Tampere University of Applied Sciences

OPTIMIZATION OF GROCERY E-COMMERCE DELIVERIES

Last Mile Process of Pirkanmaa Area

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ABSTRACT

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Optimization of Grocery E-commerce Deliveries – Last Mile Process of Pirkanmaa Area.
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Demand for home deliveries has increased during the last few years. This is partially due to the covid-19 pandemic but also due the development of digitalisation and change in the remote work possibilities. This increase has also been seen in the demand for retail home deliveries such as groceries.

This thesis studies Posti's current grocery e-commerce operations and their last-mile deliveries. The subject has been chosen due to the increased demand of grocery e-commerce deliveries and the need to match the demand with an improved process. For the research a mixed methods approach using qualitative and quantitative has been chosen. The framework for the thesis consists of process optimization and consumer logistics models as both concepts are integral for the subject.

The data collected during the research shows both technical and operative challenges in the current process. These challenges concern the current delivery areas, loading point and optimization possibilities. Development points for each challenge have been identified based on the data analysis results.

A seven-stage development plan has been created for Posti. The plan gathers findings from data and interview analysis and offers solutions based on them. During the seven stages the plan suggests the following: re-creation of delivery areas, increasing the number of loading points, locating the loading points closer to delivery areas, allocating human and vehicle assets based on analysed delivery amounts new delivery area and re-forming the delivery windows and days based on expected demand.

The plan also recommends that a separate team is put into place for a possible singular implementation to create a risk analysis. The implementation should be approached with caution as some information found in the research phase has a possibility to cause unexpected developments. The information in question is in relation to the demand of specific areas and days.

The findings of this research have been found concrete and if implemented the plan can be followed in parts or as a singular implementation. The support of other stakeholders is highly recommended if Posti chooses to implement the plan in full.

Key words: logistics, e-commerce, grocery, last-mile, e-grocery, supply chain, retail

CONTENTS

ABBREVIATIONS

E-commerce	Electronic commerce
BtoC	Business to consumer
BtoB	Business to business
PDA	Portable digital assistant
KPI	Key performance indicator
Covid-19	Corona virus disease 2019
3PL	Third party logistics
4PL	Fourth party logistics
SC	Supply Chain
SCM	Supply Chain Management
SCF	Supply Chain Flow
CSAT	Customer satisfaction

1 INTRODUCTION

E-commerce or electronic commerce in full means conducting business transactions using computer telecommunications. These transactions include the sales of information, services, and goods. Even though e-commerce commonly refers to the trade of goods and services over the internet other economic activities are included. Business to Consumer (BtoC) and Business to Business (BtoB) transactions as well as supporting organizational transactions as what e-commerce consists of. (Zwass, 2019)

E-commerce has four major market segments that include the previously mentioned BtoC and BtoB as well as Consumer to Consumer (CtoC) and Consumer to Business (CtoB). All market segments consist of the exchange of assets between two entities. The utilization of e-commerce throughout these market segments has changed the ways of purchasing and consuming goods and services. (Bloomenthal, 2021)

The retail market has been disrupted by e-commerce as more people rely on their smart devices to purchase goods and services to be delivered to their homes. Companies like Amazon and Alibaba and their popularity have forced traditional retailers to change the way they do business.

E-commerce is not only benefiting and challenging companies but is also creating possibilities for individual sellers through online marketplaces like eBay and Etsy. These platforms collect myriads of customers and sellers together for business transactions. (Bloomenthal, 2021)

Grocery e-commerce is a form of e-commerce that focuses on grocery goods or perishable goods sold by grocers. The grocer, grocery store or retail store offers their goods to be sold through digital channels to other businesses or directly to consumers. As in regular e-commerce some or all the transactions and supporting actions are executed digitally.

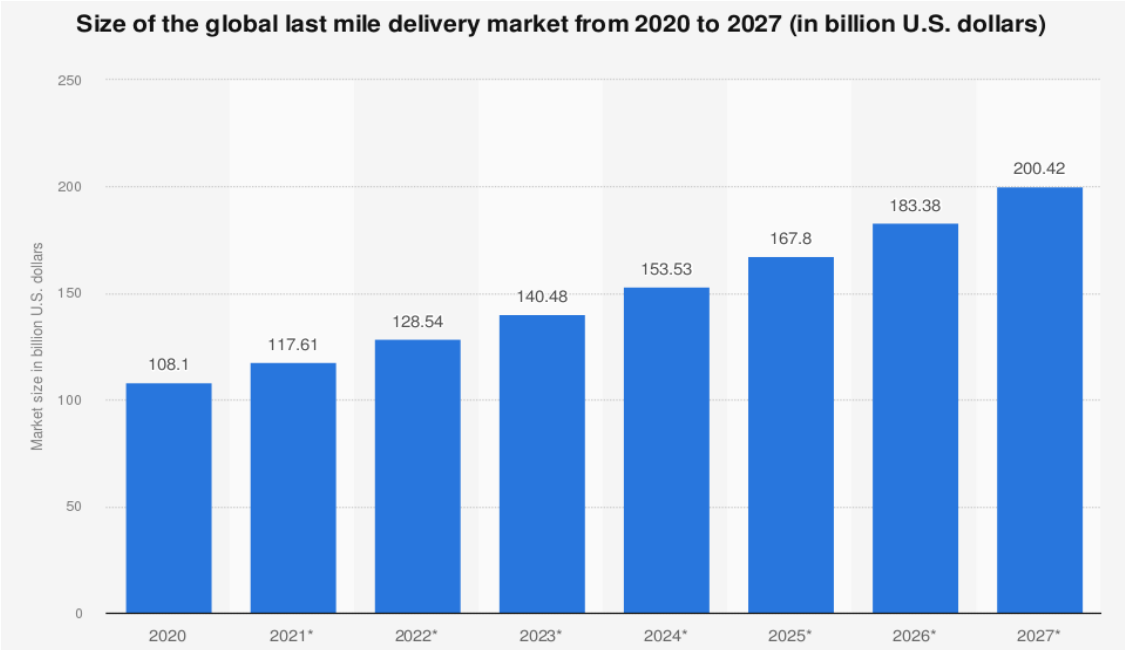
While e-commerce and grocery e-commerce are operated through digital space, logistics can still be necessary in cases where goods cannot be transferred digitally. In practise this means that either the seller or the buyer must, depending on the sales terms, purchase transportation for the goods.

The transportation modes available are the same as with most traditional retail actions and consist of road, air, rail, and sea transportation as well as multimodal transportations that use more than one transportation mode.

Depending on the possibilities and needs goods can be delivered to several locations. In some cases, goods are delivered to terminals or harbours where they are picked up from. In other cases, the goods can be delivered close to the purchasing parties' location or to their actual location.

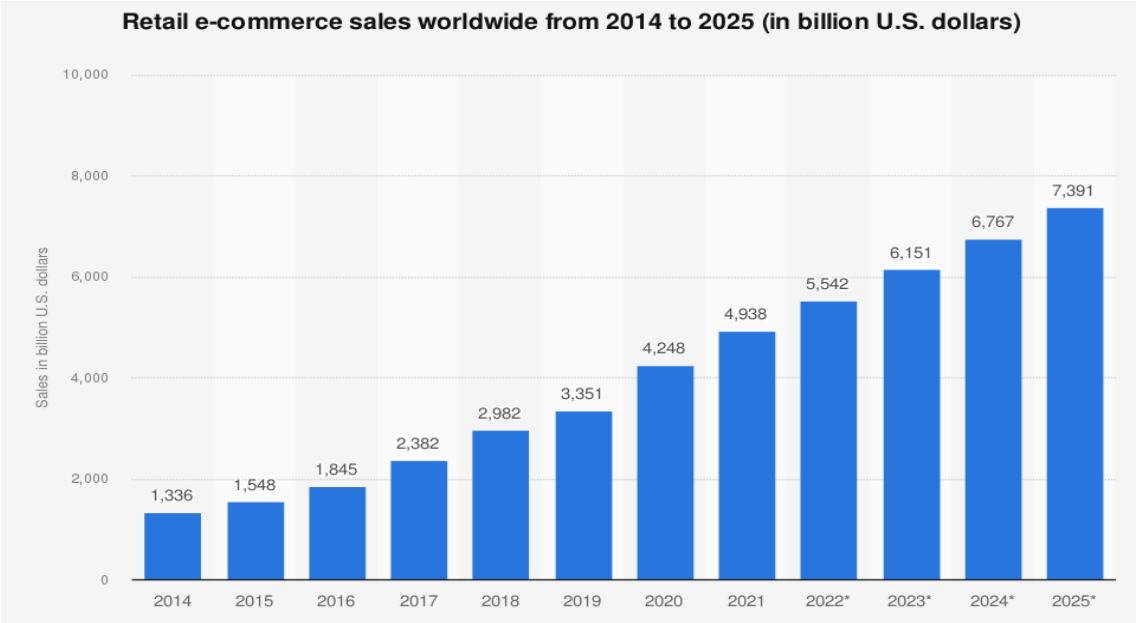
The delivery responsibility is defined during the sales transactions and is often based on the eleven global incoterms used to define delivery responsibilities and responsibility of the goods in different stages of delivery. (Logistiikan Maailma, 2022) These contractual clauses can be used in all parts of transportation required by a supply chain (SC), whether it is the transportation of resources, internal transportation between company locations or the delivery of goods to the end-users.

The delivery of goods from a warehouse or distribution centre to the end-user is known as the Last Mile -delivery in logistics. This term is used when the delivery happens in an urban area with higher population density. Last Mile operations are important and in high demand due to the instant-gratification culture that has flourished among consumers. As consumers expect faster deliveries for e-commerce purchases retailers focus on creating competitive advantages. This is done by acquiring or creating logistics solutions with low or no cost and short lead times. (Hayes, 2021)



PICTURE 1. Previous and forecasted size of the last mile delivery market during 2020 to 2027 (Mazareanu, 2022).

Last Mile -logistics have become a large market within the logistics sector. In the year 2020 the global Last Mile -market's size was 108.1 billion US-dollars and it is expected to grow up to 167.8 billion US-dollars within the next five years. (Mazareanu, 2022) In the same amount of time the global market for retail e-commerce is expected to grow from 4 248 billion US-dollars to 7 391 US-dollars. (Chevalier, 2022)



PICTURE 2. Previous and forecasted development of the global retail e-commerce sales between 2014 and 2025 (Chevalier, 2022).

The commissioner for this thesis is one of the larges logistics companies in Finland, Posti Kuljetus Oy (later referred to as Posti). Posti offers their customers several types of logistics services including freight, traditional postal services and parcel and e-commerce services. As Posti offers deliveries to business and private entities their offered services include last mile operations.

1.1 Research topic

This topic has been chosen as Posti's current grocery e-commerce last-mile operations are not at the wanted efficiency level and Posti wishes to develop their operations to offer customers a better service and to create a more efficient process for themselves. The topic of this thesis focuses on Grocery e-commerce logistics operated by Posti in Pirkanmaa area. A complete picture of the process is formed based on current operative actions, but data and research are used for focusing on the last mile -process as main objective of this thesis is to form a plan for developing the current operative model.

For this research area of Pirkanmaa is used to define the area where Posti is currently operating grocery e-commerce deliveries. This includes the following cities: Tampere, Kangasala, Lempäälä, Nokia and Ylöjärvi. As the business of Grocery e-commerce is relatively new in Finland. The aim of the thesis is to determine the best model of operation for Posti's last-mile deliveries within the area of Pirkanmaa. The model is formed by analysing the current operations and data collected from them. The analysis is divided to sections based on area, deliveries, equipment, and efficiency.

1.2 Research questions

The research questions examined in this thesis are as follows.

What can be done to optimize Posti's last-mile operations for grocery e-commerce deliveries in Pirkanmaa area?

What resources are required for the optimization of Posti's last-mile operations for grocery e-commerce deliveries in Pirkanmaa area?

Answering these questions will provide information necessary for forming a development plan for the optimization of Posti's current grocery e-commerce last-mile operations.

1.3 Research approach

This thesis will use the mixed methods approach for its research and utilize both qualitative and quantitative research methods. Quantitative methods will be used when analysing information and data based on the current operations. These methods will be used for the data collected through Portable digital assistants (PDA's) while performing deliveries with the current process model.

Qualitative methods will be used in the interview questions for Posti's employees and supervisors managing the current last-mile delivery operations related to grocery e-commerce deliveries.

These methods have been chosen due to the assumption that the combination of them will provide of more complete understanding of the research problem than using only one method over another.

1.4 Structure of the thesis

The thesis will begin by demonstrating a theoretical framework on optimization of last-mile delivery operations and urban last-mile efficiency. Following this will be the definition of methodologies used in the research, data acquisition and analysis of the methods.

Once the theoretical framework and research methodologies have been presented a description of Posti's current operations is depicted to identify challenges and requirements of the current process. This will be followed by the research section with analyses on data, assets and interview results that are used

to define the answer to the research questions. Based on the findings a development plan will be created and presented.

Once the development plan has been presented a discussion of result, practical conclusions and critical evaluation of the design and implementation of the research will conclude the thesis.

Based on the results of the research, this thesis will form a plan for optimizing the current Grocery e-commerce operations executed by Posti within the Pirkanmaa area. This plan will consist of an action list for area, resource, and efficiency optimization.

1.5 Disclosure of information

By request of Posti Kuljetus Oy the exact time frames, and units used for this research have not been disclosed to their full extent. The information has been deemed as competitive information and as such could not be published with exact descriptions. The time frames, and units have either been descripted on a general manner or displayed as percentages, but they still depict the information accurately as to make sure the results and analysis can be beneficial to others and accurately understood.

2 THEORETICAL FRAMEWORK

This chapter focuses on defining key concepts and theories relating to the chosen topic of the thesis, the main concepts and theories relating to the research topic are efficiency, consumer delivery logistics. This chapter creates a theoretical framework that assists the creation of a development plan and answering research questions later in the thesis.

2.1 Process optimization

Optimization is defined to be a process of making something as effective as possible. It can also mean making something as perfect as possible or as functional as possible. (Merriam-Webster dictionary, 2022)

The research within this thesis focuses on process optimization to improve Posti's current process efficiency. The aim is to optimize routes, usage of human resources and utilization of assets. These optimization goals fall under logistics optimization that can be viewed as a part of supply chain optimization for Posti's customers as well. Optimizing Posti's logistics processes will also help optimize their customers supply chain processes.

2.2 Consumer logistics models

According to Galkin and their associates there are two ways of delivering goods to consumers that are the main solutions for consumer deliveries. With an additional third model or distribution channel not considered as a main logistics channel. These channels consist of several movements of goods depending on the required intermediate levels. (Galkin, et al., 2018)

On their research Galkin and their associates deem the approach of these logistics channel models to be improvable through optimization. The models can be improved and managed to provide flexibility for management and decision making for the chosen logistics channels.

This research's results support the development of Posti's current processes as the last-mile model currently in use is one of the three researched by Galkin and their associates. In Posti's current operations the home deliveries of grocery e-commerce utilize the producer to consumer logistics channel and with their locker pick-up deliveries the logistics channel is producer to retailer to consumer, both channels have been included in the research by Galkin and associates.

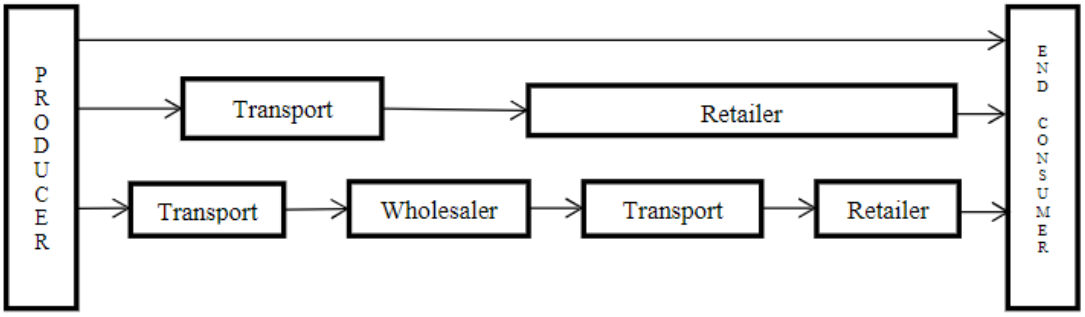


Figure 1. Logistics model description by Galkin and associates (Galkin, et al., 2018).

3 E-COMMERCE AND GROCERY E-COMMERCE

3.1 E-commerce concept

Electronic commerce or e-commerce (later e-commerce) is a business model that uses computer and telecommunications networks for selling information, services, and goods. Usually, e-commerce is connected to services and goods offered through the internet, but it also includes business-to-business (later as BtoB) and business-to-consumer (later as BtoC) and internal transactions within organizations. (Zwass, 2019)

The origin of e-commerce dates to 1948-1949 and the Berlin blockade when goods were being ordered via system using telex. During the following decades different industries developed the system until EDI (electronic data interchange) was developed to handle simple electronic business transactions. (Zwass, 2019)

With the increasing usage of the internet and creation and implementation of mobile devices, the amount of e-commerce operations has grown rapidly. This growth has also led to the increase of BtoB and BtoC electronic commerce platforms. These platforms allow businesses and consumers to handle their acquisition needs via the internet, without having to physically visit the seller’s premises.

The history of e-commerce may lie within simple transaction systems, but the operations have evolved far beyond and continue to evolve as consumer behaviour and business environments evolve. While the base idea for e-commerce is a simple acquisition transaction it has divided to support most industries and their operations.

Grocery and commodity goods as well as non-tangible goods and quick fashion are some of the industries using e-commerce to expand their operations. All these industries also require evolved logistics actions to answer to the modern customer behaviour that deems fast deliveries and low prices as the desired form of shopping.

3.1.1 Global e-commerce

When looking at the e-commerce industry companies such as Alibaba, Amazon and eBay come on top both in revenue and in the number of shipments. (Shooter, 2021) Most of the industry leading companies operate on a global field and deliver goods all around the world. This is largely due to the rapid increase in internet users that has led to an increase in global demand.

The increase in Internet users has aided the global development of global e-commerce. The development has been seen as promising for both developing and less developing countries. The development of e-commerce provides new methods for transactions but also supports economic growth. (Ndonga, 2012)

China is a prospering example of the potential of e-commerce with its rampant development during this millennia. The states support for different e-commerce platforms has surely played a part in the development of grass-root e-commerce. (Li, 2021)

Approximately ten years ago China's share of global e-commerce transactions was only 1%. This share has grown exponentially during the last decade and now China's share is over 40% of all global e-commerce transactions. China currently has the worlds largest e-commerce market with 1.1 trillion USD and the market is expected to reach 1.8 trillion USD during 2022. (Li, 2021)

E-commerce has continued to evolve past regulations and continues to grow through challenges as development of digitalization around the world accelerates. The global evolution of e-commerce has led to an increased demand for large quantity logistics for small and medium sized packages. It has also caused an increased need for better tracking, faster last-mile deliveries and more evolved solutions for return logistics. Logistics companies have started to answer to this need on a large scale by developing their whole supply chains to serve e-commerce customers from sender to receiver.

As the COVID-19 pandemic hit the world, both people and companies had to adapt to it. E-commerce companies and logistic operators were faced with

opportunity and challenges. As people were forced to limit their visits to public places and to relocate to remote working, the demand for home deliveries and e-commerce platforms for companies and services that might have not operated or offered e-commerce possibilities before. Some companies increased their sales thanks to people working from home by as much as 74%. (Bhatti;Akram;Hafiz;& Ahmed, 2020)

As the pandemic changed the nature of business it also caused around 52% of consumers to avoid going to stores and from these consumers 32% avoided going to stores before getting vaccinated. (Bhatti;Akram;Hafiz;& Ahmed, 2020)

In Finland 55% of consumers said that they had bought new products or services during the pandemic. Around 20% had bought clothes and accessories online for the first time and 14% had bought groceries. (Clausnitzer, E-commerce, 2021)

The amount of e-commerce consumers increased in Finland exponentially during the COVID-19 pandemic and the amount is still increasing as the pandemic continues. Almost 70% of current Finnish e-commerce customers are expecting to continue shopping online as much as during the pandemic and around 16% plan on increasing their online shopping. (Posti Group, 2021)

The continuous increase in e-commerce shopping will continue to demand new solutions from logistics companies. Some of these solutions need to be towards more ecological delivery options as demand for low- or no-carbon supply chains increase along consumer awareness grows.

Based on a questionnaire conducted by Posti Group more than half of the respondents believe online stores that take their environmental impact into account to become more successful in the future. (Posti Group, 2021)

3.1.2 E-commerce logistics

The increase in business operated through e-commerce platforms has led to an increased need for logistics both on a local level and on a global level. New supply

chains have been built and the digitalisation of logistics services and operations has accelerated.

As most of e-commerce transportation consist of parcel deliveries the logistics solutions required consist of high quantity and low-cost modes. These modes may include several types of transportation modes and multimodal transportation, but the base idea is the same. You transport as many parcels as possible in one transportation. These goods will then either be delivered to the customer as bulk or to pick up locations as individual packages.

To optimize the last-mile process logistics companies have developed pick up locations, parcel lockers and outdoor lockers as well as their traditional partner-based locations. These pick-up locations make it possible to reach a larger area and a higher number of customers without having to use large amounts of resources for home deliveries. Optimizing pick-up locations to high population areas lowers the need for delivery resources and creates a more customer friendly service as people do not need to wait for their deliveries at home.

There are challenges that come with high quantities of individual deliveries to consumers and businesses and companies are striving to answer to these challenges by implementing and testing new services and digital solutions as fast as possible.

Using 3PL and 4PL are widely used by e-commerce businesses as using them allows the companies to outsource the need for knowledge and expertise needed for transporting their goods and lets them focus on their product and business. Some companies fully outsource their logistics and for this reason large logistics companies either offer full services or have partners that can offer the services outside the logistics company's selection. These services consist of packing, warehouse management and full order handling processes.

3.2 Grocery e-commerce concept

The grocery e-commerce concept has the same basic idea as regular e-commerce, but it focuses on offering customers a focused way of buying grocery and

retail goods. The concept is relatively new in Finland but has a larger market globally for example in Asia where almost anything can be purchased online.

The characteristics of the grocery industry and its customers in China are a good example of the potential of e-commerce for companies. E-commerce has the potential to increase organizations performance through enhancing their operations and administration. The large volumes of transactions necessary require a lot from both operations and administration. Using e-commerce to automate daily document and other transactions enhances the efficiency of the organization. (Kurnia, 2008)

When it comes to consumers the benefits come from saved time and effort but also from the possibility to benefit from the same efficiency as the companies. Using online platforms allows the consumer to access their orders and to quickly make alterations to them. Also depending on the delivery format time can be saved by choosing the preferred method. Home delivery is the most time saving when the delivery time can be selected as a very limited time window. This serves the customer but more often causes an increase to the complete invoice of the order. Picking up the order costs less but requires the consumer to handle the logistical part between the pick-up location and the desired end location.

Companies in Finland usually offer one of two ways for both consumer and business customers: Delivery or pick up from a grocery store. In some rare cases there is an option for a delivery to a pick-up location outside of the usual grocery stores. These are usually lockers built specifically for handling the cold chain required for perishable goods such as dairy and meat products. The lockers are also used in the grocery store locations.

The basic process of a grocery e-commerce action is almost identical to a normal e-commerce action, but it requires specialised equipment and IT-infrastructure to abide to rules and regulations set for perishable goods.

3.2.1 Grocery e-commerce logistics

Any temperature sensitive transportation needs to have measuring equipment that transmit temperature information to the driver. This information can also be required by the customer shipping the goods, as with it they can ensure and monitor that the cold chain is not broken during transportation. Tracking the cold chain is on its own necessary for keeping a high service and product quality. While planning the route, shortest possible time between delivery points should be selected when aiming for efficiency. Doing this can be challenging if the distribution area is large with only a small number of deliveries.

Selecting an area for distribution is important when aiming for efficient logistics solutions for grocery e-commerce. This and other variables determine the sustainability and profitability of the chosen logistical solution. Other variables that have an affect are human resources, production resources and volume of goods delivered. All of these affects the final cost and eventually the whole price of grocery e-commerce deliveries per order.

When looking at the supply chain flow charts from Schöder, Saskia and Ehrler it is possible to compare the singular conventional flow of fresh goods and the more modern Internet-driven flow of fresh goods with its multiple flow possibilities.

Looking at the conventional flow of goods, we can identify the point where goods reach the consumer as the point of sale. In comparison the Internet-driven SCF model offers multiple points where the goods can be handed over to the end user, in the SCF chart we can identify these points to be either pick-up points (PP) that occur after the point of sales or direct deliveries to the consumers.

The conventional flow of goods can be viewed as straight forward and simple; this provides the producers with a clear method of operations but limits the possibilities for consumers. The internet-driven flow provides several possibilities for producers to meet their consumers demands as there are several branches from the main flow. This can be seen as beneficial to both consumers and producers but may also cause challenges if the flows are not managed properly and communicated clearly to the consumers.

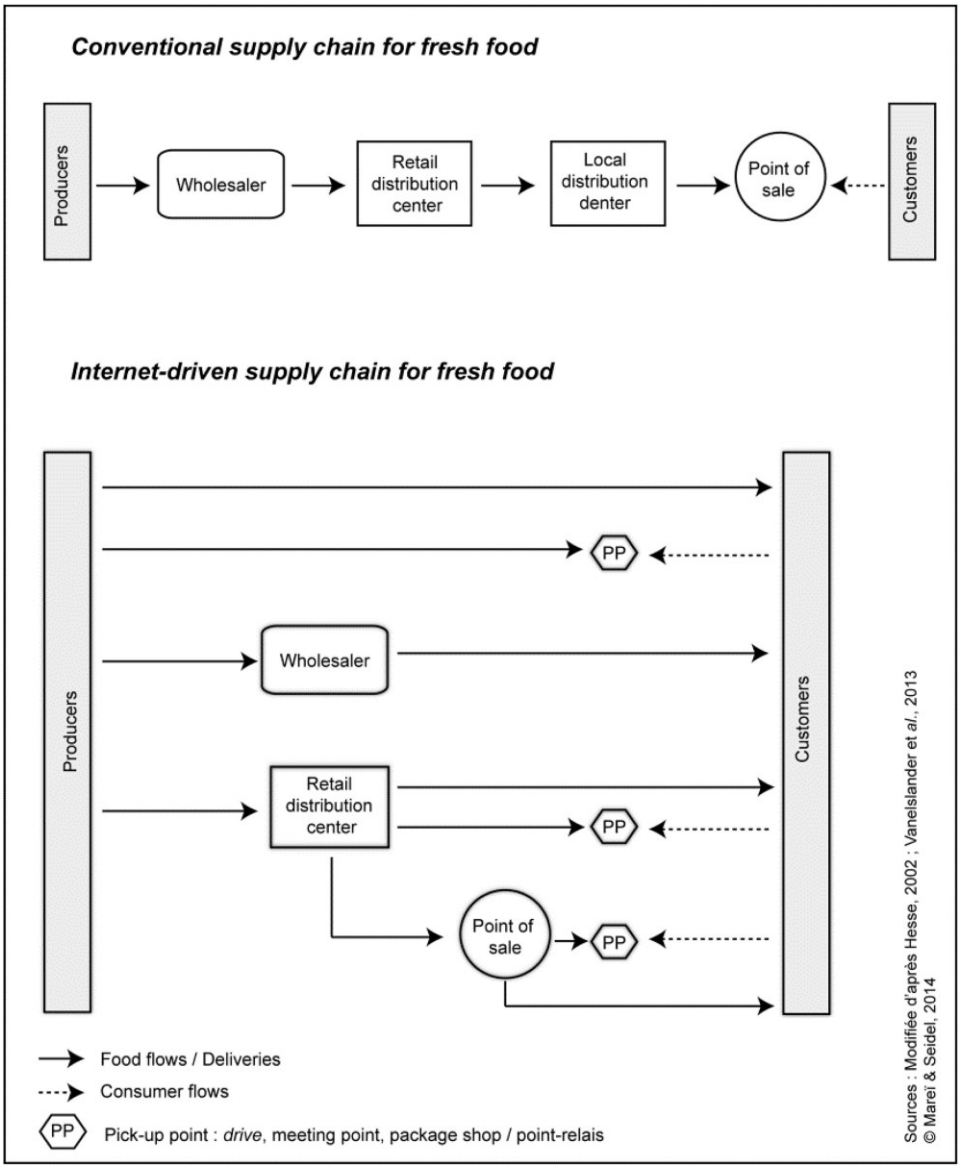


Figure 2. Supply chain flows of fresh food (Schöder;Saskia;& Ehrler, 2021).

3.2.2 Global grocery e-commerce

When looking at the global situation of grocery e-commerce globally it is clear that there are a lot of differences between nations and their grocery e-commerce infrastructures.

Countries that have larger densities in population in urban areas, tend to have more evolved grocery e-commerce infrastructures. Good examples of these are China, Japan, and South-Korea where most things can be bought online and be delivered to your home or place of employment. Other factors are also the

requirements set for perishable goods and their handling as well as the variation and costs for the service and goods. These vary based on local regulations and laws.

As an example, China is a good example of a market where the consumers choice is based on product price, service cost and range of products available. Lead time and delivery time window on the other hand have a lower impact on consumer behaviour. Chinese grocery e-commerce products are less short-lived, this means that most consumers can order goods through the internet which in turn supports the growth of the Chinese grocery e-commerce market. (Valerio Gatta, 2021)

In China grocery e-commerce has evolved and stabilized its market throughout the country. This is not the case in most countries yet as e-commerce and especially grocery e-commerce are relatively new concepts and markets when comparing to traditional retail markets.

In US the grocery e-commerce has not yet stabilised its market and is still beginning to build a base for itself with around 3% of total grocery sales being from e-commerce platforms in 2016. Similarly in 2018 grocery e-commerce covers only around 4% of total e-commerce sales in the US. (Chin Soon Chua, 2018)

Looking at China and the US, both countries that are regarded as superpowers in the world, the difference is clear when it comes to grocery e-commerce. Where both countries are leading edge in digitalization and development of supply chains, China is far more advanced when it comes to grocery e-commerce.

Where China and the US hold a clear lead in the grocery e-commerce market, countries following them are relatively close to each other. UK, Japan, South-Korea, and Germany all had sales of over 100 billion US$ during 2021. (Boukarroum, 2021)

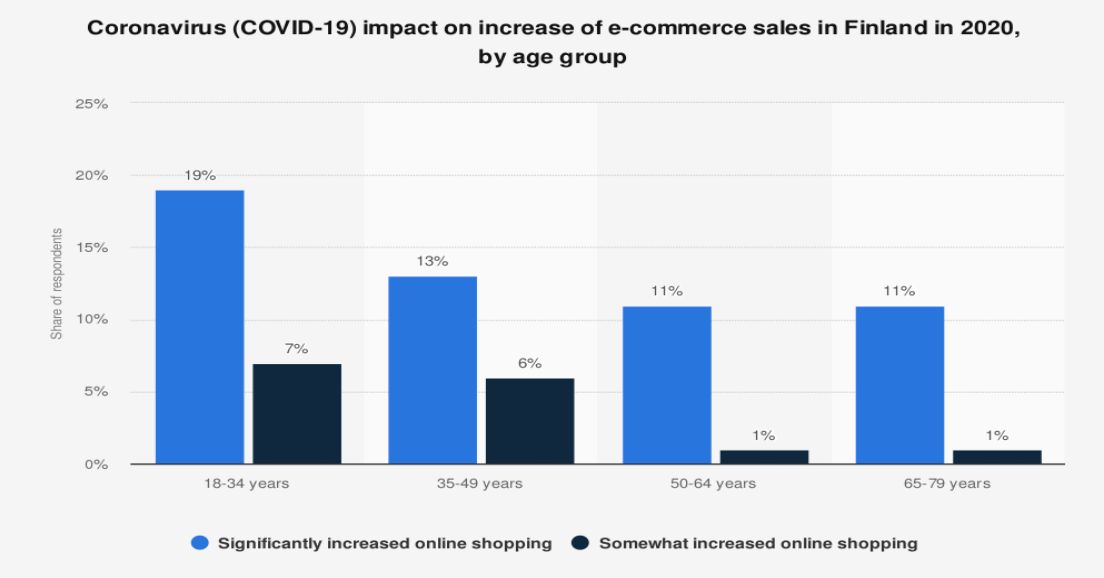
On a global level grocery e-commerce is an up-and-coming market, this causes great differences within countries. The market is developing with every new digital innovation and along the increase in e-commerce demand.

3.2.3 Industry development

Grocery e-commerce is expected to grow along with the development and growth of e-commerce in general, as more and more solutions are found to solve current challenges. Meeting the customer needs and being able to create more demand are paramount for the future of grocery e-commerce not only in Finland but also on a global level. Grocery e-commerce has its own subtypes when it comes to logistical solutions and selection, focusing on developing the ones with most benefits and demand will help in increasing the consumer demand within the market.

With the current services provided, people are hesitant to use homedelivery but find a lower threshold when it comes to picking up orders from retailers. (Silverstein, 2021) This shows how the consumers are still trying to understand and define the usage of grocery e-commerce and its benefits to them. Homedeliveries cost more as logistical expenses need to be included to the price, currently it also requires more commitment from customers with limited delivery time options.

When the market can solve issues like logistics costs and lead time along with defining the optimal selection for e-commerce customers, it is expected that grocery e-commerce will begin to reach its potential. The market is expected to start growing not only in Finland, but also globally as logistical issues are solved. The demand for both local and imported goods is already in place but available processes limit the possibilities of both companies and consumers. During the pandemic the grocery e-commerce sales of Finland have increased significantly throughout ages between 18 and 79. This has been deemed to be a direct effect of the pandemic and its effects to consumer behaviour. (Clausnitzer, Digital shopping behaviour, statista, 2020)



PICTURE 3. Impact of coronavirus on e-commerce in Finland – (Clausnitzer, Digital shopping behaviour, statista, 2020).

4 POSTI'S CURRENT GROCERY E-COMMERCE PROCESS AT PIRKANMAA AREA

4.1 Process description

The current process has been established at the start of Grocery e-commerce operations in 2018 and has been updated actively sense then. The baseline of the process is rather straightforward and consists of four operative sections: Delivery order management, Resource management, Route management and Last-mile management. These base operations include lower-level operations within them that are essential for completing the process.

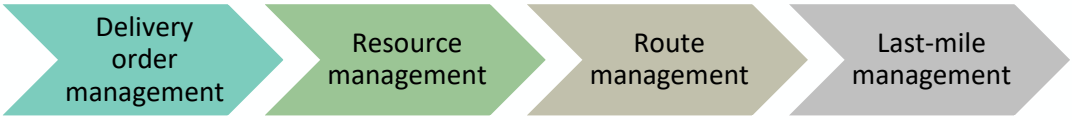


Figure 3. Flow of operative sections required in the current process.

The process starts with Posti receiving delivery orders from the grocery operator, these orders are then planned for delivery by assigning them a route. These routes are optimized by the system in use but also by logistics operators when necessary. Once the routes have been planned and optimized, they are provided to the drivers.

Following this the drivers move to their designated loading points. Once at the loading points drivers begin loading deliveries based on the list provided for them. The list has been loaded to a PDA (personal digital assistant). As a precaution for situations where the PDA's do not work, the lists can be produced as printed versions as well. Once the loading operations have finished, drivers move to their respected delivery areas and begin delivery operations.

Drivers use the PDA to mark deliveries as completed, this provides the information necessary for invoicing and delivery time monitoring. The data from the PDA is also used to collect other delivery and order related data such as order

frequency per postal code and length of delivery from loading or from arrival to end customer.

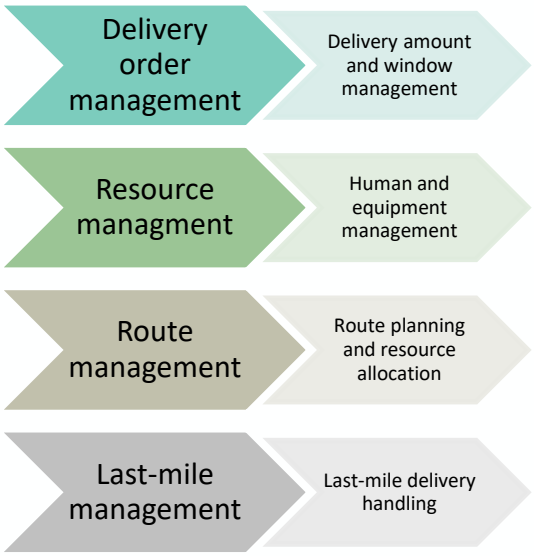


Figure 4. Descriptions of actions of each operative section.

The operative sections each have their own level of required activity during the process. Delivery amounts and windows are managed when necessary but monitored daily for any changes in demand.

Resources are managed on a daily level depending on available assets (vehicles) and resources (drivers). The level of orders might degrease or increase to the point where resources and assets need to be adjusted for optimal performance.

Routes and their respective resource allocations require actions depending on the number of routes operated during that day. The number or routes is defined by how effectively orders can be optimized during the route planning.

The final delivery to end-customers or the last-mile part of the operations is monitored by the logistics operators. Drivers and the grocery operator can contact the logistics operators in case any issues arise during deliveries. These issues can be things like missing or forgotten orders, deviations in the quality of goods or breaks in the cold chain. Once the issue is brought to the logistics operators' knowledge, actions to correct or fix the issue can be taken. In some cases, the possibility of a need to compensate the grocery operator might arise.

4.2 Operative requirements

The current operative requirements consist of transportation equipment, human resources, ICT -equipment and resources, administrative resources (part of human resources) and special equipment mostly included into the transportation equipment. Human resources consist of drivers and logistics operators, transportation equipment from delivery trucks and vans, special equipment include temperature monitoring systems, freezers, and cooling units. ICT -equipment and -resources consists of PDAs and the application used in the PDA as well as the corresponding computer program used by logistics operators for routing.

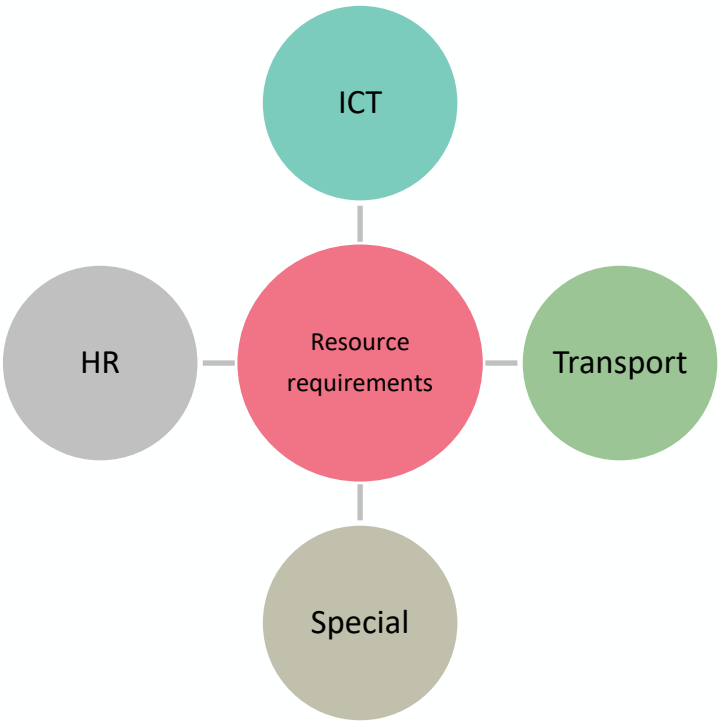


Figure 5. Resources and resource areas.

4.2.1 Transportation assets

Posti is using two of their own vehicles and drivers with additional six outsourced drivers and vehicles in Pirkanmaa area. Each truck or van drives their own route, and they have different schedules and delivery windows, so all the transportation assets are not in use at the same time. Posti's own vans are Mercedes-Benz's Sprinter models with a capacity of around 875kg when fully loaded. They also have a tail lift capable of lifting 600kg of weight. They are fully equipped for

grocery deliveries with freezers and temperature monitoring and handling equipment.

The assets that Posti has required through outsourcing for grocery e-commerce deliveries are required to fulfil the same factors as Posti. They are required to have temperature controlling and monitoring equipment as well as freezers in their trucks. These are a must when delivering perishable goods.

4.2.2 ICT-requirements

The ICT-resources and equipment currently used by Posti fulfil the requirements for operating grocery e-commerce deliveries. The operations are run through a desktop routing platform that creates delivery routes based on the resources inputted by the logistics operators. These routes can then be manually modified if need be. Once the routes are ready, they are published for drivers to load on to their PDA's or printed on paper in cases where using a PDA is not possible.

Posti has developed the system with an ICT -system operator and creator specialized in delivery platform creation and development. The system is specialised based on Posti's requirements and updated when necessary. Posti has limited amount of inhouse support as most of the support is purchased from the ICT -systems provider. The information flow is pictured below as a process illustration.

Figure 6. ICT requirements.

4.3 Challenges with the current last mile process

The last-mile process comes with multiple challenges that need to be solved to operate in an efficient manner. The current challenges that Posti has within their last-mile process can be divided in to two different sections: Operative challenges and technical challenges. In this case operative challenges include anything related to practical work such as loading, unloading, deliveries and other physical

actions. Technical challenges consist of challenges relating to delivery windows, delivery areas and other factors that affect how the operative side needs to be executed. The technical section can also be referred to as the planning section as all areas and operational variables are planned with the customer.

4.3.1 Operative challenges

The main challenge for Posti with its operative process is the waste or resources and low delivery efficiency. In this case the number of resources that are wasted is based on the time on the route that is used for actions that are not planned to be executed as a part of the route. The route consists of loading, several deliveries and in some cases unloading. This also includes, when necessary, the break the driver needs to have based on transportation laws regarding drivers. The waste can be measured by analysing the route data and distinguishing any points in time where the truck is not loading, moving from one delivery to another or finishing a delivery. Identifying waste from the current process will be done by examining the data of executed deliveries. This data is chosen for examination as it is viewed as the most accurate of all available data.

The delivery efficiency in this case is measured by how many deliveries can be finished within in an hour. The delivery data used for measuring deliveries per hour can also provide us with possible factors that affect the efficiency rate. The data includes information such as delivery amounts, delivery area, delivery times and how long they lasted, number of packages per delivery and other useful metrics. With the current processes delivery windows and areas challenges appear to the operative sector through delays in deliveries and time wasted in loading and long re-locations from loading to delivery areas.

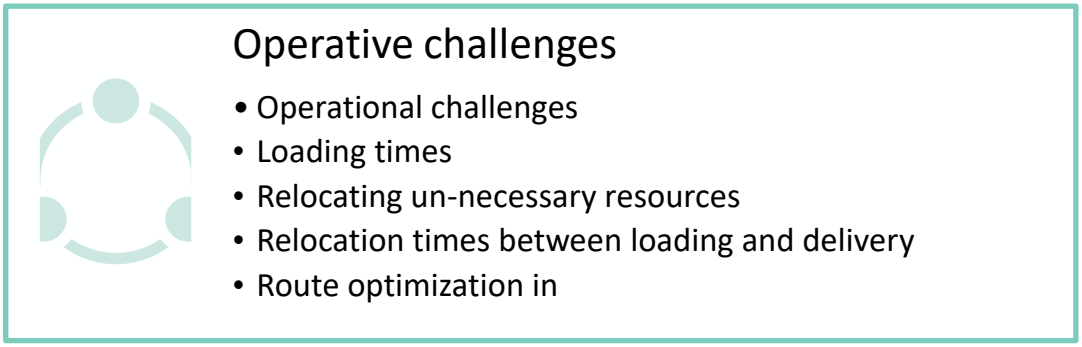


Figure 7. Operative challenges.

4.3.2 Technical challenges

Technical challenges faced by Posti in their last-mile logistics operations are largely related to delivery areas, delivery windows and delivery density. All these factors originate and are managed by the planning of grocery e-commerce home delivery sales areas. The current areas make it challenging to optimize deliveries in a way that would allow for maximum efficiency and the current delivery windows add additional challenges for reaching the wanted efficiency level. Largest issues they cause for the technical sector are the hinderance of optimization and efficiency levels. These factors need to be researched to find possible bottlenecks and development points to make it possible to reach better efficiency levels and KPI performance levels.

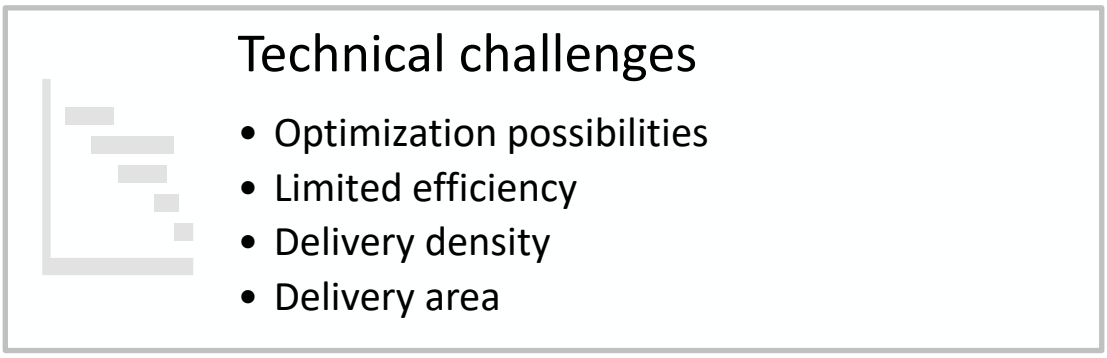


Figure 8. Technical challenges.

5 RESEARCH

5.1 Data and asset analysis

The data used for the research is derive from Posti reporting systems and from personnel interviews. The operational data is collected by Posti's Desktop and PDA system used for grocery e-commerce deliveries and interview data by the thesis writer. The timespan used for this research consists of a timeframe of 19-months and the area of Pirkanmaa defined trough postal code numbers of delivery areas. The areas covered by the research and data contain Tampere, Pirkkala, Lempäälä and Kangasala as the main operative areas but may also contain smaller surrounding areas based on their importance for the development of the process. All areas considered in the research and data will be displayed by their postal codes.

A timespan of 19-months for total delivery data and 12-months for area data were chosen because a longer timespan would bring in excessive amounts of pre-covid-19 data. As the market is not expected to return to its pre-pandemic state it was deemed best to use data gained during the pandemic. This is expected to provide the most valid information regarding future market situations of grocery e-commerce. The area of Pirkanmaa was chosen for its unique demographic consistency that includes urban areas with denser population as well as areas with less population and more similarities to the more rural areas of Finland.

The data analysis for this research consists of five different sections: Delivery data, Area data, Asset data, Logistics operator interviews and Production- and Asset manager interviews. These interviews have been executed with open ended questions during development and administrative meetings relating to the subject (see appendix 5). The aim for using open ended questions was to gain as much information as possible on challenges and possibilities that might not arise from through automated data collection. From the responses the main development points have been highlighted as a part of the analysis for the creation of a development plan.

Using the development points identified from both data collection methods a development hierarchy has been formed as a part of the development plan. This hierarchy has been created to identify short-term and long-term development points that could be implemented to further enhance the technical and operative performance of Posti's grocery e-commerce last-mile process. Short-term development points are considered actions that can be implemented within a period of 1-week to 1-month, long-term developments are considered to take anywhere between 1-month and 3-months.

5.1.1 Delivery data

Using the total delivery amount for the period of 19-months the average number of deliveries per day (Pcs/D) is around 0,24% of total deliveries and the average weekly amount (Pcs/W) around 1.25% deliveries. There have been 18 different delivery windows that have been used during the selected timespan. Some of these delivery windows have been created for a specific period such as Christmas to fulfil customer needs and will be excluded from the analysis as their nature is not continuous. Such delivery windows are 9:00-16:00,12:00-17:00, 16:00-18:00 and 16:00-20:00. This leaves us with 14 delivery windows that can be used for analysis.

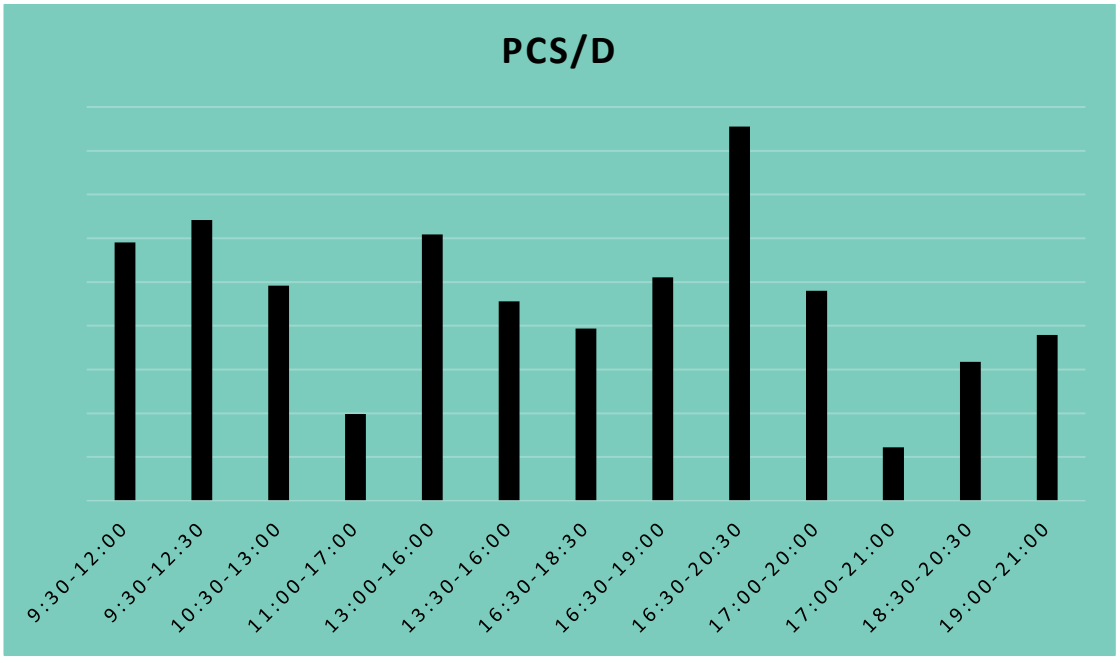


CHART 1. Daily delivery amounts per delivery window during the selected 19-months (Periodical delivery windows have been excluded).

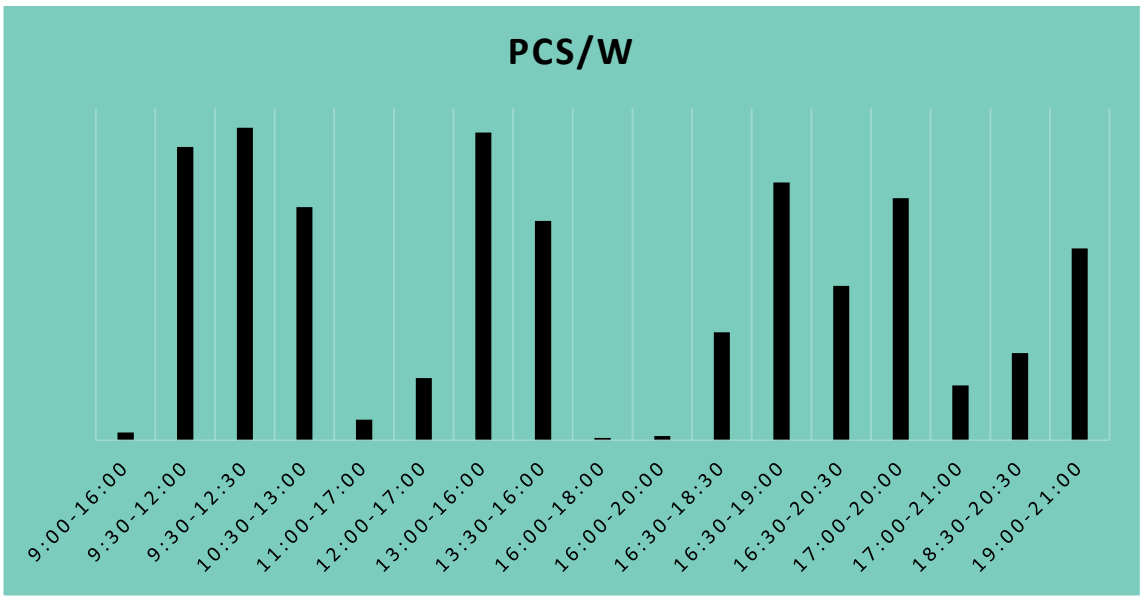


CHART 2. Weekly delivery amounts per delivery window during the selected 19-months.

From the total delivery unit amount (Pcs/Total) of the 19-months, the largest numbers of orders have been for windows covering the following intervals: 9:30-13:00, 16:30-19:00 and 17:00-20:00. We can identify the most wanted delivery time for customers to be between 9:30 and 13:00 or 16:30 and 21:00. Making the time between morning and early afternoon and early evening and evening the most desirable delivery times for end customers. The data is limited as there is no information from the time not portrayed in the delivery windows used. As this data is not available and cannot be accessed for this research the development points will be focused on the available information.

Analysing the delivery windows and numbers of deliveries within them, it is possible to see that the delivery amounts are slightly higher during afternoons and evenings than during the morning. Further inspecting the total delivery numbers per delivery window, we can see that the two windows with the most demand are 13:00 - 16:00 and 19:00 - 21:00 with 9:30 – 12:00 being closest to the two.
This could indicate that people want to have their home deliveries after the general office hours.

The general working time in Finland is a maximum of 8 hours per day totalling 40 hours per week, this does not cover period-based working times. (Ministry of Economic affaris and Employment, 2021) The office hours in Finland tend to be

between 8:00 and 16:00, which based on the data could be a reason for a larger number of deliveries during the evening than in the morning or day.

There is overlap between the delivery windows used during the selected timespan, this is caused by active adjustments to the delivery windows. The adjustments have been made per the grocery operators requests. Due to the overlap, it is not possible to summarize delivery windows and the delivery numbers per time of day. As the demand per time of day cannot be summarized, the defined delivery windows with higher demand should be looked at with reservations. It is not possible to say with certainty that the identified higher delivery windows are not the cause of limited supply or that they are direct implications of customer demand.

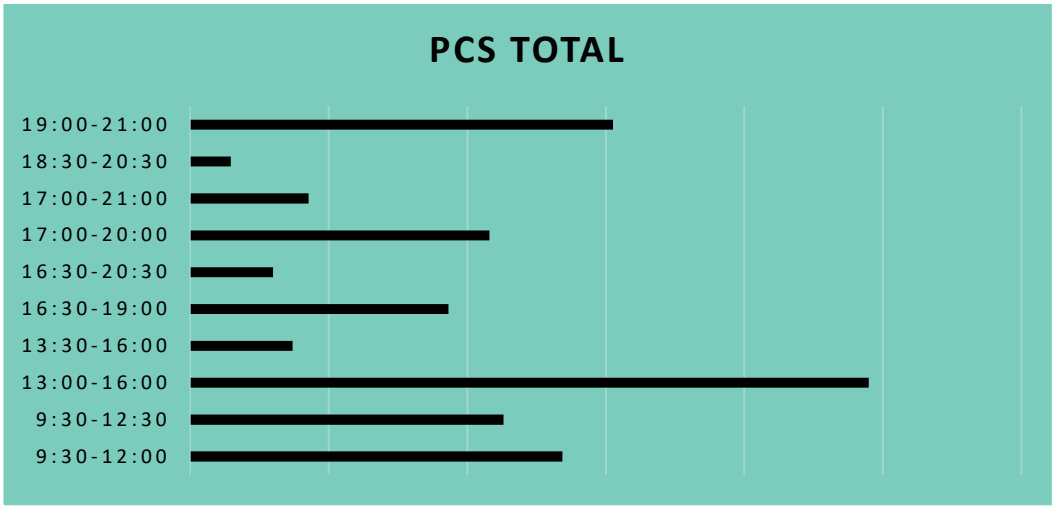


CHART 3. Delivery window data for the 19-month period.

Using these delivery windows could help solve technical challenges that are currently faced. Focusing the deliveries on high-demand times could help in creating delivery windows with enough orders for efficient routing possibilities. With higher number of orders per delivery window it is possible to increase number of deliveries per route and create a possibility to achieve a better delivery rate.

This would however require the routes to be designed with minimal distances between delivery destinations as the efficiency is depended on two factors: number of deliveries and deliveries per hour.

5.1.2 Area data

As mentioned earlier the research area is limited to Pirkanmaa and defined by the usage of postal codes. The postal code selection is done based on the current operative areas and areas that are suitable for expanding delivery operations.

In the current operative process one delivery unit is referred to as a grocery bag (gb), this definition is used to describe a singular unit that is delivered to a customer. One delivery can have multiple grocery bags with varying packing materials. The most used packing materials are boxes and plastic bags. In cases where an ordered item is too large to fit either of the mentioned packings, the item can be delivered without a packing or in a plastic wrapping.

Currently operations are performed on over 50 different postal code areas. From these areas 5 individual areas all have deliveries succeeding 5,23% of the total delivery amount during the selected timespan (see appendix 1). The exact number of deliveries could not be disclosed and is referred to as 100% so that other correlating amounts can be presented trough percentages.,

Table 1. Unit data.

Average delivery unit amount per delivery during the 12-month period	
Delivery units	100% (undisclosed total amount)
Deliveries	36% of the total unit amount
Average of units per delivery	**0,0024% of the total unit amount**

When looking at the population demographics of the five delivery areas with the largest number of deliveries, we can see that all of them are in the top 10 based on number of inhabitants in the Tampere region (see appendix 2) and all the areas have more middle-income class population than low- or high-income population (see appendix 3). The higher population should be considered as a factor when it comes to order amounts in the area. With higher population the number of potential customers should on average increase as well, leading to higher delivery numbers.

When looking at the more detailed demographics we can see that the average household size of all the areas is between 1,6 and 2. This would indicate that the number of inhabitants per household varies between average or below average when looking at Tampere area demographics. The household sizes could also indicate that there are mostly couples or singles. However, it is worth noting that the number of occupants in an apartment is not always an indication of the occupants marital or relationship status.

The demographics on inhabitants show us that the areas are consists of several types. Adults with and without children, young single people and couples and pensioners. These areas appear to fit a more diverse population. The largest number of inhabitants in the area however are adults. When looking at the household modes of the 5 postal code areas we can detect that owner-occupied and rental households have the highest numbers, from these rental household has the highest total number, but the popularity varies between areas. (See appendix 4).

Based on this information we can determine that an optimal delivery area has a mostly middle- to high-income classes and adults with or without children that either live on a rental apartment or own their apartment. (See appendix 2,3 and 4). The main factor in this being the income class of the area but areas with a higher population could yield more potential customers and a more optimal delivery concept. This assumes that more population in a denser area should yield more potential purchases with shorter driving distances between deliveries.

5.1.3 Asset analysis

For the current delivery areas, the number of vehicles varies between 2 and 6 depending on the amount of delivery orders. The required human resources vary from 2 to 6 as well depending on how long the routes are within the delivery windows. In some cases, one driver and car can be used for driving 2 routes in one day, when the order numbers are high this possibility is more limited as the resources have a higher utilization level throughout the day.

Based on the current delivery amounts it is possible to see a trend during Tuesdays and Thursdays when the number of deliveries is slightly higher than the rest of the week. This could be expected to cause a higher demand for transportation assets and human resources during these days. Based on Posti's data both Tuesday and Thursday accumulate on average around 10% more orders than the rest of the weekdays. The significance of this variation is debatable and should be looked at critically during the planning of the process development steps.

Posti holds in reserve all the resources that are necessary, for fulfilling all offered delivery windows with full delivery amounts. This causes waste of resources in situation where the delivery windows are not fully booked. The resources that are not needed for grocery e-commerce operations need to be re-allocated to other operations. This however might not always be possible as Posti has its own resources for operative processes.

Balancing the demand for resources during the week can be difficult as it is not possible to forecast the demand for deliveries with high enough accuracy. There are two methods that could help resolve this challenge. The first method is guiding the customer's shopping behaviour by offering more deliveries in the high demand time windows during lower demand delivery days. This could however drive customers to shop from competitors if their needs are met better.

The second method would focus on the high demand delivery days and windows and limit the lower demand ones. This way the delivery windows with lower demand could have a higher occupancy rate. In case the demand grows in either the high demand or low demand windows, resources could be added to respond to the demand.

5.2 Interviews

Interviews with logistics operators and production and asset managers have been completed as open-ended question relating to the topic (see appendix 5 and 6). The information collected considers the usability of current and modern assets,

utilization of current assets within the delivery area and the operative functionality of the current loading point and delivery area.

5.2.1 Interview results

The questions presented to Posti's Production manager, 2 Logistics operators and Asset manager covered the following topics: Delivery area, Delivery windows, Loading points and Transportation assets.

The questions focused on the current situation of the topics and to possible future aspects of them. The aim was to collect information on challenges with the topics as well as possible development points. The questions and information received and from the are listed below. (For detailed answers see appendices 5 and 6)

Question topic: Delivery area
Q1: Is the current delivery area optimal for grocery e-commerce deliveries?
Q5: What challenges are caused by the usage of one delivery area?
Q7: How could the delivery are be improved?

Result: The answers indicate that the current area is not optimal as it is too large to manage in an optimal way. The size is hindering the performance and utilization of resources and requires long transitions between locations. Possible development points mentioned are division into smaller areas. Additional challenges are caused by overlapping delivery windows that can cause additional long transitions during routes. Possible solution for these is sectioning the delivery windows so that they are not overlapping over long-distance areas. From the answers we can detect two challenges and development points that can help solve them: Long-distance transitions and over lapping delivery windows are challenging but could be solved by dividing the area and sectioning the delivery windows.

Question topic: Delivery windows
Q8: What challenges are there in the current delivery windows?
Q9: What could be improved in the current delivery windows?

Result: From the answers we can identify challenges caused by the length of the delivery windows and by the overlapping windows through different areas. Possible development points are the division of delivery windows and shortening of the windows depending on the area. This would be in line with the development points regarding the delivery area. Managing the delivery amounts per area could also be done through delivery window changes.

Question topic: Loading points
Q3: Is one loading point optimal for Pirkanmaa last-mile deliveries
Q4: Are there Challenges caused by the usage of one loading point?
Q6: How could the loading operations be improved?

Result: The singular loading point is seen as having a risk of delays to the delivery routes. According to the answers this is caused by other logistics operations using the same platforms as Posti. Other challenge is the long transition to certain areas where the routes are operated. Possible developments could be made by sectioning or reserving the loadings so that Posti can always load at the same time or by increasing the amount of loading points.

Question topic: Transportation assets
Q2: Are Posti's own vehicles suitable for grocery e-commerce operations?
Q11: Could electronic vehicles be used for grocery e-commerce in Pirkanmaa area?
Q12: Would it be possible to change the current grocery e-commerce operations to use only electronic vehicles in Pirkanmaa area?

Result: The current vehicles are suitable for the operations but work better when used in an urban environment. Moving towards areas with less population density can lead to a lack of capacity with the vehicles.

Electronic vehicles are seen as suitable for grocery e-commerce deliveries in the Pirkanmaa area but are currently not feasible. More research and information on the vehicles performance and equipment possibilities are needed. After piloting and researching the vehicles more they could be implemented to the operations,

but the implementation would need a large investment and development steps in other processes and is currently not feasible.

5.3 Complete findings from data and interviews

The information received from the data and interview answers indicates that the current area and delivery windows are not optimal for continuing the operations. The loading point currently used is challenging as the loading operations can be delayed due to outside entities and the transition to delivery areas can in some cases be long and waste resources through increased driving time.

Possible development points from the data and interviews are the distribution of the current delivery area into smaller separate areas, re-allocating and updating delivery windows based on location and demand and re-allocating resources according to the new areas. These findings will be used as the outline of the development plan and the data and answers will be used to support more in-depth creation of development actions for the plan.

The challenges detected from data and interviews are:

- Delivery area is too large and causes wasted resources
- Delivery windows are too long and overlap through areas causing waste
- Delivery windows might waste resources if there are not enough deliveries
- Loading point can cause delays and causes long transitions increasing costs

6 DEVELOPMENT PLAN

6.1.1 Delivery areas and loading points

Based on the finding from the research 5 new delivery areas have been created as a part of the development plan. These areas are West 1, West 2, Centre, South, and East based on their location from the largest population area in Pirkanmaa, Tampere. These areas are created to target the challenge caused by the current large delivery area. The areas are also designed to support possible growth to surrounding areas in the future. The challenges caused by the large delivery area are met with limited delivery areas with loading points included 4 of the 5 areas.

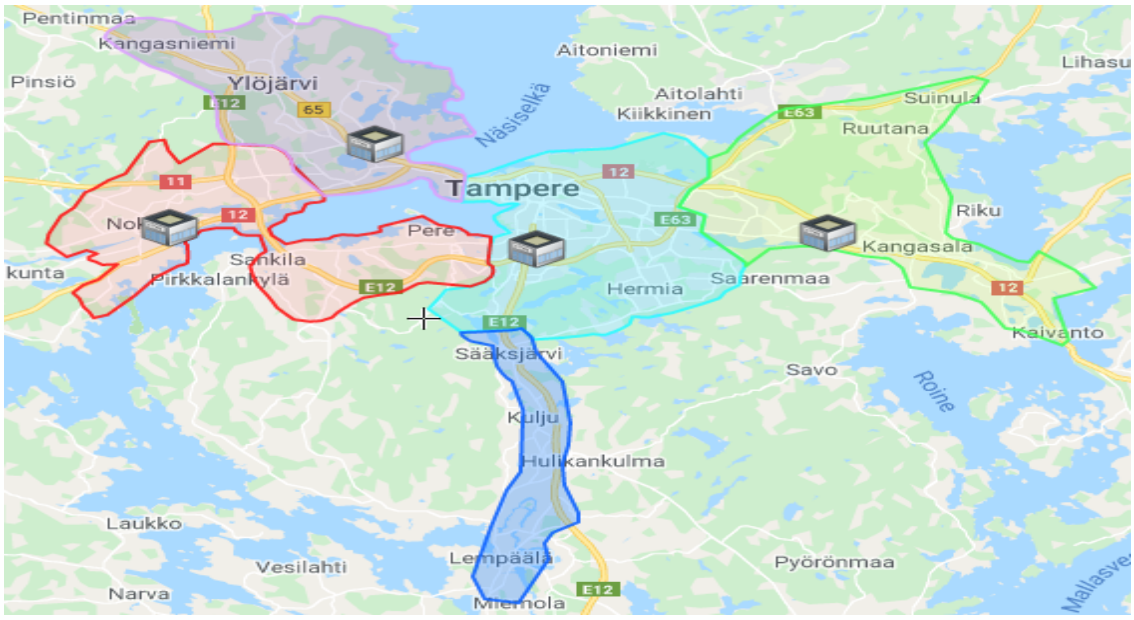
Creating new delivery areas and loading points are is rather straight forward but requires resources and alterations from an IT point of view. The changes need to be disclosed to the customers as well, due them possibly effecting the service the customer is receiving.

The creation of new delivery areas requires mapping and street level border creation. This is done straight into the system so that orders are located to the correct loading point. The base for the geological fencing comes from postal code areas and their borders. In some cases, these borders need to be limited or deviated to suit the planned areas better. In some areas, limiting the area is necessary as the grocery operator or Posti have deemed the area to be outside of profitable operations.

The delivery areas and loading points are created to the IT infrastructure so that orders arrive to Posti as individual listings per loading point. From here it is possible to plan routes accordingly. The routes and loading points become available to the PDA and it is possible to utilize one driver and car for multiple loading points as the routes can be loaded individually.

Loading points for the new areas have been proposed to be in the West 1, West 2, Centre, and East areas. This is to minimize the transition between loading and

delivery. Centre areas loading point is located so that it can also work as the loading point for the south area. All loading points are proposed to be close to high density areas with good infrastructure to support transitions to and from the loading and delivery area. (See appendix 7 for larger scale picture)



PICTURE 4. New delivery areas and loading points based on the research findings.

6.1.2 Delivery windows

The challenge with the current delivery windows was determined to be their overlapping with each other and the possible waste caused when the delivery window is not full. The challenge of overlapping is targeted by creating new delivery windows that are in the new delivery areas so that there are no overlapping deliveries in the specific delivery area. The waste of resources is targeted by changing delivery days depending on the areas demand.

The re-organized delivery days make it possible to rotate resources during days and weeks so to different areas and increase the utilization rate. Internal division on West 2 and East areas creates delivery areas with a more compact size and the resources allocated to the areas can be utilized better as the two separate areas within the main area guide provide a possibility for more condensed routes to be planned. This in return should lead to a higher efficiency rate in the areas.

Table 2. Delivery window and day allocation.

New delivery windows and days	
West 1	Tuesday and Thursday 10:00-13:00 and 17:00 to 21:00
West 2	Monday to Friday (internal division) 16:30 to 19:00
Centre	Monday to Friday 9:30-12:00, 13:00-16:00, 17:00-20:00
South	Monday, Wednesday, and Friday 17:00-20:30
East	Monday to Friday (internal division) A) 10:00-13:00 and 16:00 to 20:00 B) 15:00-18:00

6.1.3 Resource allocation

The re-allocation of resources is based on the new smaller delivery areas and their delivery windows. Resources allocated to certain are planned to be rotated between or within the areas to utilize them at a more efficient level. West 2 and East are areas where the resources are rotated internally and West 1 and South are areas where the resources are planned to rotate between the areas on alternating days. This allocation is expected to increase the utilization rate of the resources and reduce cost in the long-term. In the resource allocation plan (table 7) Posti's own resources are marked as "Posti Resource x" and outsourced resources are marked as "resource x", this is to indicate what type of resources should be allocated to certain areas based on the information.

Table 3. Resource allocation.

Resource allocation plan	
West 1	Tuesday and Thursday 10:00-13:00 and 17:00 to 21:00 **Resource 1**

West 2	Monday to Friday *(internal division*) 16:30 to 19:00 **Resource 2**
Centre	Monday to Friday 9:30-12:00, 13:00-16:00, 17:00-20:00 **Posti resource 1 and 2** **Resource 4**
South	Monday, Wednesday, and Friday 17:00-20:30 **Resource 1**
East	Monday to Friday (*internal division)* A) 10:00-13:00 and 16:00 to 20:00 B) 15:00-18:00 **Resource 3**

6.2 Development plan outline

Based on the findings from the data and interview analysis the following outline for the development plan was created. The outline consists of development steps that are meant to target the challenges identified during the research part of this thesis. The development steps have each been connected to a particular challenge as depicted in table 5 below.

Table 4. Development plan outline.

Development outline	
Challenge	**Development actions**
Waste caused by delivery areas size	Division of the delivery area to several more optimal size areas
Waste caused by delivery windows length	Re-designing of the delivery windows to focus resources and delivery units
Waste caused by the allocation of delivery windows and resources	Re-allocating delivery windows and resources to the new delivery areas

Delays and waste caused by a singular loading point	Creating multiple new loading points closer to the new delivery areas.

These development points offer possible solutions but should also be viewed critically if implemented. Each development point aims to solve larger challenges for the process, but new challenges can arise from the changes.

The division to smaller areas will demand more from logistics operators as resources and assets are divided to a larger area. The necessity to actively manage the allocation and operative issues can cause increased workloads. The workload to logistics operators should be monitored to make sure it does not take resources away from other operative tasks.

Creating more compact delivery windows to increase delivery amounts per route can have negative effect on customer satisfaction and operative quality. When the route is full of deliveries any possible unforeseen challenges can cause delays that lead to degrease in operative quality. The limitation of delivery windows can on the other hand lower the customer satisfaction if the wanted delivery window is not always available. The aim of creating a higher occupancy rate for the routes

Reserved loading times at loading points or creating new loading points closer to delivery areas are expected to diminish the possibility of delays caused by loading and waste from long transitions. Reserving loading times to loading points also creates a need to be on time at the destination. Any challenges causing delay while transitioning to a loading point can cause a driver to miss the loading window making them have to wait for an availability for loading. This could lead to a delay in starting the deliveries and as such does not eliminate the original challenge.

6.3 Compiled development plan

Combining all the different development actions to form one singular plan has been done by using the delivery area development as the baseline and connecting the rest of the development steps to it.

Table 5. Development plan with stages for each development point.

Development plan			
Stages	**Challenge**	**Development**	**Suggested action**
Stage 1	Waste caused by a large delivery area	Creating new more compact delivery areas	Division to 5 new delivery areas
Stage 2	Delays caused by the loading point	Implementing new loading points	Creation of 4 loading points close to the delivery areas
Stage 3	Waste caused by the length and overlap of delivery windows	Re-creation of delivery windows	Creation of delivery windows based on area specific delivery and demand data
Stage 4	Waste of resources caused by transitions and lack of deliveries	Creating more focused delivery areas and windows to increase delivery frequency. Locating loading points closer to delivery areas.	Allocating resources based on the expected demand per area and creating rotation for the resources based on area specific requirements
Stage 5	-	-	Implementation of development plan actions
Stage 6	-	-	Monitoring of results after the implementation
Stage 7	-	-	Applying changes and updates based on results after the implementation

By following the plan and its steps Posti could update their grocery e-commerce deliveries last-mile processes and potentially increase their functional efficiency and cost efficiency. The plan should be implemented through an individual project that distributes responsibilities throughout planning, management, and operative sides. The plans success should be measured by KPI indicators following delivery efficiency and costs from delivery operations as well as customer satisfaction.

These KPI's could be based on delivery efficiency d/h (deliveries per hour), loading efficiency l/r (loading time per route) and CSAT (customer satisfaction) that is collected by reviews by the receiving customers. The data for d/h and l/r can be collected through the PDA's used by drivers and the CSAT can be collected as

an after-sales review questionnaire. This could also provide valuable information for the grocery operator on how the customer are adjusting to the changes.

Creating a project team and distributing responsibilities according to capabilities should be considered as a vital part of the plan. Once the plan is implemented the results should be monitored and alterations made based on efficiency and cost data.

If Posti decides to implement the plan a more detailed execution plan is recommended, the plan should include timeframes and milestones for each step and the actions they require. Including other stakeholders from relating organizations and possibly even companies can be beneficial for the results of the plan. Departments such as ICT -department and Development -department can be crucial for the success of the implementation process and the grocery e-commerce process relates to the operations of both sections.

Before the possible implementation of this development plan, it is recommendable that Posti analyses the plan and creates a risk analysis and risk management plan to support the implementation. Creating a risk analysis and a risk management plan can be vital when making large scale changes to operative processes.

7 CONCLUSION

This thesis has created a plan for the development of the last-mile delivery process operated by Posti. The plan has been based on the definition of grocery e-commerce presented in this thesis. Data from current operative processes and from interviews with Posti's employees has been utilized for the creation of this plan.

The plan targets challenges detected in the data analysis phase and uses potential development points to do so. These development points have been turned into feasible actions that support other actions and from a unified development strategy.

The plan recommends the re-distribution of the current delivery area, re-allocation of both current delivery windows and resources and increasing the amount of loading points from the current singular point. These recommendations are provided through a 7-step plan with the previously mentioned actions described. The plan includes the follow-up steps recommended in case Posti decides on implementation of the plan.

The findings have been concrete challenges, bottlenecks and issues from the current processes and defined to be of negative impact to the current process. The development actions created have been justified with the information gained from the current processes and their data. They have also been supported by the findings from the employee interviews.

The plan is recommended to be implemented as a singular implementation, but the execution is possible either in fractions or through a singular implementation throughout the area. Shareholders from at least the ICT- and Development -departments are suggested to be included into the possible implementation process.

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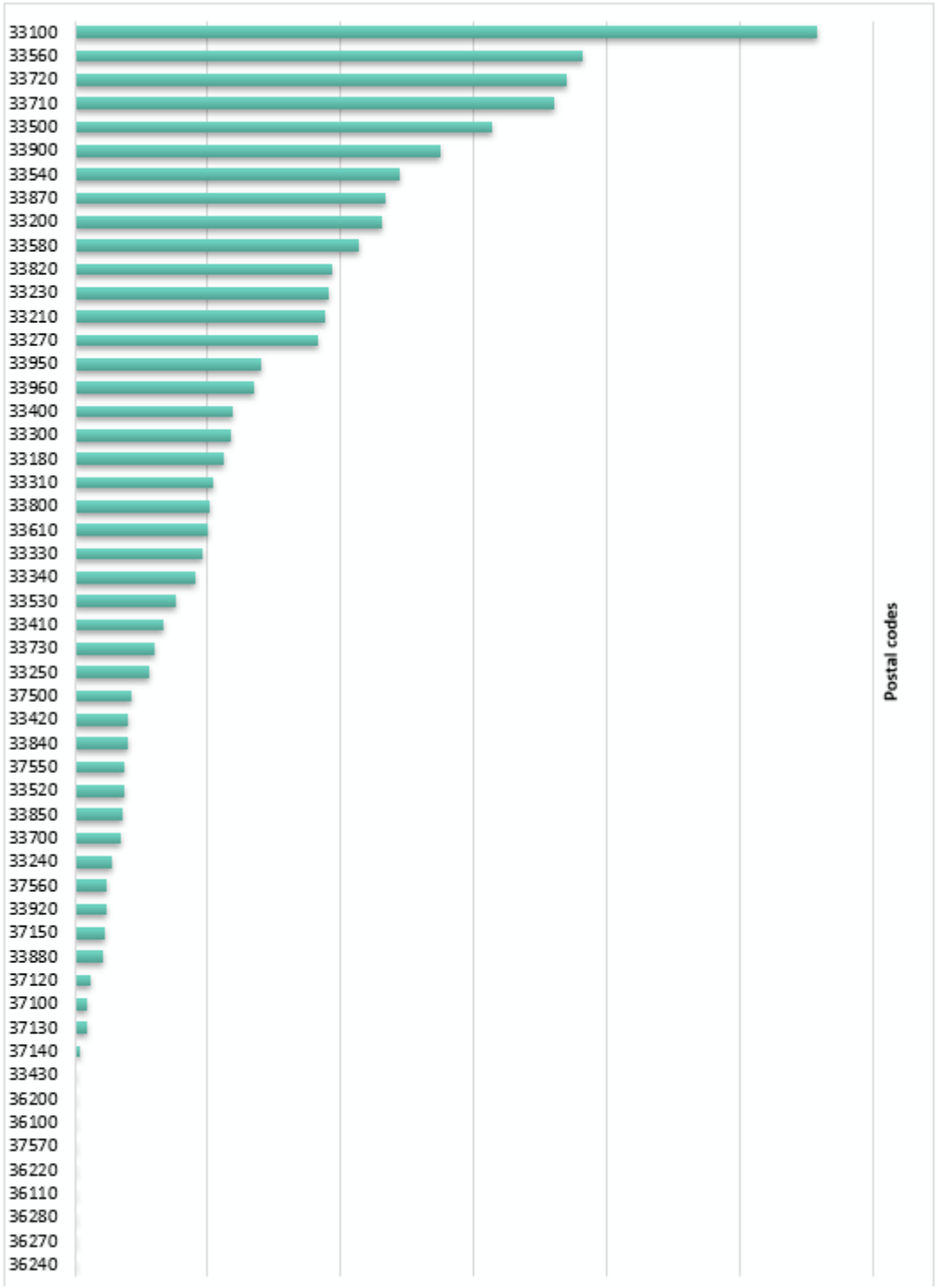
APPENDICES

Appendix 1. Postal code delivery areas and delivery amounts during the selected time frame



Appendix 2. Total habitants per postal code in 2018

Postal code area	Total inhabitants, 2018 (HE)
33100	17317
33180	2330
33200	6479
33210	5998
33230	6059
33240	1637
33250	2316
33270	7536
33300	5148
33310	7449
33330	3371
33340	5304
33400	8891
33410	4888
33420	2044
33500	11335
33520	955
33530	4985
33540	9901
33560	10184
33580	15512
33610	3820
33680	1646
33700	1715
33710	18542
33720	25326
33730	2028
33800	5382
33820	9065
33840	3325
33850	2415
33870	5056
33900	12077
34240	1697
34260	879
34270	295

(Tilastokeskus, 2020)

Appendix 3. Income classes by postal codes in 2017

Postal code area	Low-income class population, 2017(HR)	Middle income class population, 2017 (HR)	High income class population, 2017 (HR)
33100	3581	**8950**	3146
33180	384	1226	436
33200	1304	3481	1215
33210	1140	3398	945
33230	916	3045	1348
33240	236	649	445
33250	386	1007	527
33270	1065	3723	1327
33300	729	2373	951
33310	1263	3946	635
33330	508	1717	394
33340	689	2460	890
33400	1324	4093	1500
33410	807	2645	519
33420	343	921	396
33500	2181	**6422**	1618
33520	186	440	176
33530	1238	2462	790
33540	2457	5327	949
33560	1543	**5053**	1683
33580	1946	7510	2604
33610	419	1669	835
33680	271	673	346
33700	314	686	392
33710	3192	**8649**	2555
33720	7188	**12372**	1902
33730	235	840	410
33800	996	2628	793
33820	1381	4082	1768
33840	741	1919	325
33850	460	1316	198
33870	647	1729	713
33900	2042	6193	1556
34240	229	696	300
34260	177	400	147
34270	71	132	49

(Tilastokeskus, 2020)

Appendix 4. Populations demographics by postal code in 2018

Postal code area	Average size of households, 2018 (TE)	Living space, 2018 (TE)	Young single person households, 2018 (TE)	Households of childless young couples, 2018 (TE)	Households with children, 2018 (TE)	Households of adults, 2018 (TE)	Pensioner households, 2018 (TE)	owner-occupied dwelling households, 2018 (TE)	Rental households, 2018 (TE)	Other dwelling households, 2018 (TE)
33100	1,6	37	2825	1081	930	7357	2509	4508	6022	254
33180	1,9	38,2	118	71	143	529	269	480	444	16
33200	1,5	39,2	1128	312	333	2753	1171	1860	2281	109
33210	1,5	38,7	981	283	317	2407	1208	1530	2325	73
33230	1,7	38,3	594	227	473	1911	1211	2105	1399	85
33240	2	41,9	107	31	185	461	192	565	245	26
33250	1,9	37,4	231	64	246	758	243	662	537	43
33270	1,9	37,8	505	224	850	2085	1008	2007	1853	72
33300	2	39	349	125	588	1331	649	1535	992	35
33310	1,8	36,6	451	148	842	1949	1344	1965	2090	71
33330	1,9	35,9	242	104	420	959	344	778	919	22
33340	2,2	39,6	216	96	631	1060	752	1785	619	34
33400	2	38,2	691	253	1039	2282	1099	2304	2054	50
33410	1,7	39,2	433	140	416	1413	947	1750	966	51
33420	2,2	41,4	69	21	231	421	270	643	247	28
33500	1,5	35,8	1746	663	747	4493	1998	3038	4028	161
33520	1,8	35,6	124	37	98	336	110	229	305	7
33530	1,7	37,7	695	244	329	1891	767	1345	1584	51
33540	1,5	33,8	2222	733	605	4707	1227	2227	4190	116
33560	1,9	38,5	668	246	1060	2512	1663	2882	2237	96
33580	2	38	965	419	1910	3848	1874	4224	3322	73
33610	2,4	40,2	76	59	495	716	419	1451	159	12
33680	2,4	49,2	13	8	186	216	273	621	23	23
33700	2,1	38,5	138	65	193	424	194	538	258	13
33710	2	36,3	1368	598	2158	4925	2271	4552	4690	99
33720	1,7	34,4	3783	1243	2120	9157	3106	4459	9727	171
33730	2,4	40,3	34	31	261	338	235	749	66	15
33800	1,7	32,6	874	171	535	2027	635	1325	1810	53
33820	2,1	39	503	224	1069	2214	1026	2685	1529	79
33840	1,7	38	335	132	261	1095	547	1102	757	43
33850	1,8	37,9	201	55	251	745	358	688	645	18
33870	1,8	32,6	1069	299	657	1925	168	942	1774	34
33900	1,7	34,6	1670	747	1023	4747	1384	2378	4671	98
34240	2,6	43,1	13	6	227	222	216	507	134	20
34260	2,1	47,5	18	8	88	176	161	341	57	20
34270	2	47,2	8	2	25	65	59	139	4	5

(Tilastokeskus, 2020)

Appendix 5. Interview plan for defining current process

INTERVIEW PLAN FOR GROCERY E-COMMERCE CURRENT PROCESS DEFINITION

INTERVIEW PARTICIPANTS:

- Logistics operators – Two Logistics operators, that are focusing on current grocery e-commerce process operations
  - Questions 1-9 and 11-12
- Production managers – One Production manager, responsible for grocery e-commerce operations in Pirkanmaa area
  - Questions 1-9 and 11-12
- Asset manager – One asset manager, responsible for acquiring and managing vehicles and special equipment
  - Questions 2, 11 and 12

QUESTIONS:

Q1. Is the current delivery area optimal for grocery e-commerce deliveries?

Q2. Are Posti's own vehicles suitable for grocery e-commerce operations?

Q3. Is on loading point optimal for Pirkanmaa last-mile delivery operations?

Q4. Are there challenges caused by the usage of one loading point?

Q5. What challenges are caused by the usage of one delivery area?

Q6. How could the loading operations be improved?

Q7. How could the delivery area be improved?

Q8. What challenges are there in the current delivery windows?

Q9. What could be improved in the current delivery windows?

Q11. Could electronic vehicles be used for grocery e-commerce in Pirkanmaa area?

Q12. Would it be possible to change the current grocery e-commerce operations to use only electronic vehicles in Pirkanmaa area?

EXECUTION OF INTERVIEWS:

The questionnaires will be sent to the participants to read and view. Following this a meeting will be agreed upon and the questionnaire will be gone through. The meetings are required to make sure all participants have understood the questions and that the feel their answers are interpreted correctly. The answers are to be collected during the meeting with open discussion on the subject itself.

Appendix 6. Interview questionnaire Q1-Q5

Questions	Q1. Is the current delivery area optimal for grocery e-commerce deliveries?	Q2. Are Posti's own vehicles suitable for grocery e-commerce operations?	Q3. Is one loading point optimal for Pirkanmaa last-mile delivery operations?	Q4. Are there challenges caused by the usage of one loading point?	Q5. What challenges are caused by the usage of one delivery area?
Logistics operators					
Operator 1	The area is too large and the driving distances take a lot of time, so the area is not optimal.	The vehicels are suitable for the operations but limited in capacity. When driving a larger route, the limitation can cause a need for additional resources.	No, the loading point is also used by other logistics operations and that causes delays in loading.	The loading point can become growded which causes delays.	Routing is not optimal as delivery orders can occur in low numbers in a large area.
Operator 2	Driving from the loading point to the start of the route can take a long time. This in turn uses the time reserved for deliveries.	As the vehicles are mainly used in urban envrionments with narrow roads and spaces they are well suited for the operations. Larger vehicels would work better in a more rural area but for city environments the current vehicles are good.	Using only one loading point causes the need to drive longer distances to the first delivery of some routes. This is not optimal.	Driving long distances uses time received for deliveries and causes efficiency to be lower.	Orders from the same delivery window or from two delivery windows close to eachother can be on different sides of the delivery area. This causes the need to relocate a longer distance and can cause delays if the route is not on time.
Production managers					
Manager 1	The area is not limited enough in order to achieve the desired efficiency levels. Operating a smaller area with high delivery numbers would help achieve this.	The vehicles are suitable for current operations and optimal for certain types of areas.	One loading point is not optimal as the vehciles need to drive to their routes. Using multiple loading locations close to different areas would be better.	Timing the loading and loading on time can be problematic as well as the loss of delivery time for delayed loading and travel to destination.	Operating on one delivery area hinders performance because the distance between delivery windows and the large variety of possible delivery points. It can also cause claims from the customer or an increased need in resources which leads to increased costs
Asset manager					
Manager 1	**No answer required.**	The vehicles are new and have good equipment for handling grocery e-commerce deliveries	**No answer required.**	**No answer required.**	**No answer required.**

Appendix 7. Interview questionnaire Q6-9 and Q11-12

Questions	Q6. How could the loading operations be improved?	Q.7 How could the delivery area be improved?	Q8. What challenges are there in the current delivery windows?	Q9. What could be improved in the current delivery windows?	Q11. Could electronic vehicles be used for grocery e-commerce in Pirkanmaa area?	Q.12Would it be possible to change the current grocery e-commerce operations to use only electornic vehicles in Pirkanmaa area?
Logistics operators						
Operator 1	Loading could be sectioned so that vehicles could always load at a certain time. This would help avoid delays.	It could be more limited so the driving distances would be shorter and easier to manage.	The windows are open at the same time trough the whole delivery area, which makes it difficult to know how much resources will be needed	They could be distributed trough areas, so that it is easier to know where the vehicles well be and when.	If they have enough range and are stable enough so that they can operate long hours, yes.	It would most likely be difficult and cause a lot of operational challenges unless the vehicles have a good range.
Operator 2	The loading point could be reserved for Posti's vehicles at a certain time so there would not be a growded platform. Or there could be other loading points closer to other parts of the delivery area.	The delivery area could be divided in to different sections, so the deliveries would be closer to each other.	The amount of deliveries varies a lot which makes it difficult to target vehicles for delivery windows. The windows are also really long which means there can be a lot of wasted time.	The windows should be made shorter and optimized with delivery amounts so that the routes could be made more efficient.	Depends on how long they can be driven without loading. If there is a good enough battery and equipment then yes.	Depends on the range, how they can handle cold and if they can be properly equipped
Production managers						
Manager 1	The loading platforms should be reserved for Posti's vehicles for loading before the delivery windows open. This way the vehicles would be loaded when deliveries can start.	The area should be made in to several smaller areas so it is easier to manage and the resources could be directed better.	The windows are too large and divided to the whole area at the same time. With the current process it is not possible to optimize the routes well enough.	Changing the time and length of the windows could help improve efficiency and planning of routes.	Yes but that would require loading points and the vehicles would have to be able to run a freezer and temperature contorl as well trough the battery.	It would require a large investment and other vehicles would have to be disposed of. The vehicles could work but the investement would require a good reason at this point.
Asset manager						
Manager 1	**No answer required.**	**No answer required.**	**No answer required.**	**No answer required.**	They could be used but the current modles have limited range, capacity and equipment possibilities. They also require a certain type of loading points for the battery.	At the moment the change would not be feasible as there is not enough information on the vehicles capabilities. Once they have been tested more and the investment is researched enough it could be possible.

Appendix 8. New distribution areas and loading points