percent within 30 minutes, 7,7 percent within 45 minutes, 10 percent within 60 minutes and 15,8 percent within 90 minutes. No unique location has a population reach higher than 30 percent within the longest time interval in this study. This means that in order to reach a larger share of the population, it is required to either utilize more than one warehouse in different geographical regions or to increase the time interval for deliveries. By increasing the transportation time, the relative lead time decreases, which could be problematic if companies aim to manage same-day deliveries.

Among the 20 warehouses with the highest population reach, there are both similarities and differences. Within the shortest and the longest time interval, warehouses in all sizes and from all commodity categories are represented. The warehouses with the highest population reach within the shortest time interval are located in proximity to Stockholm city center. One observed difference, within the shortest time interval, was the large representation of small warehouses

compared to the distribution in the sample. 70 percent of the warehouses with the highest reach were smaller than 5,000 m^2, which could be compared to representation of 42 percent in the entire sample. This indicates that e-commerce companies' warehouses located in urban areas tend to be smaller than warehouses in the hinterland. This finding is supported by previous research that suggests that costs and limitations in available land are two main reasons why smaller warehouses are more common in central areas.

Within the shortest time interval, the commodity category Groceries are higher represented compared to the sample average. A substantially higher share of the warehouses within the category can reach five percent of the population within the given time interval. It could be explained by the fact that all warehouses within the category are located in one of the primary regions, which are all densely populated. Besides warehouse size and commodity category, the companies' turnover was compared to their warehouses' population reach. No clear relationship between turnover and population reach was identified in this study.

Proximity to transport infrastructure, in terms of proximity to a main road, showed to be highly prioritized, supported by both the qualitative and quantitative part of this study. Over two thirds of the companies in the quantitative study are located close to a main road and all interviewees in the qualitative study ranked this characteristic high. Other types of transport infrastructure, proximity to seaports and airports, showed not to be highly prioritized by the respondents in the qualitative study. These findings are strengthened by the fact that the majority of the e-commerce companies in the quantitative study were located with a large distance to this infrastructure.

Costs of land or rental costs for warehouses showed to be less important in relation to other aspects, such as distance to customers, transport infrastructure and access to employees. Half of the interviewees valued access to employees high meanwhile the other half did not consider that to be a strategic matter. All interviewees argued that their municipality were supportive and actively investing in sustaining a good business environment. Half of the interviewees found this important and the other half stated although it was a positive feature, it did not have an impact of the locational decision. Operations around the clock were not prioritized.

The qualitative study showed that some companies offer same-day deliveries to customers located in certain parts of Sweden, but the large majority of customers receives delivery within one to three business days, depending on customers' delivery choice. The companies that offers same-day delivery stated that it is not the geographical location of the warehouses that is the fundamental barrier to manage faster deliveries. Other aspects, such as inhouse operations or the limitations of the third-party logistics providers, could have a larger impact on the possibility to increase the share of same-day deliveries. Depending on the e-commerce companies' core business strategy, the possibilities to manage fast deliveries differs. Companies with a low-cost approach are less likely to prioritize the fast, high cost deliveries. Businesses that specializes on superior logistics and fast deliveries are more likely to prioritize high speed deliveries over costs.

This study shows that Swedish e-commerce companies could manage a transportation time of less than 24 hours to almost all residential address within the country. However, the total delivery time depends on many different activities and choices and is often substantially higher than only the transportation time. Today, the warehouse location is not the limitation to manage

same-day deliveries but could impact the possibilities to deliveries within even shorter time intervals, for example a couple of hours, which could be the reality for e-commerce companies in the near future.

A fundamental issue or barrier for transforming the standard deliveries, from a couple of days to same-day delivery, is the lack of incentives for the e-commerce companies. The transportation costs will be significantly higher, especially when the delivery time is restricted to a couple of hours. There are not many customers that today are willing to pay additional freight costs for express delivery, which arises the question - who will pay for this service?

6.2 Suggestions for future research

The e-commerce industry is changing rapidly with new companies emerging and present companies developing through mergers and acquisitions. This study has captured a specific moment in time regarding warehouse localization. A suggestion for further research is executing a longitudinal study, following e-commerce companies' warehouse location over time. This could show how the companies adapt to changes in customers' demand for fast deliveries within limited time windows. By applying a geographical approach to a longitudinal study, it could show how the built environment changes over time and possibly identify the next trend after logistics sprawl.

This study compared transportation time between warehouses and residential addresses in Sweden. The transportation time between a warehouse and an end-customer is only a fraction of the total lead time. Another suggestion to further research is to study all parts of the lead time, from order placement to final delivery. This would require an increased scope of the study, including a larger number of stakeholders and variables. This study is limited to the Swedish context and cannot be fully generalized to other regions or parts of the world with other geographically preconditions. Regions with higher population density are likely to show different results and the findings could be of interest for different stakeholders within e-commerce.

The literature review in this thesis showed that new technologies and innovations could have a significant impact on last-mile deliveries. Autonomous vehicles, drones, unattended deliveries are examples of innovations and technologies that possibly could revolutionize the e-commerce industry and impact the optimal choice of warehouse location greatly. The final suggestion for future research is to conduct a study of how new developments in technology impacts the optimal choice of warehouse location.

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Appendix 1

Compilation of the quantitative data

						% of population that can be reached within X minutes				
ID	**Location**	**Coordinates**	**Warehouse size**	**Commodity**	**Turnover**	**15min**	**30min**	**45min**	**60min**	**90min**
1	Rosersberg	59.571919, 17.876209	10,000+	Electronics & computers	8689669	3,22%	15,20%	21,72%	23,92 %	27,00%
2	Ljungby	56.818187, 13.901006	10,000+	Electronics & computers	1721072	0,00%	0,22%	0,50%	1,95%	5,75%
3	Borås	57.693629, 12.820468	10,000+	Clothing & footwear	1619359	0,52%	1,18%	1,86%	4,05%	14,55%
4	Morgongåva	59.936356, 16.955681	10,000+	Others	1449069	0,07%	0,38%	2,74%	5,11%	21,21%
5	Strövelstorp	56.190844, 12.851474	10,000+	Clothing & footwear	1407400	0,42%	1,84%	3,97%	5,60%	13,17%
6	Falkenberg	56.888773, 12.482667	10,000+	Clothing & footwear	1195213	0,45%	0,97%	1,69%	5,70%	13,03%
8	Morgongåva	59.938205, 16.948473	10,000+	Health & beauty	967620	0,07%	0,37%	2,72%	5,08%	20,90%
9	Bromma	59.350153, 17.966581	10,000+	Groceries	961363	12,41%	18,63%	21,03%	23,96 %	27,45%
10	Mölndal	57.674222, 12.012556	0-2,499	Groceries	961363	6,05%	8,28%	9,51%	11,60 %	14,68%
11	Arlöv	55.646129, 13.077072	7,500-9,999	Groceries	961363	4,75%	6,57%	8,31%	9,98%	12,57%
12	Helsingborg	56.019349, 12.709340	10,000+	Machinery, raw materials etc.	927830	1,38%	2,79%	5,00%	9,44%	13,07%
13	Trollhättan	58.275664, 12.326098	10,000+	Health & beauty	805172	0,85%	1,50%	2,28%	4,69%	15,05%
14	Ängelholm	56.253792, 12.904945	10,000+	Machinery, raw materials etc.	718467	0,42%	1,84%	3,97%	5,60%	13,17%
15	Mölnlycke	57.670764, 12.130118	10,000+	Groceries	701741	4,64%	7,92%	10,12%	11,38 %	14,62%
16	Mölndal	57.671115, 12.015013	0-2,499	Groceries	701741	5,97%	8,26%	9,49%	11,56 %	14,66%
17	Eskilstuna	59.366820, 16.699506	10,000+	Sports & leisure	701634	0,85%	1,27%	2,57%	5,55%	28,67%
18	Göteborg	57.720955, 11.965998	0	Electronics & computers	687402	6,07%	8,24%	9,51%	11,39 %	14,62%
19	Backa	57.781938, 11.994850	5,000-7,499	Others	637544	5,37%	8,12%	9,49%	11,62 %	14,59%
20	Arendal	57.700114, 11.823053	10,000+	Others	637544	4,45%	7,56%	8,91%	10,28 %	14,26%
21	Kärra	57.781789, 11.994900	5,000-7,499	Others	637544	5,39%	8,12%	9,49%	11,62 %	14,59%
22	Backa	57.767224, 11.999538	7,500-9,999	Others	637544	5,67%	8,13%	9,47%	11,59 %	14,53%
23	Göteborg	57.732172, 11.849215	0	Others	637544	2,11%	6,83%	8,46%	9,62%	13,65%
24	Sävedalen	57.733468, 12.064376	2,500-4,999	Others	637544	5,87%	8,19%	9,45%	11,36 %	14,68%
25	Jordbro	59.144829, 18.110833	10,000+	Electronics & computers	578185	0,88%	12,49%	19,22%	20,98 %	25,01%
26	Falun	60.577994, 15.597628	2,500-4,999	Others	569941	0,00%	0,00%	0,00%	0,00%	0,00%
27	Orrefors	56.841987, 15.748388	10,000+	Furniture & homeware	510752	0,03%	0,24%	0,85%	1,55%	4,27%
28	Jönköping	57.651925, 14.191058	10,000+	Others	501839	1,00%	1,50%	1,99%	3,18%	7,36%
29	Uppsala	59.853699, 17.662082	2,500-4,999	Furniture & homeware	476245	1,72%	2,64%	5,08%	16,56 %	27,63%
30	Vansbro	60.509843, 14.232069	10,000+	Health & beauty	437568	0,00%	0,00%	0,00%	0,00%	0,00%
31	Hägersten	59.296959, 18.013909	10,000+	Sports & leisure	433693	13,64%	19,30%	20,94%	22,48 %	27,68%
32	Lammhult	57.148153, 14.591686	10,000+	Furniture & homeware	417391	0,76%	1,05%	1,48%	2,24%	5,36%
33	Borås	57.727811, 12.921211	7,500-9,999	Clothing & footwear	409842	0,27%	1,10%	2,04%	3,47%	15,88%
34	Växjö	56.886483, 14.733764	7,500-9,999	Sports & leisure	337148	0,76%	1,05%	1,48%	2,24%	5,36%
35	Norsborg	59.255595, 17.859957	10,000+	Machinery, raw materials etc.	322402	7,66%	18,37%	20,72%	22,00 %	26,77%
36	Frölunda	57.650810, 11.943827	5,000-7,499	Groceries	267875	5,65%	8,10%	9,32%	11,32 %	14,50%

37	Årsta	59.295990, 18.031470	2,500-4,999	Groceries	267875	13,61%	19,29%	21,03%	22,22 %	27,61%
38	Arlöv	55.645694, 13.074335	5,000-7,499	Groceries	267875	4,75%	6,57%	8,31%	9,98%	12,57%
39	Farsta	59.241034, 18.118101	2,500-4,999	Clothing & footwear	252544	10,98%	18,58%	20,62%	21,83 %	26,35%
40	Trollhättan	58.320195, 12.314368	0-2,499	Clothing & footwear	250142	0,85%	1,50%	2,28%	4,69%	15,05%
42	Malmö	55.575129, 12.931788	2,500-4,999	Furniture & homeware	236653	3,47%	5,94%	7,17%	9,32%	12,13%
43	Malmö	55.614512, 13.013200	2,500-4,999	Furniture & homeware	236653	4,24%	6,20%	7,50%	9,71%	12,40%
44	Kista	59.421047, 17.914406	5,000-7,499	Clothing & footwear	229036	9,52%	18,27%	21,17%	23,99 %	27,06%
46	Helsingborg	56.069390, 12.783226	10,000+	Clothing & footwear	218829	1,38%	2,79%	5,00%	9,44%	13,07%
47	Växjö	56.887228, 14.729310	10,000+	Health & beauty	216712	0,69%	0,99%	1,36%	2,16%	4,98%
49	Helsingborg	56.014138, 12.768989	10,000+	Sports & leisure	208109	1,38%	2,79%	5,00%	9,44%	13,07%
50	Falkenberg	56.916843, 12.497592	5,000-7,499	Sports & leisure	199556	0,45%	0,97%	1,69%	5,70%	13,03%
51	Kvänum	58.326464, 13.118361	10,000+	Sports & leisure	198649	0,17%	0,78%	2,74%	6,26%	15,63%
52	Skurup	55.483500, 13.488494	7,500-9,999	Furniture & homeware	191261	0,23%	1,58%	7,01%	7,91%	11,48%
53	Täby	59.448227, 18.129914	0-2,499	Health & beauty	186864	4,70%	17,51%	21,02%	23,44 %	26,25%
54	Malmö	55.612318, 13.011578	5,000-7,499	Others	185773	4,25%	6,20%	7,49%	9,73%	12,40%
55	Karlstad	59.391995, 13.573860	2,500-4,999	Machinery, raw materials etc.	185346	0,90%	1,30%	1,57%	2,32%	4,57%
56	Borås	57.693629, 12.820468	10,000+	Furniture & homeware	185229	0,52%	1,18%	1,86%	4,05%	14,55%
57	Jönköping	57.693068, 14.155979	10,000+	Others	184104	1,00%	1,50%	1,99%	3,18%	7,36%
58	Kalmar	56.698026, 16.320806	2,500-4,999	Furniture & homeware	183399	0,63%	0,96%	1,24%	1,71%	3,03%
59	Borås	57.717842, 12.942376	2,500-4,999	Clothing & footwear	178483	1,01%	1,62%	2,93%	10,09 %	17,01%
60	Fåglum	58.128299, 12.777457	2,500-4,999	Electronics & computers	174651	0,17%	0,78%	2,74%	6,26%	15,63%
61	Hägersten	59.304935, 18.009814	0-2,499	Machinery, raw materials etc.	165960	14,05%	19,22%	20,98%	22,95 %	27,95%
62	Borås	57.689978, 12.810726	2,500-4,999	Furniture & homeware	159961	0,52%	1,18%	1,86%	4,05%	14,55%
63	Trollhättan	58.297375, 12.304886	10,000+	Clothing & footwear	158844	0,85%	1,50%	2,28%	4,69%	15,05%
64	Borås	57.722790, 12.876410	2,500-4,999	Clothing & footwear	147049	0,27%	1,11%	2,04%	3,47%	15,88%
65	Borås	57.693629, 12.820468	5,000-7,499	Clothing & footwear	146361	0,52%	1,18%	1,86%	4,05%	14,55%
67	Kungsängen	59.505991, 17.737199	10,000+	Health & beauty	143947	0,05%	0,81%	9,71%	20,40 %	26,61%
68	Upplands-Väsby	59.516923, 17.899102	0-2,499	Sports & leisure	141230	3,22%	15,20%	21,72%	23,92 %	27,00%
70	Kista	59.402134, 17.963905	2,500-4,999	Health & beauty	138553	11,30%	18,69%	21,02%	23,97 %	27,14%
71	Norrköping	58.611020, 16.154754	2,500-4,999	Furniture & homeware	137845	1,20%	1,68%	3,31%	4,54%	6,98%
72	Rosersberg	59.575846, 17.884506	5,000-7,499	Health & beauty	136102	3,22%	15,20%	21,72%	23,92 %	27,00%
73	Stockholm	59.334978, 18.034318	0	Health & beauty	135636	14,50%	19,47%	21,17%	23,98 %	27,92%
74	Norrköping	58.594360, 16.220042	7,500-9,999	Others	134695	1,20%	1,68%	3,31%	4,54%	6,98%
75	Borås	57.727891, 12.921262	5,000-7,499	Clothing & footwear	133789	0,27%	1,11%	2,04%	3,47%	15,88%
76	Borås	57.696215, 12.834090	5,000-7,499	Others	133786	0,69%	1,28%	2,00%	5,71%	15,01%
79	Göteborg	57.742188, 11.865819	10,000+	Furniture & homeware	130211	1,38%	6,65%	8,39%	9,52%	13,62%
80	Göteborg	57.724118, 11.980920	2,500-4,999	Clothing & footwear	128525	5,89%	8,18%	9,44%	11,31 %	14,63%
81	Habo	57.904636, 14.100090	2,500-4,999	Health & beauty	126241	0,22%	1,28%	1,90%	3,22%	7,37%
82	Västervik	57.745227, 16.628271	7,500-9,999	Health & beauty	124813	0,23%	0,26%	0,31%	0,37%	1,20%
84	Landvetter	57.687441, 12.162682	0-2,499	Others	117300	4,64%	7,92%	10,12%	11,38 %	14,62%
85	Götene	58.533297, 13.483109	0-2,499	Sports & leisure	111261	0,13%	1,05%	1,98%	2,54%	5,19%
86	Norsborg	59.230903, 17.830200	10,000+	Furniture & homeware	110822	13,61%	19,29%	21,03%	22,22 %	27,61%

88	Växjö	56.887228, 14.729310	10,000+	Electronics & computers	106000	0,69%	0,99%	1,36%	2,16%	4,98%
89	Gävle	60.639751, 17.129037	5,000-7,499	Others	103924	0,02%	0,91%	1,42%	1,72%	4,52%
90	Trollhättan	58.296868, 12.331280	0-2,499	Sports & leisure	103066	0,85%	1,50%	2,28%	4,69%	15,05%
91	Eskilstuna	59.365912, 16.692865	5,000-7,499	Furniture & homeware	101341	0,85%	1,27%	2,57%	5,55%	28,67%
95	Nykvarn	59.184226, 17.460459	5,000-7,499	Sports & leisure	97463	0,79%	3,04%	15,67%	20,62 %	24,99%
96	Tyresö	59.239101, 18.210296	2,500-4,999	Health & beauty	94248	6,48%	17,14%	19,78%	21,49 %	25,33%
97	Sollentuna	59.492342, 17.924555	5,000-7,499	Others	91647	4,40%	16,33%	22,17%	23,94 %	26,98%
98	Mörrum	56.193401, 14.752749	0-2,499	Machinery, raw materials etc.	88534	0,33%	0,75%	1,34%	2,91%	5,39%
99	Frölunda	57.654437, 11.935557	2,500-4,999	Electronics & computers	85355	5,74%	8,13%	9,30%	11,32 %	14,56%
100	Västerås	59.611629, 16.614382	0-2,499	Sports & leisure	83946	0,94%	1,70%	2,59%	5,38%	21,87%
101	Eskilstuna	59.388174, 16.490374	2,500-4,999	Machinery, raw materials etc.	82880	0,85%	1,27%	2,57%	5,55%	28,67%
102	Stockholm	59.351581, 18.086311	0-2,499	Clothing & footwear	81039	14,50%	19,47%	21,17%	23,98 %	27,92%
103	Jönköping	57.675518, 14.160447	0-2,499	Health & beauty	80316	0,75%	1,45%	2,06%	3,17%	7,20%
104	Glimåkra	56.302769, 14.131132	7,500-9,999	Machinery, raw materials etc.	79082	0,00%	0,00%	0,00%	0,00%	0,00%
105	Nynäshamn	58.922548, 17.934085	0-2,499	Electronics & computers	78694	0,22%	0,57%	7,00%	17,90 %	22,19%
106	Bromma	59.355718, 17.959671	2,500-4,999	Clothing & footwear	78166	13,07%	19,03%	21,09%	24,01 %	27,65%
109	Varberg	57.123539, 12.285842	0-2,499	Sports & leisure	76436	0,45%	0,97%	1,69%	5,70%	13,03%
111	Laholm	56.500246, 13.021211	0-2,499	Machinery, raw materials etc.	75217	0,19%	1,01%	2,31%	4,49%	9,47%

Appendix 2

Quantitative data collection

Part 1. Company characteristics

Size (1-100)

Name

Commodity category

Revenue 2017 (TSEK)

Number of terminals (No.)

Part 2. Terminal characteristics

Warehouse address

Coordinates

Contact Tel No.

Terminal size, M2, measured

Terminal size, M2, by article

Part 3. Geographical characteristics of the terminal(s)

Located in the same municipality as one of the two largest airports, Härryda or Sigtuna (0 or 1)

Located in the same municipality as one of the 5 largest ports (0 or 1)

Located in proximity (<5km) to road “E4” (0 or 1)

Located in proximity (<5km) to road “E6” (0 or 1)

Located in proximity (<5km) to road “E18” (0 or 1)

Located in proximity (<5km) to road “E20” (0 or 1)

Located in proximity (<5km) to road “RV40” (0 or 1)

Appendix 3

Interview guide

Part 1. General questions

1A Please describe your background, working experience and current position at your company.

1B What is your company's field of business within e-commerce?

1C Could you please describe your order processing, from placed customers order to customer delivery?

Part 2. Customers

2A Please describe your customer target group.

2B What kind of delivery options do you offer to your customers?

2C What do your customers expect in terms of delivery times?

Part 3. Current warehouses

3A Where are your current warehouses located?

3B Please elaborate on challenges and benefits with your current location.

3C When did you establish your logistics facility(ies) and what was the reasons behind this choice?

Part 4. Important aspects when locating a new warehouse

4A Which aspects are important when choosing location of a new warehouse?

4B Which aspects are not important?

4C According to previous research, the following aspects have been identified as important when locating a new logistics facility. Please rank them 1-5, 1 being the most important and 5 being the least important. Please motivate your choices.

1. Costs of land
2. Distance to customers
3. Distance to transport infrastructure
4. Possibilities to operations 24/7
5. Access of employees

Part 5. Future challenges and opportunities

5A In the future, customers might demand same-day deliveries or deliveries within a couple of hours. How will you manage such short delivery times?

5B Besides delivery times - what other aspects are likely to impact the choice of geographical location in the future?