

Optimizing the Last-mile Segment in the Supply Chain

The Lastmile system applied on Logisoft

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Abstract

This research aims to improve the Lastmile system for the supply chain by addressing the challenges and exploring opportunities for optimization. The study seeks to fill a research gap in the Finnish context by investigating the benefits and drawbacks of different delivery systems in the last-mile, analyzing the pros and cons of current business from logistics companies, and examining the potential of last-mile systems to enhance the logistics process and reduce delivery costs.

Drawing upon existing literature in logistics management, supply chain management, and e-commerce, the research adopts a perspective primarily focused on supply chain businesses in Finland. The theoretics encompasses concepts such as last-mile optimization, customer-centric delivery, and technological advancements in logistics. The study's context is firmly rooted in the Finnish market, recognizing the specific needs and dynamics of the local Supply chain sector.

Delimitations of the research include a narrowed point of view, prioritizing the perspective of Supply chain businesses in Finland. The study does not extensively delve into detailed financial analysis or specific company strategies but focuses on delivery systems and techniques within the last-mile segment. The research also considers the impact of last-mile systems on logistics companies and their stakeholders, with a less extensive exploration of broader societal or economic implications.

The research objectives encompass evaluating the benefits and drawbacks of delivery systems in the last-mile, analyzing the impact on logistics companies and their workforce, and assessing the role of last-mile systems in improving the logistics process and reducing delivery costs. Methodologically, the study adopts a mixed-method approach, utilizing both quantitative and qualitative data collection techniques, including surveys, interviews, and case studies.

The anticipated outcomes of this research include practical recommendations, insights, and best practices for businesses, policymakers, and logistics companies to optimize Logisoft's Lastmile Delivery system. By addressing the identified research gaps, this study aims to contribute to informed decision-making, enhanced operational strategies, improved customer satisfaction, cost management, and the overall competitiveness of e-commerce businesses in Finland.

The names "the Lastmile system" or "the Lastmile Delivery system" are used in this document mention a system developed by Logisoft. The names "last-mile" or "last-mile system" used in this document are mentioned to systems in general on the market.

Language: English

Key Words:

last-mile system,

last-mile delivery (LMD),

third-party logistics (3PL),

route planning,

route optimization

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1 Introduction

In recent years, the exponential growth of e-commerce has revolutionized the retail landscape, providing consumers with convenient access to a vast array of products and services. As a result, the efficient and timely delivery of goods to customers has become a critical success factor for businesses operating in the supply chain for e-commerce and wholesale sectors. The last-mile, referring to the final step of the delivery process from a distribution center to the customer's doorstep or nearest parcel locker, represents a crucial and often challenging segment of the supply chain (Petersen et al., 2019).

The delivery of parcels to urban residential areas increases the challenge due to the amount of delivery volume, tight delivery schedules, and continuously changing delivery conditions. The Last-mile Delivery tries to address the challenges, taking advantage of the available automation, sensor and communication technologies, and people's attitudes toward parcel delivery for the benefit of all stakeholders. Various approaches to last-mile delivery have been proposed and analyzed in the literature (Silva V, 2023). The last-mile process of home parcel deliveries presents unique complexities and demands that differ significantly from traditional supply chain models. Customers now expect fast and reliable deliveries, flexible delivery options, real-time tracking, and seamless customer experiences. Meeting these evolving customer expectations requires businesses to optimize their last-mile delivery operations, balancing efficiency, cost-effectiveness, and customer satisfaction (Santos et al., 2020).

However, the traditional last-mile delivery models face various challenges in meeting these demands. Traditional models, characterized by centralized distribution centers and fixed routes, struggle to accommodate the increasing volume and variability of e-commerce orders. As a result, businesses are turning to innovative delivery systems and technologies to enhance their last-mile operations (Bastin et al., 2020).

This research aims to enhance and optimize Logisoft's Last-mile system while addressing the specific challenges encountered by businesses within the context of Finland. Through investigating the advantages and disadvantages of various delivery

systems in the last-mile, analyzing their impact on logistics companies and their workforce, and assessing the potential of last-mile systems to improve the logistics process and lower delivery costs, this study seeks to contribute to the optimization of last-mile delivery operations.

Existing research has explored various aspects of the last-mile delivery segment, including optimization techniques, customer expectations, and technological advancements. The last-mile business is often described as one of the most expensive, inefficient, and polluting parts of the supply chain (Gevaers et al, 2014). Some studies estimate that the last-mile accounts for 13–75% of total supply chain cost, depending on various factors (Gevaers et al, 2009). However, a research gap exists regarding the specific needs and dynamics of last-mile services in the Finnish market. To fill this gap, this study focuses on the Finnish context, providing insights and recommendations tailored to the unique challenges faced by businesses operating in this environment.

By conducting a comprehensive analysis of the last-mile delivery landscape in Finland, this research aims to stakeholders about the advantages and disadvantages of different delivery systems and their impact on the overall customer experience. The findings of this study will contribute to the development of strategies and practices that enhance operational efficiency, cost-effectiveness, and customer satisfaction in the supply chain sector.

1.1 The last-mile solution

A solution formulated against the backdrop of the delivery challenge is the transportation of shipments to a locker at a location near the final destination so that the consumer can collect the shipment himself in his spare time. The lockers house the contents of the shipment in a protected manner until collected by the recipient and in addition, allow the courier to make one drop in which the courier will deliver several shipments where each shipment will be housed in a separate compartment in the lockers.

Against the same background, another solution was formed in which suppliers and sellers offer the possibility of shipping the goods to a convenience store of the consumer's choice to pick up the shipment from there (figure 1). This distribution channel not only allows for the consolidation of shipments and the delivery of several items in one drop but also enables consumers to purchase products at convenience stores.



Figure 1 Core of the Last-mile system in supply chain logistics

Logistics include many steps and each step needs to be efficient and cost-effective for any business to prosper, endure, and thrive in a cutthroat market. To ensure safe, and effortless transportation of goods, from source to destination, the First mile, Middle mile (in cases), and Last mile are the stages within the distribution and supply chain (figure 2).



Figure 2 First-mile and Last-mile in the logistics model

In the following sections, this research will present a justification for the project, research questions, objectives, delimitations, a literature review of relevant studies, a research design, a preliminary table of contents, and references.

1.2 Research Topic

This topic has been chosen to investigate the importance of Last-mile Delivery. The last-mile segment of the supply chain has gained significant importance in recent years due to the exponential growth of e-commerce. Businesses are increasingly recognizing that the efficiency and effectiveness of their last-mile delivery operations directly impact customer satisfaction, brand reputation, and overall business success.

The last-mile process in the Supply chain presents unique challenges and complexities, including the need for fast and reliable deliveries, flexible delivery options, real-time tracking, and seamless customer experiences.

By enhancing the Lastmile product, Logisoft has the potential to make a practical impact on its businesses, and logistics companies. Findings and recommendations

from this research can help Logisoft optimize its Lastmile product's features in delivery operations, enhance customer satisfaction, and improve cost-effectiveness.

1.3 Research Questions

The research questions examined in this thesis are as follows.

IQ1: How can businesses optimize delivery routes to minimize time and cost while ensuring timely customer delivery?

IQ2: What methods and technologies can be used to manage and optimize the performance of delivery drivers and vehicles?

IQ3: How can companies efficiently manage their drivers, vehicles, and delivery personnel to ensure on-time deliveries?

1.4 Research Approach

This thesis will employ a mixed-methods approach, utilizing both qualitative and quantitative research methods. These methods were selected based on the assumption that their combination will offer a more comprehensive understanding of the research problem compared to employing only one method separately.

This thesis will present the theoretical framework for optimizing last-mile delivery operations based on the logistics system. Following this will be definitions of the methods utilized in the study, data collection, and analysis methods.

After presenting the theoretical framework and research methods, a description of the current operations of standard distribution systems will be outlined to identify the challenges and requirements of the current process.

1.5 Research Design

The study employs a descriptive methodology focused on a specific issue to assess its updating status. The primary aim of the research is to furnish insights into the last-mile delivery process within the Finnish e-commerce market. Hence, individuals

utilizing the internet are encouraged to share their perspectives via a tailored questionnaire, intending to investigate the current state of the online market in Finland and, subsequently, the role of last-mile delivery in connecting customers with sellers.

This thesis employs a quantitative and qualitative research approach, utilizing an online survey distributed across various social media platforms and through targeted emails. Facebook, particularly through influential groups like “Uber & Bolt Drivers Union Helsinki Finland” (1.5k members), “Uber, Bolt Drivers & Riders Platform” (5.2k members), and “Foodora, Uber, Bolt, and Wolt Rider” (15.9k members), will serve as the primary platform for survey dissemination. Subsequently, an approaching strategy will engage a substantial portion of the studied population. Leveraging the Novia emailing system to connect with students represents a practical approach, facilitating a swift and efficient collection of the necessary responses. Besides, experts will be consulted via interviews to discover experiences, and issues in actual businesses.

2 Theoretical Framework

The research for the optimization of the last-mile delivery system project will be based on a theoretical framework consisting of two stages. Stage 1 will involve the following steps, identifying existing issues in the Last-mile Delivery (LMD) solutions, determining criteria for research and optimization, and collecting, and analyzing data. Stage 2 will include the following steps, discussing the achieved results and drawing conclusions, defining ideas for solutions, selecting optimal solutions, and developing an optimization plan (figure 3).

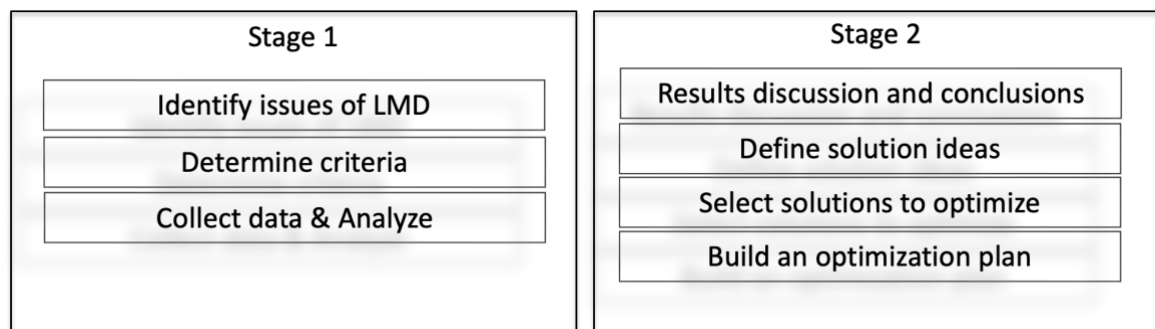


Figure 3 Research theoretical framework

3 Last-mile Delivery

This chapter employs most kinds of literature related to last-mile delivery in the logistics and e-commerce fields.

In the supply chain including B2B and B2C, Last-mile Delivery (LMD) is a term used to describe the final step of delivery to customers. It is a shipment of goods/parcels from a warehouse/ a hub/ distribution center/ micro-depot to a consumer's home or the nearest parcel locker. It has become a significant challenge for retailers and logistics service providers, constituting a major portion of logistics costs, often exceeding 50% (Guy B. 2023).

3.1 Last-mile Delivery Framework

According to Olsson et al (2019), a Last-mile Delivery framework with three central components including last-mile fulfillment, last-mile transport, and last-mile delivery, as seen in Figure 4. The framework can be extended to the core components of the business' tactical characters and mid-term planning horizon. The framework can be examined from two perspectives including back-end and front-end. The back end constitutes the part of the framework oriented towards the sender, whereas the front end is directed towards the receiver of the system. (Olsson et al., 2019)

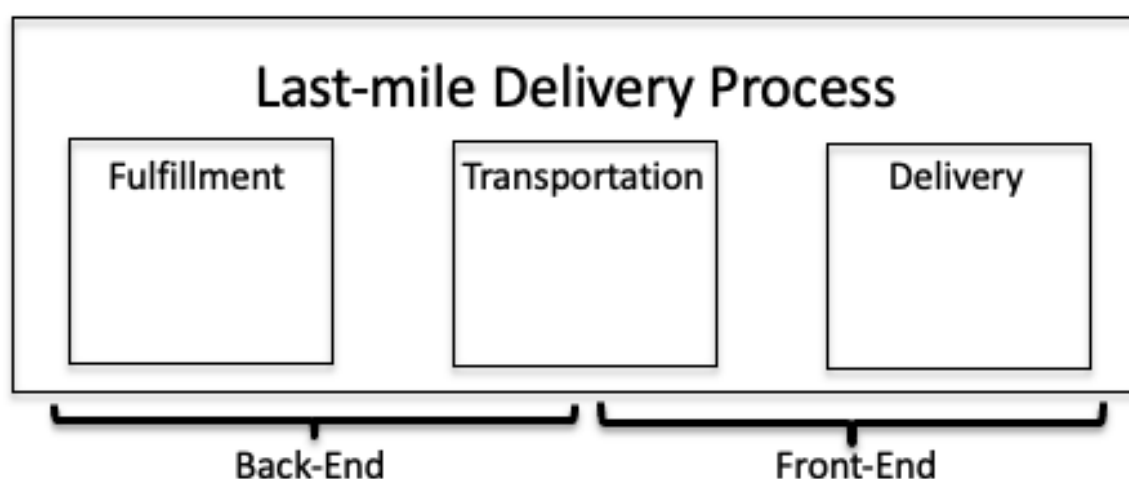


Figure 4 Overview framework of LMD (Olsson et al., 2019)

Besides, according to Galkin and associates (2018), there are two main ways of delivering goods to consumers, which are considered the primary solutions for consumer delivery. In figure 5, the third model, in addition to or through distribution channels, is not considered a primary logistics channel. These channels involve various freight transport activities depending on the required level of intermediaries.

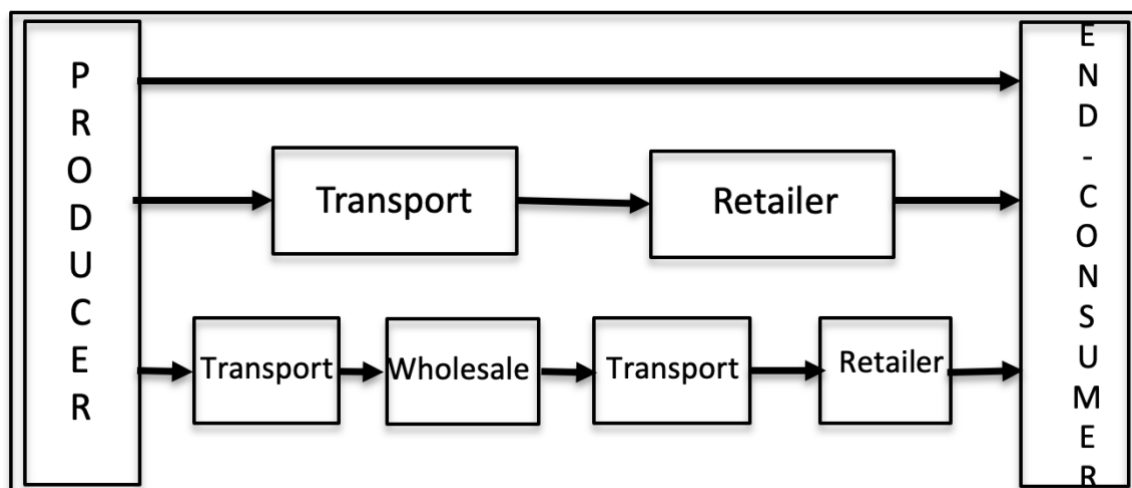


Figure 5 Schemes of delivery (Galkin et al, 2018)

Last-mile Delivery is the last stretch of the business-to-consumer (B2C) part parcel. It takes place from the order penetration point (i.e., fulfillment center) to the final consignee's preferred destination point (e.g., home or cluster/collection point), for the reception of goods. (Lim et al., 2019, Galkin et al., 2018).

The results of this study support the enhancement of current processes in businesses, as the last-mile delivery model currently in use is one of the three models researched by Galkin and their colleagues (figure 6). In the current operations of the delivery company, the locker delivery for e-commercial goods utilizes the post-production channel from the producer to the consumer. With the delivery to their lockers, both the producer's channel and the retail channel to the consumer have been examined in the research conducted by Galkin and their colleagues.

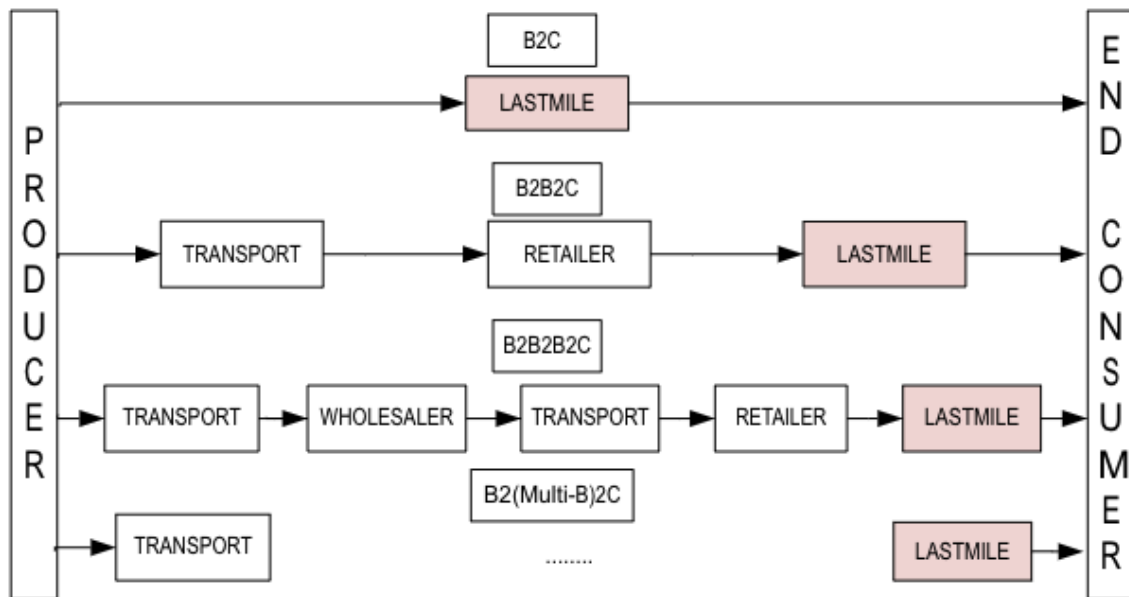


Figure 6 Schemes of Last-mile Delivery

3.2 Landscape of Last-mile Delivery

With the rise of e-commerce and same-day delivery expectations, this sector has witnessed significant innovation. From traditional courier services to the emergence of crowdsourced delivery platforms and autonomous vehicles, the last-mile delivery landscape continues to evolve rapidly, driven by technological advancements, customer demands, and sustainability considerations.

3.2.1 Demand for Last-Mile Delivery

According to various surveys and studies, online sales currently account for up to 21% of the total retail market, compared to 5.1% in 2007 (Ali, F, 2021). The demand for last-mile delivery is also expected to grow by 78% by 2030. This is supported by the increase in urban population and other factors such as the COVID-19 pandemic or diversification in peer-to-peer personal sales channels. In Finland, 55 percent of surveyed Finns said that they purchased essentials during the coronavirus pandemic and stated that they would continue buying after that period (Clausnitzer J., 2021).

The total value of e-commerce spending in 2020 was \$24 billion, with 63% coming from B2B and 37% from B2C. On the consumer side, 49% spent over \$100, and 21% spent over \$500 in the last 3 months. For single transactions, 64% had a value below

\$50, although this amount has increased since 2019, mainly due to higher customs duties. Within three months, the average Finn made more than 5 online purchases. The average annual expenditure in 2020 was \$900 per person. The share of e-commerce in B2B revenue is 22%, slightly higher than the EU average of 20%. (Tiina K., 2023).

3.2.2 Parcel Lockers

Using parcel lockers as hubs or storage locations to replace home delivery is one of the approaches in last-mile delivery. Customers will pick up their goods from their home's nearest lockers. This way reduces costs for less urgent deliveries that customers are willing to pick at close to their homes. The customers are guided to pick up their goods via mobile messages including the address of the locker, locker key/code, and window time information.

Parcel lockers are used on a large scale. For example, in Finland, Posti's network includes nearly 2,300 Posti Parcel Lockers stations (posti.fi, 2023), Matkahuolto network has 1,000 parcel lockers stations (matkahuolto.fi, 2022), DHL has around 500 parcel lockers stations which are installed in Finland's K-Group stores.

The use of parcel lockers for receiving online orders is on the rise. In Finland, 54% of online shoppers prefer parcel lockers as their delivery location, with this option being popular across all age groups and especially favored by those aged 35–49. Retrieving items from parcel lockers is considered swift and convenient, given their strategic placement in locations with easy transportation access along daily routes (Posti's survey, 2021).

To optimize the last-mile logistics process, logistics companies have introduced pick-up locations, parcel lockers, and outdoor lockers, and maintained their traditional partner-based sites. These pick-up locations enable a broader reach and serve a higher volume of customers, eliminating the need for extensive resources dedicated to home deliveries. By optimizing pick-up locations in densely populated areas, the demand for delivery resources is reduced, resulting in a more customer-friendly service where individuals don't have to wait for deliveries at home.

3.3 Last-mile Delivery in electronic commerce – retail

3.3.1 E-commerce Logistics

There are significant differences among countries in the global e-commerce retail industry, and many large e-commerce platforms are in operation. Countries with significant differences in population size in urban areas tend to be actively involved in e-commerce. Clear examples from Southeast Asian countries such as Vietnam, Indonesia, Malaysia, and Thailand show that they have a young population residing in densely populated major cities. These populations exhibit a strong demand for online shopping due to affordable prices and the convenience of placing orders through mobile applications. Goods can be distributed to their workplaces or residences, or a specified address requested by the buyers. Other factors include specific requirements for perishable goods and their handling, as well as variations and costs related to services and products. These changes are influenced by local regulations and laws.

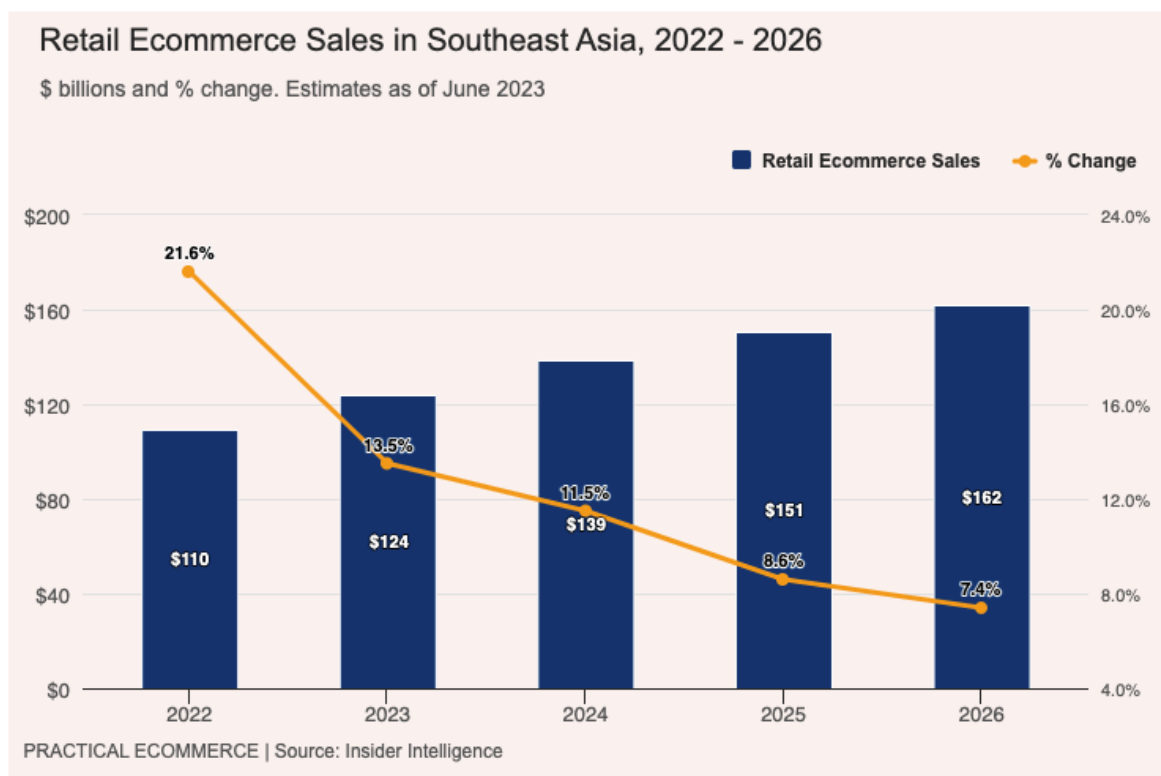


Figure 7 Retail Ecommerce Sales in Southeast Asia (Source: PracticalEcommerce)

On a global scale, last-mile logistics is becoming the largest market segment within the logistics industry. Figure 8 shows that, from 2020, the revenue from e-commerce sales reached a staggering 5 trillion USD, with an annual growth rate of 6%-10%, and it is projected to continue growing steadily in the upcoming years. Following this growth trend, the global e-commerce market is expected to reach 8 trillion USD in 2027.

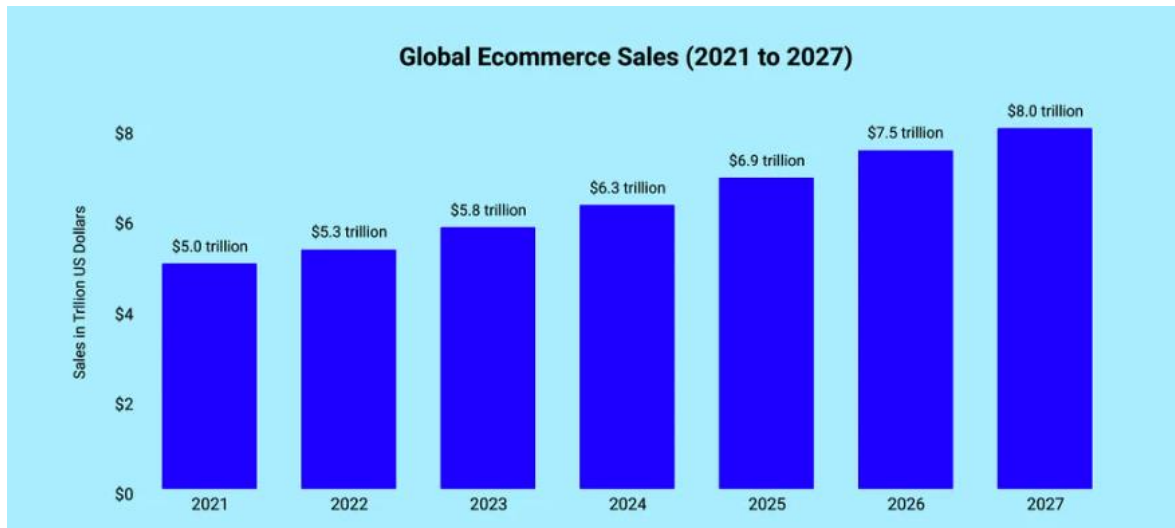


Figure 8 Previous and Forecasted Global E-commerce Sales (2021 to 2027) (Shopify.com)

3.3.2 Thirst-party logistics (3PL) services in E-commerce

A 3PL provider is described as a unique intermediary in the logistics channel that offers comprehensive or partial logistics services to other businesses. This includes various services ranging from basic transportation to the planning, executing, and operating of an entire distribution and logistics system for a specified duration, as outlined in a contractual agreement (Duo Zhang, 2000). A 3PL service may provide a single service such as transportation warehouse storage or warehouse management such as fulfillment, packing, and loading. The primary purpose of utilizing a 3PL service is to save costs and increase advantages for competitors. Figure 9 shows some of the 3PL services in E-commerce.

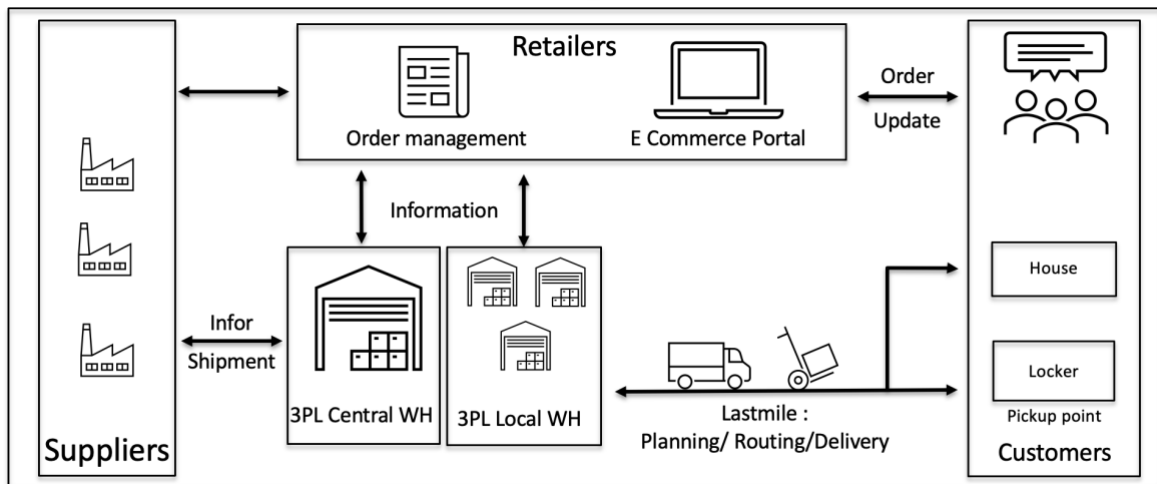


Figure 9 Last-mile Delivery in E-Commerce

3PL transportation is widely used in retail e-commerce especially in small and medium businesses (SMB) to allow those companies to outsource the delivery needs for transporting their goods and let them focus on their product and business.

In this research, the 3PL service focuses on transportation service in the last-mile delivery segment.

3.4 Current last-mile process in the competitive landscape

3.4.1 Posti Business Model

Posti is the national postal and logistics service provider in Finland. They offer a comprehensive range of postal and logistics services, including last-mile delivery, to both business (B2B) and individual (B2C) customers.

Posti provides customized last-mile delivery solutions for businesses, tailored to their specific needs and requirements. They offer various delivery options, including standard delivery, express services, and parcel locker delivery.

Posti's business model includes both traditional mail and parcel delivery, with an extensive network of post offices and service points.

Posti emphasizes efficient and sustainable delivery methods and has been actively exploring electric delivery vehicles and green logistics solutions.

#	Service	Description
1	Parcel Delivery Services	Posti offers parcel delivery services for businesses, enabling them to send packages to customers and partners. This may include B2B and B2C deliveries.
2	Freight Delivery	Posti provides a service of sending large shipments, ranging from a single package to an entire load, flexibly as freight. The transport unit is usually a pallet, and the waybill will serve as the transport document.
3	Express Parcel Delivery	Posti may provide options for express and 8 A.M – 4 P.M next-day deliveries, allowing businesses to meet urgent delivery requirements.
4	Integrated Solutions	A. Posti often tailors its last-mile delivery solutions to meet the specific needs of businesses. This could include options for businesses' transportation order systems such as Posti by nShift(Browser Based), Direct EDI integrations, Posti pickup points, Browser-based Item tracking, warehouse integration, etc.
5	Delivery Time Windows	Businesses may have the option to choose specific delivery time windows for their shipments, ensuring flexibility and alignment with recipient schedules.
6	Parcel Lockers and Pickup Points	Posti operates a network of parcel lockers and pickup points, providing businesses with alternative delivery options and convenient locations for recipients to collect their packages.
7	Green Logistics Solutions	Posti has been active in exploring sustainable and eco-friendly logistics solutions. Businesses may have the option to choose environmentally friendly delivery methods.

8	Return Logistics	Posti may provide businesses with solutions for managing returns efficiently, including the pickup of returned items from customers.
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3.4.2 Matkahuolto Business Model

Matkahuolto is a well-known bus and courier service provider in Finland. They offer a variety of transportation and delivery solutions, including last-mile delivery services.

Matkahuolto provides last-mile delivery services for businesses, connecting various locations and urban areas across Finland. They offer a range of courier and parcel delivery options for businesses, including same-day and express services.

Matkahuolto operates an extensive network of service points, making it convenient for customers to send and receive packages.

They have a strong presence in both passenger and freight transportation, allowing for synergy between their various services.

#	Service	Description
1	Courier and Parcel Delivery Services	Matkahuolto offers businesses the ability to send parcels and packages to their customers or partners, both in B2B and B2C contexts.
2	Express Delivery Options	Matkahuolto may provide express delivery services, allowing businesses to meet urgent delivery requirements and provide fast shipping to customers.
3	Delivery Network	Matkahuolto operates an extensive network of service points and terminals, facilitating the last-mile delivery process and providing convenient locations for recipients to pick up their packages.

4	Same-Day Delivery	Depending on the service level chosen, Matkahuolto may offer same-day delivery options for businesses looking to provide expedited services to their customers.
5	Integrated Solutions	Matkahuolto may offer customized MParcel customer interfaces to meet the specific needs of businesses, including options to manage user IDs and the company's delivery addresses, complete and print the shipping documents using a computer and upload consignment information directly to the Matkahuolto system, track and trace your consignments in real-time, monitor cash-on-delivery payments in real-time, email a track and trace link to the recipient of your parcel, view invoicing history, and upload your entire customer register to the delivery system.
6	Parcel Lockers	Matkahuolto may have a network of parcel lockers, providing businesses with an additional delivery option and recipients with a secure and convenient way to retrieve their parcels.
7	Return Logistics	Matkahuolto likely provides solutions for managing returns efficiently, including the pickup of returned items from customers.

3.4.3 DHL Business Model

DHL is a global logistics and courier company with a strong presence in Finland. They provide a wide range of logistics and last-mile delivery solutions to businesses.

DHL offers businesses tailored last-mile delivery solutions with a global network and a local presence in Finland. They provide a variety of delivery services, including express deliveries, same-day services, and last-mile delivery for e-commerce businesses.

DHL focuses on advanced tracking and visibility solutions, allowing businesses to closely monitor the progress of their shipments.

They offer specialized services for different industry sectors, such as healthcare, automotive, and e-commerce, to meet specific business requirements.

3.5 Last-mile Delivery in the Supply Chain

The last-mile represents the final part of the distribution process (figure 10), where the delivery takes place from the last distribution point, such as a warehouse or distribution center, to the home or collection point of the ultimate customer (Archetti & Bertazzi, 2021). There may be many challenges in the last-mile, but the focus of the current thesis will be on the transportation issue, where daily activities are all related to distribution. Routing issues are an example of those challenges (Archetti & Bertazzi, 2021).

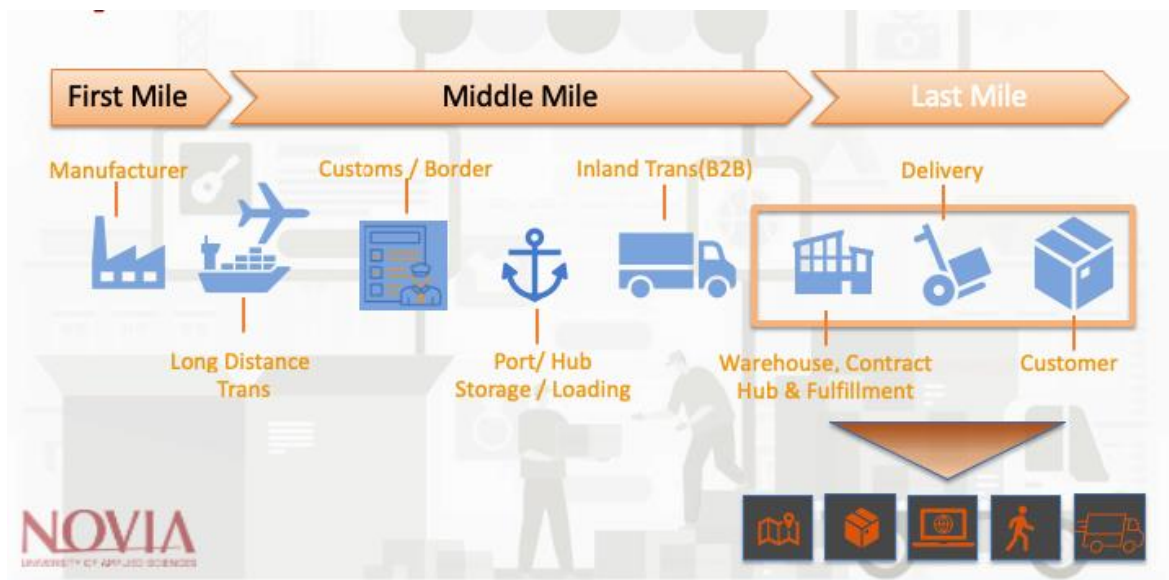


Figure 10 The Logistics distribution services

4 The Last-mile Delivery Process

The current Lastmile delivery process of Logisoft was established in 2021 and has been continuously upgraded up to the present.

4.1 Process Description

The backbone of Logisoft's Lastmile process is still maintained, consisting of four components including Order management, Route management, Driver & vehicle management, delivery management, and master data and API connection management (figure 11). This process also opens information channels to integrate with other systems via API services or data importing. Considered from the perspective of an independent system, Logisoft's Lastmile solution is fit to deploy for 3PL businesses, carrier service providers, or transportation providers. On the other hand, the Lastmile system can also be deployed for companies that have distribution needs and existing logistics infrastructure, such as finished goods warehouses, transportation fleets, and other resources.

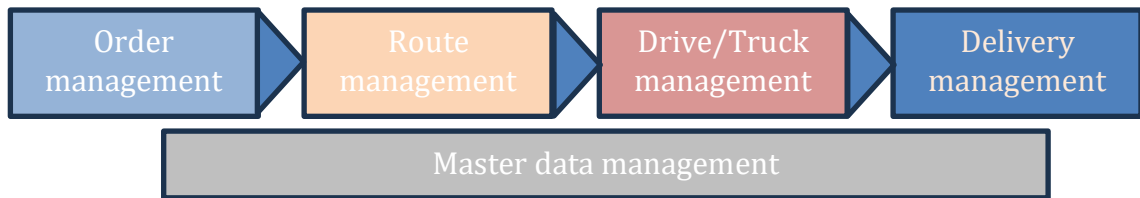


Figure 3 Operation blocks in the Lastmile system

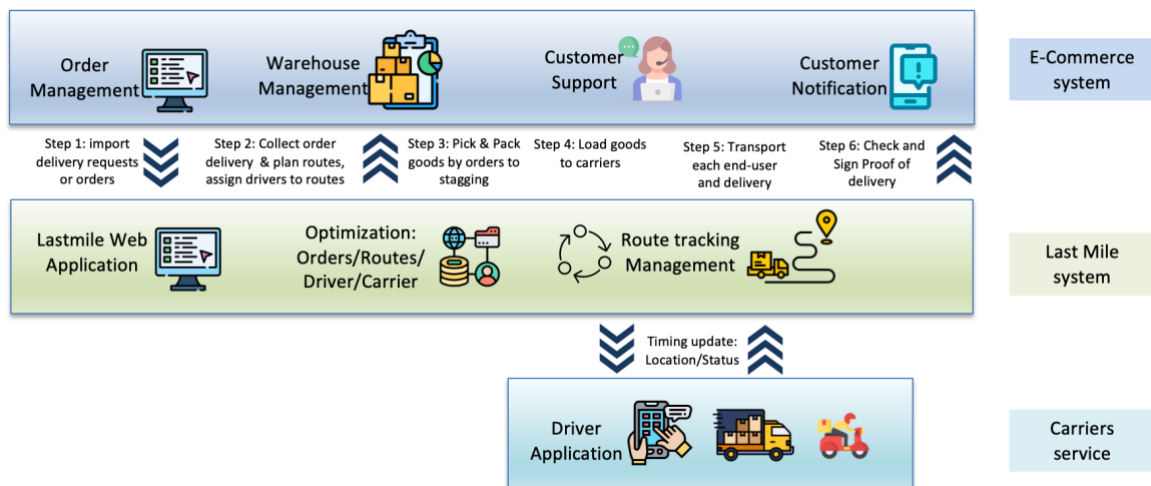


Figure 12 An integrated system between a last-mile system and a retail eCommerce system

4.1.1 Order Management

The process begins with sales orders/delivery orders from retail e-commerce businesses (figure 12). The main information of an order includes customer contact, location, and quantity of goods. Orders then are filtered by conditions such as customers' location and grouped if same or near locations. In most cases, goods are available in warehouses or delivery hubs, in rare cases if goods are lacking, orders can be delivered as partial deliveries. To facilitate customer payments, many e-commerce companies implement flexible payment policies such as cash on delivery (COD). Therefore, in the order information, there will be an amount to be collected upon delivery. In this case, drivers need to be equipped with devices to read bank credit cards or handle cash transactions and sign off on the amount collected using the mobile driver application.

4.1.2 Route Management

Orders are planned delivery on a date and a route, which can be covered by many orders that have the same areas of the route path. These routes are optimized and assigned to drivers by some algorithms and constraints including total volumes and total weight less than truck/motorbike loading capacity, the total estimated time within a work shift of drivers, and total distance less than the maximum distance of a shift (figure 12). However, routes must be approved by logistics operators. Once routes are approved, the route information will be synchronized to warehouse management to prepare picking and packing and send to the assigned driver in the driver application.

4.1.3 Route Planning in Last-mile Systems

Route planning is the process of calculating an efficient transportation method or route through multiple stopping points. Essentially, route planning is utilized to determine which route minimizes costs when moving from one location to another.

Generally, logistics or transportation companies utilize software solutions for route planning and compile the necessary routes.

Following is a multi-stop route planning. The process of importing a list of orders with customers' addresses in text and putting relevant start-points (Warehouse or hub) and destinations into an order that makes sense is known as route planning. Based on basic information such as truck type, departure time, and average delivery time, the route planning software will generate a route for the driver to follow and provide an estimated time for customer notification.

Most navigation systems utilize information on road length and speed limits to calculate the shortest or fastest routes. When executed, these routes often become suboptimal, as the solution tends to overlook the inherent randomness of traffic flow and changing road conditions. Real-time traffic flow data can be estimated from the road sensor network, so expecting into the extent to which the efficiency and effectiveness of such information can be leveraged.

In Figures 13 and 14, the data shows how to make a routing plan. the orders are collected from the sales system, the route planning feature will be invoked to calculate an optimized route.

#	Address	Name	Service time	Ready time	Due time
1	Myllärinkatu 1, 65100 Vaasa, Finland	Biltema WH	00:10	09:00AM	00:00AM
09:13	Kaupunginkatu 18, 65300 Vaasa, Finland	Ord-0779-Cus-0005	00:10	00:00AM	00:00AM
09:30	Metsätie 7, 65610 Mustasaari, Finland	Ord-0579-Cus-0003	00:10	00:00AM	00:00AM
09:46	Torpankatu 9, 65230 Vaasa, Finland	Ord-0600-Cus-0008	00:10	00:00AM	00:00AM
10:01	Aurinkotie 10, 65280 Vaasa, Finland	Ord-0972-Cus-0004	00:10	00:00AM	00:00AM
10:16	Järvikatu 22, 65100 Vaasa, Finland	Ord-0973-Cus-0007	00:10	00:00AM	00:00AM
10:32	Satamakatu, 65170 Vaasa, Finland	Ord-0847-Cus-0009	00:10	00:00AM	00:00AM
10:50	Myllärinkatu 13, 65100 Vaasa, Finland	Parking	00:10	00:00AM	00:00AM

Figure 13 Sample data of a delivery list (data is randomly picked from Google map)

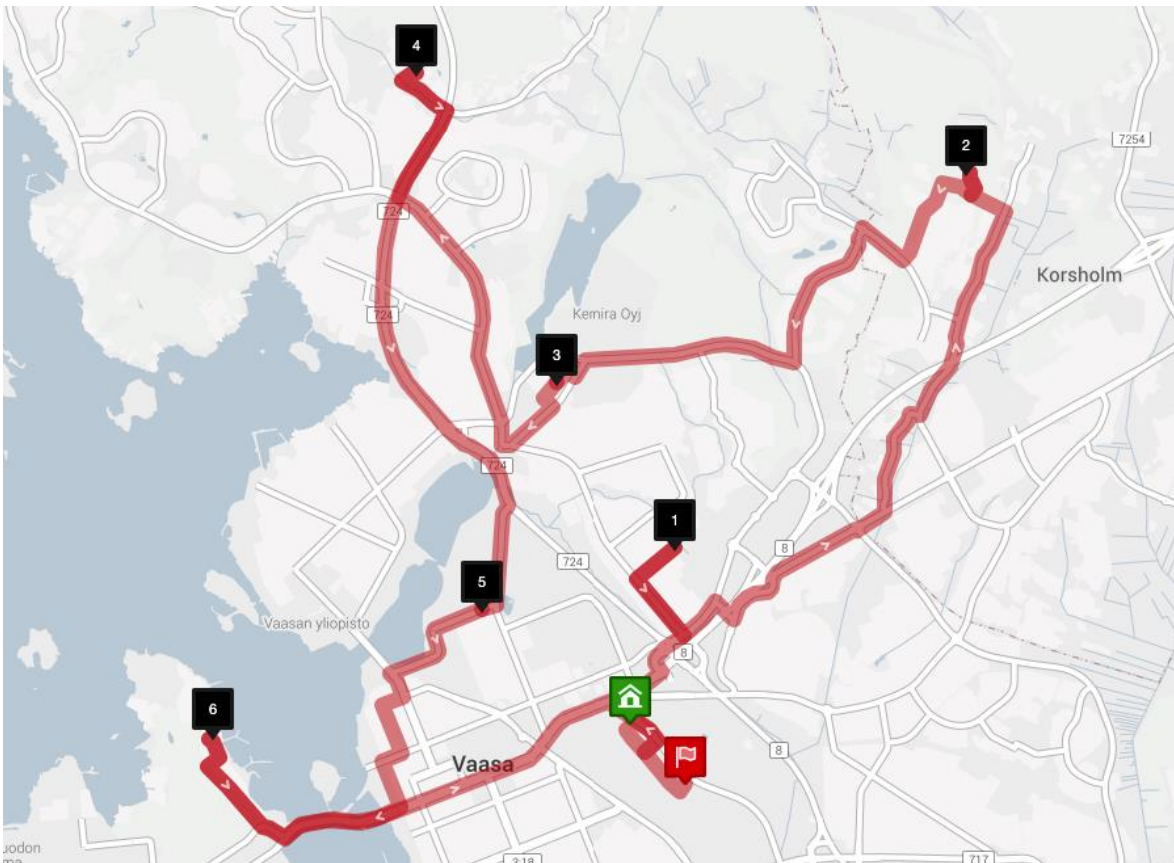


Figure 14 The optimized route planning

4.1.4 Driver and Vehicle Management

Drivers are registered into the system including basic personal information, driver's license type, and due date. Due to their responsibilities for the safe transit of cargo in short distances, almost all drivers should drive less than four hours in a six-hour shift. Drivers register working shifts to the system. Vehicles are registered into the system including their basic information, capacities, fuel type, fuel consumption, maintenance information, and parking locations. A driver and a vehicle are paired together and assigned to routes. Drivers will work via a mobile application with detailed delivery of goods, route information, and stop points. In most cases, drivers have to communicate with customers to verify the time window and how to deliver.

4.1.5 Delivery Management

The main functions of delivery management in Last-mile aim to manage the process of delivery including steps from loading to the vehicle, transporting on routes, delivering to the customer, printing receipts, and signing proof of delivery (POD). In

some cases, if customers are not satisfied, the goods can be returned right after delivery, and the return process will be included in the delivery management. Delivery information is updated continuously from the driver application automatic or driver's manual. Updated information includes vehicle location, order delivery status, and route status. Operators can monitor vehicles' location on the map and track routes by logged data which updates timing.

4.1.6 Master data and API connection management

This subsystem has features aimed at managing master data and integrated data from other systems. The master data comprises events defining a business entity, events that can be used to model one or more definitions or perspectives of an entity. Entity definitions based on core data provide consistency in business and data integrity when multiple information technology (IT) systems in an organization (or beyond) identify the same entity in different ways. (Ibrahim et al). In the last-mile system, the master data includes data of the owner businesses, operators, drivers, trucks, authorizations, stock keeping unit (SKU), locations with geographic information (latitude and longitude), and many other basic information.

In the e-commerce system, besides last-mile systems, many systems are integrated via API or electronic files. Firstly, order information from the online sales system is synchronized to the last-mile system's schedule. Secondly, Google geocoding API service, which can convert an address into latitude and longitude coordinates or convert latitude and longitude coordinates into an address, and Google geolocation API service that displays the geographic location of an end-user or a vehicle on a map in the mobile application. Thirdly, route planner API service that finds the best multi-stop route for deliveries or pickups.

4.2 Real-time Route Optimization Process Description

During the delivery time on the route, the system must adjust delivered routes based on the most current information available during the actual delivery process, considering various factors to ensure the most efficient and timely deliveries.

Real-time route optimization is a continuous process that dynamically adjusts delivery routes as new information becomes available. This can include changes in traffic conditions, unexpected delays, or alterations in delivery priorities. The integration with GPS and traffic data are the key factors. The last-mile system utilizes GPS technology and real-time traffic data to monitor the location and movement of delivery vehicles. This information is integrated into the route optimization algorithm to make instant adjustments based on the current traffic situation. The system takes into account specified delivery windows for each customer. It ensures that deliveries are made within the agreed-upon time frames, optimizing routes to accommodate these windows while minimizing overall delivery time.

In some cases, if customers provide specific delivery instructions or preferences during the delivery process, the system adapts the route accordingly. For example, if a customer requests a change in delivery location or timing, the route is adjusted in real time. The main function of real-time optimization is to respond to unforeseen delays or obstacles such as road closures, accidents, or construction. The system re-routes vehicles to avoid these obstacles and minimize delays. The system is also designed to improve the productivity of delivery personnel, optimizing routes to ensure a balanced workload and efficient use of resources. This includes factors as driver breaks, working hours, and rest periods.

#	Factors	Description
1	Traffic Conditions	Real-time traffic updates play a crucial role in route optimization. Heavy traffic, accidents, or road closures can impact the planned routes, requiring adjustments to ensure timely deliveries.
2	Weather Conditions	Adverse weather conditions, such as storms or snowfall, can affect road conditions and impact delivery routes. Real-time optimization considers weather-related challenges and adjusts routes accordingly.

3	Customer Availability	If customers are not available at the specified delivery windows or request changes during the delivery process, the system adapts routes to accommodate these variations.
4	Order Priorities	Changes in order priorities or urgent deliveries may require immediate adjustments to the planned route. Real-time optimization ensures that priority deliveries are accommodated efficiently.
5	Vehicle Breakdowns or Issues	If a delivery vehicle experiences mechanical issues or breakdowns, the system re-optimizes routes to redistribute deliveries among available vehicles. The drivers update the situation via the driver mobile application.
6	Operational Constraints	Operational constraints, such as limited vehicle capacity or specific vehicle types for certain deliveries, impact route planning. Real-time optimization addresses these constraints during the delivery process.
7	Dynamic Demand	Changes in demand or order volumes during the day can impact routes. Real-time optimization adjusts routes to efficiently handle varying order quantities and delivery locations.

5 Data research implementation

Based on a research plan including both qualitative and quantitative research methods, the research will be conducted in parallel including a survey and a set of interviews.

5.1 Survey implementation

The data used for the research is gathered from surveying individuals who utilize delivery systems or courier partners of delivery platforms such as Wolt, Bold Food, Uber, and Foodora companies, as well as from interviews with experts in the freight transportation field. Survey information is disseminated within large groups and communities on the Facebook social network. The majority of members in these groups are drivers and partners affiliated with delivery companies. The membership of these communities ranges from approximately 1,000 to 15,000 members. The survey was conducted over 6 weeks, starting in early February 2024 and concluding in mid-March 2024. It successfully gathered over 100 responses. Figure 15 shows the survey result in general.

Quantitative Insights: Last-Mile Logistics

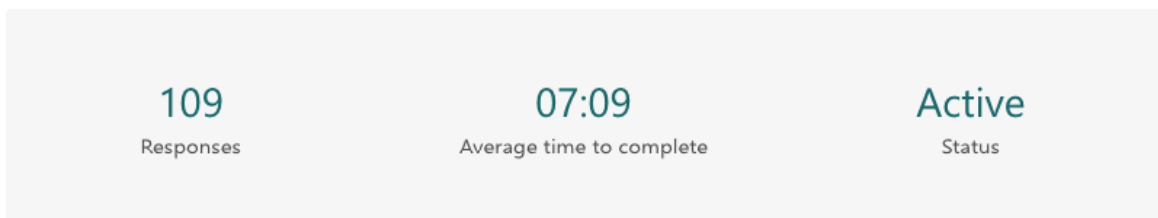


Figure 4 The survey's general result

The survey was conducted on the Microsoft Forms platform, and the data was exported to an Excel file as raw data (see Appendix 1). The study aimed to understand the satisfaction levels of users of last-mile software as well as other delivery systems. Additionally, the study aimed to explore the integration needs for system functionality or essential features for a comprehensive last-mile system. The study also measured challenges and obstacles encountered in operations and the business aspects of delivery personnel and drivers.

5.2 Interview Implementation

Interviews with logistics experts and managers have been completed as open-ended questions relating to the topic. These experts attended interviews.

Logistics system product owner – An expert in logistics system development at Logisoft

Logistics taxi and transportation CEO at VH Transportation

Logistics Specialist – Manager at Inex

The interview questionnaire (see Appendix 3) was sent to participants for them to read and respond to based on their knowledge, experience, and real-world challenges of the participants.

These interviews have been executed with questions via video meetings relating to each interviewee. The information collected considers the usability of current systems, demands for upgrades or optimization in the future, as well as integration with other technologies and services. The questions focused on the current situation of the groups and possible future aspects of them. The aim was to collect information on challenges with the topics and features that possible development points. The questions and received answers are listed in Appendix 4.

This research includes four data groups including Customer Satisfaction and Experience, Operational Efficiency and Resource Management, Administrative and Compliance Considerations, and Technology Adoption and Integration. This data aims to consolidate the necessary elements for a comprehensive last-mile system in the future to develop and optimize features. Existing features can be adjusted in the short term, and additional technologies will be integrated to meet real-world requirements in the long term.

6 Data Analyses

In this chapter, data includes two groups of survey data (quantitative data) and interview data (qualitative data). The data will be analyzed according to predetermined criteria to clarify factors from the context in Finland.

6.1 Survey Data c

Data collected from the questions in the survey (appendix 1), is divided into 8 sections presented below. The raw data is stored in appendix 2.

6.1.1 User Satisfactory

Based on the chart below, it can be seen that the satisfaction level of users is quite low. Only about 30 percent believe that they are satisfied with the current features of the last-mile application in their work, while over 54 percent express dissatisfaction and suggest improvements for enhancing service quality and work productivity.

1. How satisfied are you with the current last-mile delivery services you use for your business or your personal?

[More Details](#)

● Highly dissatisfied	20
● Dissatisfied	39
● Neutral	18
● Satisfied	25
● Highly satisfied	7



Chart 1 User satisfactory

The majority of users (59 out of 109) express dissatisfaction, this indicates a notable room for improvement in user satisfaction. This could be due to reasons about service quality, features, or overall user experience.

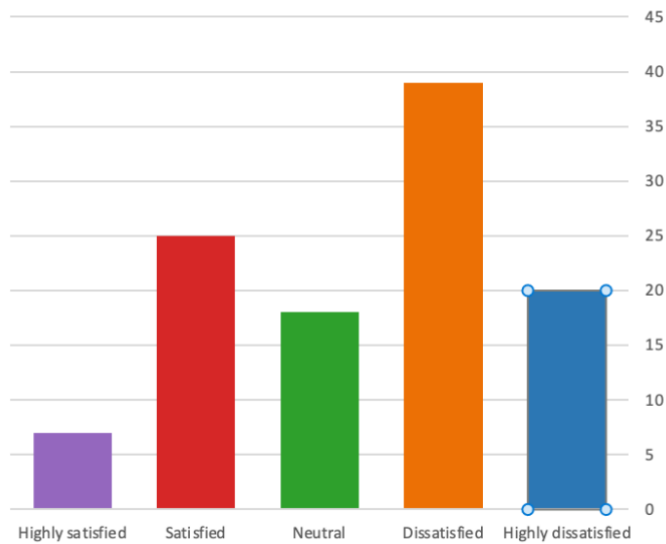


Chart 2 The number of users selecting "Dissatisfied and Highly Dissatisfied" is predominant.

6.1.2 Frequency of Delays

Approximately 5 percent of those surveyed responded that they have never faced delay issues. The majority of users believe that delay problems occur on a weekly and monthly basis, reaching nearly 60 percent. This is quite concerning for a delivery system, as delays can incur additional costs for handling them and impact both productivity and service quality. Additionally, delivery delays have a chain-like nature, impacting subsequent deliveries along the same route. If the delay is significant, it can lead to unsuccessful deliveries as customers may not be able to wait, resulting in delivery personnel having to work overtime, thereby increasing costs. Besides, delays in deliveries can indeed lead to additional working hours for both drivers/couriers and support staff because the general working time in Finland is a maximum of 8 hours per day totaling 40 hours per week, this does not cover period-based working times. (Ministry of Economic Affairs and Employment, 2021)

[More Details](#)[Insights](#)

● Daily	15
● Weekly	19
● Monthly	40
● Rarely	29
● Never	6



Chart 3 Ratio of Delays

The largest number of users' answers is 40 for "Monthly", which means that delays occur 1-2 times a month for the majority of drivers and couriers. The causes can stem from various external factors as well as reasons related to the service system or technical issues. The objective causes could be attributed to weather conditions, traffic congestion, and unsuccessful deliveries due to customers not being available. These causes necessitate further research into weather patterns, traffic conditions, and customer behavior to reduce the frequency of delays. However, subjective causes can be addressed or optimized through new technologies. For example, integrating a professional route planner, hiring a talented delivery workforce, upgrading vehicles, and strengthening the internal business ecosystem can help overcome the causes of delivery delays.

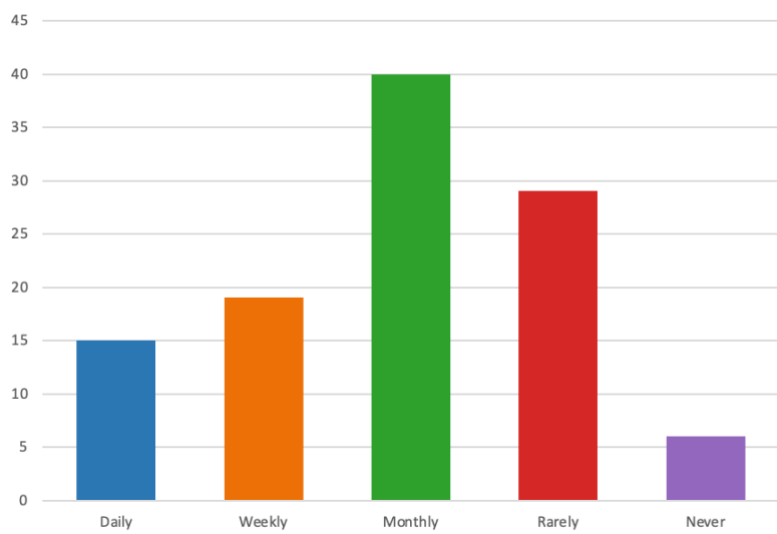


Chart 4 Frequency of Delays

6.1.3 Delivery Costs

From this analysis, it is evident that a significant portion of respondents, comprising approximately 45% (Significantly and Extremely combined), perceive a considerable contribution of the current last-mile system to high delivery costs. This suggests that there is a widespread acknowledgment among respondents regarding the impact of last-mile operations on overall delivery expenses, highlighting the need for strategies to optimize last-mile logistics and minimize associated costs.

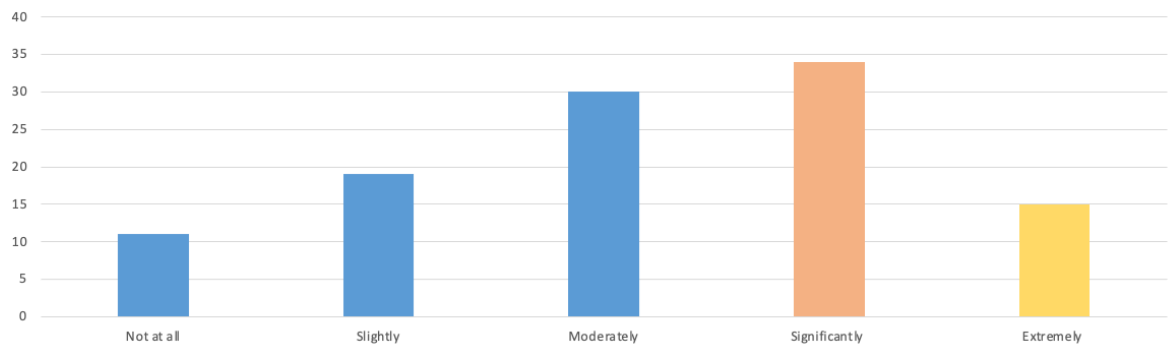


Chart 5 Opinions about the current last-mile systems contribute to delivery cost

A considerable portion (31%) believes that delays significantly contribute to delivery costs and a portion (15%) believes that delays extremely impact costs. This emphasizes the financial impact of operational challenges and highlights the need for strategies to mitigate delays and associated costs.

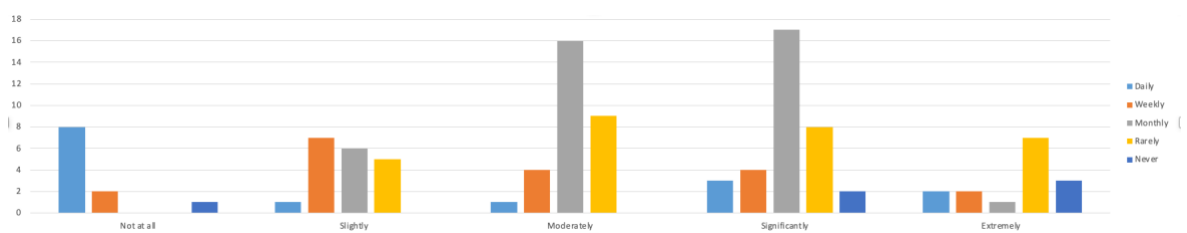


Chart 6 Portion between delays and delivery costs

6.1.4 Technological Integration

The majority of users (78%) rate technological integration positively. This indicates that the service's technological aspects are generally well-received. Further investment in and optimization of technology could continue to enhance user satisfaction. The majority of respondents rated the level of technological integration

in last-mile delivery services as "High" (assuming "High" corresponds to a rating of 7-10). This indicates that there is already an acknowledgment of the importance of technology in optimizing delivery processes.

33% of people answered Significantly for the question #3, and the majority answered "High" for this question.

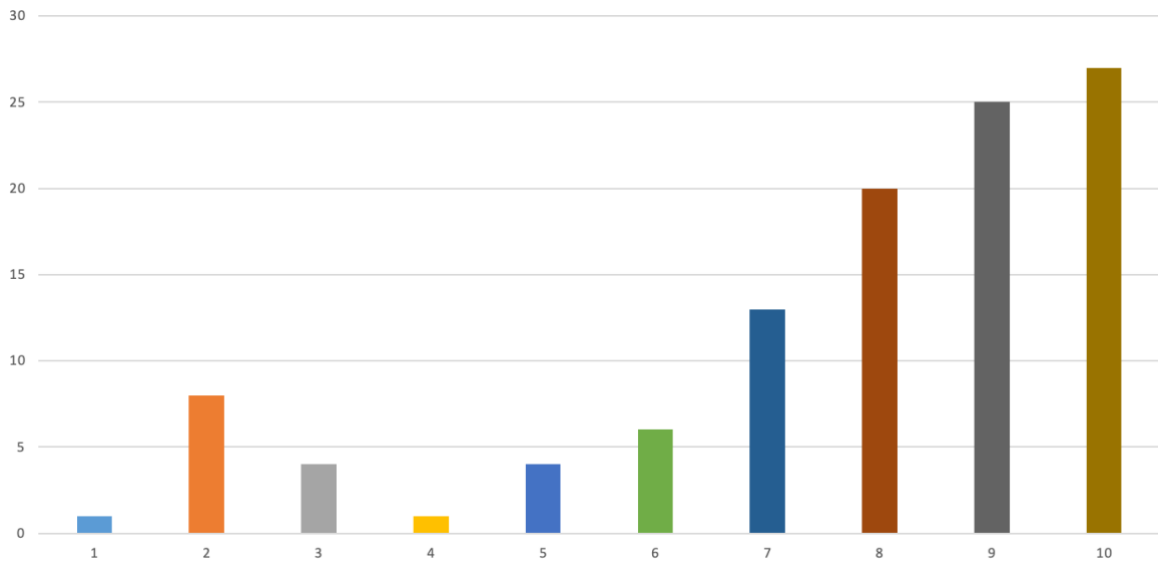


Chart 7 Rate the level of technological integration

67% of people answered “High” for question 4, and the majority answered "High" for Question 10. This indicates that many people desire the technology integration into the Last-mile system and wish for improvements or integration of real-time communication features, including text messages, voice messages, message templates, timely messages, etc.

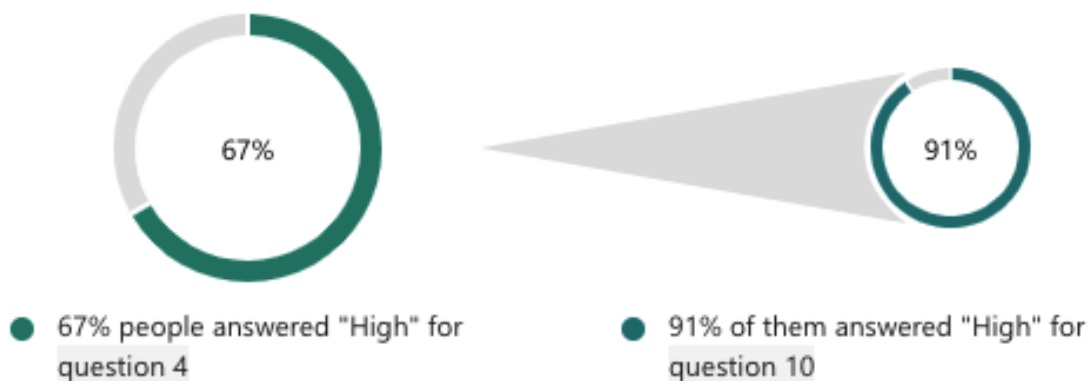


Chart 8 Relation between demand for “Technical integration” and “Real-time Communication”

6.1.5 Frequency of Incorrect/Damaged Deliveries

The majority (61%) experience occasional incorrect/damaged deliveries, suggesting that while this is not a pervasive issue, there is room for improvement in accuracy and quality control. With 56% of respondents experiencing issues related to incorrect or damaged deliveries occasionally, there is a clear indication of inconsistency or inadequacy in the current last-mile processes. This inconsistency can result in customer dissatisfaction, increased operational costs, and lost revenue due to returns or compensations.



Chart 9 Frequency of Incorrect/Damaged Deliveries

Combining these insights, it is evident that while there might be a high level of technological integration in the current services, there are still significant gaps or inefficiencies leading to incorrect or damaged deliveries. Therefore, there is a clear demand for further integration, possibly leveraging advanced technologies like real-time tracking, route optimization, and proof of delivery systems. Integrating such technologies can enhance accuracy, minimize errors, improve visibility throughout the delivery process, and ultimately enhance customer satisfaction and operational efficiency.

6.1.6 Real-time Tracking

The data indicates that a substantial portion of respondents, with 13% rating it as 'Extremely' important and 36% rating real-time tracking information as 'Significantly' important. Additionally, 28% rated it as 'Moderately' important. This suggests that the majority of businesses place considerable importance on having access to real-time tracking data for managing last-mile logistics efficiently.

Real-time tracking provides businesses with valuable insights into the location and status of their deliveries in real time, allowing them to monitor and manage their logistics operations more effectively. It enables better coordination, and timely interventions in case of delays or disruptions, and enhances overall transparency in the delivery process.

The significant number of respondents emphasizing the importance of real-time tracking highlights the growing recognition of its role in optimizing last-mile logistics and meeting customer expectations for visibility and reliability in delivery services.



Chart 10 How important of real-time tracking

6.1.7 Communication Issues

A moderate to significant number (77% choosing 4 or 5) emphasize the importance of real-time communication features. This suggests that enhancing communication tools within the application could positively impact user satisfaction and operational efficiency.

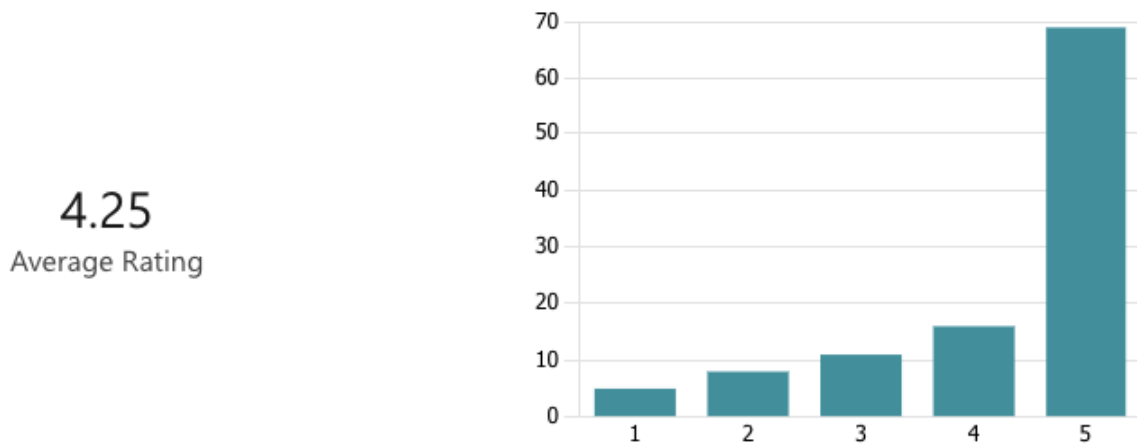


Chart 11 How important real-time communication features

Even though the percentage of respondents directly citing communication issues seems low (6%), it doesn't necessarily reflect the overall impact of communication limitations on the delivery process. Effective communication plays a crucial role in ensuring smooth and transparent interactions between delivery personnel and customers. Issues such as “Wrong message content”, “Missing notifications”, or message instructions rely heavily on clear and timely communication channels.



Chart 12 Issues with communication features in the mobile application

Therefore, addressing and enhancing communication features within last-mile delivery applications could significantly improve operational efficiency, minimize misunderstandings, and ultimately enhance the overall customer experience. This could involve integrating features like real-time messaging, delivery status updates, and customer feedback mechanisms to bridge any existing gaps in communication between delivery agents and customers.

6.1.8 Challenges or Obstacles on the Road

A significant portion (80%) raised issues encountered during delivery on the road. The responses highlight a myriad of challenges and obstacles that users encounter while using delivery applications on the road. These challenges range from communication issues with delivery personnel and tracking inaccuracies to distractions while driving and technical glitches in the application interface. Moreover, external factors such as traffic congestion, language barriers, and weather conditions further exacerbate the difficulties that users face. To effectively address these challenges, a holistic approach is necessary. This includes refining user interfaces, enhancing technology, improving communication features, and seamlessly integrating with real-time data sources for traffic and weather updates.

Additionally, there is a need for better training and support for users to navigate through these challenges successfully. By addressing these issues comprehensively, delivery applications can enhance user experience, streamline last-mile logistics, and ultimately improve overall operational efficiency and customer satisfaction.

Based on this information, we can determine that the optimal delivery areas have high traffic density and population density, with residents living in rented or owned apartments. Some responses also indicate that language barriers in communication affect delivery, indicating a diverse urban population, predominantly consisting of young individuals in school or employment. This demographic presents an ideal customer base for e-commerce retailers. The key factor here is the income level of urban residents, which can attract more potential customers and optimize distribution ideas. This assumes that denser populations in crowded areas will result in more potential transactions with shorter driving distances between delivery stops.



Chart 13 Challenges or obstacles on the road

However, this would require the routes to be designed with minimum distances between delivery points, as efficiency depends on two factors including delivery frequency and the number of deliveries within each route.

The majority of respondents are dissatisfied with the last-mile delivery services. Delays and technological issues are common concerns. Real-time tracking and communication features are deemed important, but there are reported challenges, especially some of them related to communication and network issues. Additionally,

issues with incorrect or damaged deliveries, as well as obstacles on the road, are noted by some respondents.

6.2 Interview Data Analyses

The researcher sent a list of questions and conducted discussions with experts to gather the necessary information for the research. Although the number of experts was not as many as expected, however through the interview results, the author was able to shape the needs and desires of experts in the logistics industry.

6.2.1 Group 1 - Customer Satisfaction and Experience

Result of question 1 shows the responses indicate that last-mile solutions in Finland are not yet optimized because there are too many factors to manage efficiently. Firstly, Finland has a large area, abundant forests, and a sparsely distributed population. Only the southern regions have major cities, and some central areas have centers, most areas are natural forest land. This geographical dispersion poses a significant challenge for last-mile delivery, as delivering to remote areas may be less efficient and more costly. Secondly, Finland's weather is characterized by long and harsh winters. Snow, ice, and limited daylight hours in winter can slow down the delivery process and affect the safety of delivery personnel, significantly impacting delivery operations. Thirdly, urban areas like Helsinki with traffic congestion, strict regulations on vehicle emissions, and delivery times may further complicate last-mile delivery. Continuous updates on traffic information and congestion forecasts are needed to help drivers avoid delays. Lastly, similar to many developed markets, Finnish consumers have high expectations for delivery speed, convenience, and reliability. Balancing these expectations with the logistical challenges of the market requires leveraging technology to monitor real-time, dynamic routing, and effective communication with customers.

Result of question 2 shows that firstly, optimizing delivery routes and schedules significantly saves fuel, vehicle maintenance, and labor costs. Secondly, a system capable of automating route planning and distribution based on order volume and geographical territory has greatly optimized driver routes. This allows businesses to

execute more deliveries in less time, reducing fuel consumption and operating costs. Automating the task assignment for drivers also streamlines the distribution process, improving operational efficiency. Thirdly, with real-time tracking and dynamic scheduling capabilities, customers receive accurate delivery times and can monitor their order status in real-time through the mobile app. This transparency and reliability enhance the customer experience, leading to higher satisfaction and purchase demand. The dynamic nature of the system allows for quick adjustments based on real-time data, such as traffic conditions, weather, and last-minute order changes. Lastly, this flexibility ensures that businesses maintain service quality in different situations. Additionally, the system can scale business operations, meeting increasing order volumes and expanding geographically without compromising efficiency.

Result of question 3 shows firstly, logistics companies in Finland and similar markets are investing in technology-based solutions, including AI and machine learning to optimize routes, IoT to monitor vehicles and goods, as well as complex customer interaction platforms. Secondly, customers expect fast, reliable, and environmentally sustainable delivery services. Thirdly, customers in Finland value transparency and flexibility in delivery. They want to be notified of their order status in real-time and appreciate the ability to modify delivery time or location if necessary. This requires last-mile distribution systems to include customer-centric technologies, such as mobile apps and SMS notifications, providing real-time tracking information and flexible delivery options. Lastly, there is an increasing desire for personalized delivery experiences, where customers can specify delivery instructions, choose environmentally friendly delivery options, or select time frames that suit their schedules.

Result of question 4 show that firstly, prioritizing investment in technology for better tracking and communication, exploring sustainable distribution methods, and training their customer service team to handle inquiries and issues quickly and efficiently. Secondly, the impact of the delivery experience on loyalty levels. Customers are more likely to return and support companies that provide seamless and positive last-mile delivery experiences. Thirdly, timely delivery and, for dry food products, the

condition of the goods upon arrival is paramount. Any damage or signs of mishandling can negatively impact customer trust. Additionally, providing customers with the option to choose delivery times, easily reschedule, or provide specific delivery instructions for their convenience enhances their satisfaction with the service. Lastly, there is a clear trend of increasing customer expectations for delivery speed and flexibility. Customers also expect the delivery process to cater to their specific needs and preferences, and they consistently express high satisfaction with services that offer real-time tracking and updates.

The analysis of responses from Group 1 underscores the multifaceted challenges facing last-mile delivery systems in the Finnish market. Geographical hurdles, exacerbated by harsh weather conditions and urban congestion, intersect with high customer expectations for speed, reliability, and sustainability. To optimize these systems, integrating technology solutions such as AI, IoT, and customer-centric platforms is paramount. Furthermore, prioritizing sustainability, flexibility, and adaptability while ensuring seamless communication and real-time tracking can significantly enhance customer satisfaction and loyalty. By continuously refining processes, training personnel, and embracing sustainable practices, last-mile delivery providers can navigate complexities, improve efficiency, and deliver superior service experiences tailored to meet evolving customer demands in Finland.

6.2.2 Group 2 - Operational Efficiency and Resource Management

Related to question 5, experts consider upgrading route optimization software incorporating real-time traffic data, weather conditions, and urgency of deliveries to determine the most efficient routes. This technology helps reduce delivery time and fuel consumption, even in challenging weather conditions or remote areas.

Establishing local distribution centers at strategic locations is considered. This approach shortens the distance to final delivery points, reducing delivery time and costs. It also allows for quicker responses to orders or last-minute changes.

Understanding Finland's diverse terrain and weather conditions, developing a fleet consisting of various types of vehicles suitable for different environments, from urban

electric trucks for congested city areas to off-road vehicles equipped for harsh winter conditions in rural areas. This flexibility ensures year-round service quality.

Deploying a mobile app and SMS notification system is to provide customers with real-time tracking of their deliveries and the ability to communicate with delivery personnel. This transparent and open communication enhances customer satisfaction and trust significantly.

From recognizing the importance of convenience for customers, offering flexible delivery options such as choosing delivery times, safe delivery locations, and easy schedule rearrangements. These options cater to diverse customer needs, ensuring a positive experience.

To stay ahead in the rapidly evolving logistics field, collaborating with technology startups to provide innovative solutions for last-mile delivery challenges, such as drone or autonomous vehicle delivery. These collaborations enable businesses to test and potentially integrate advanced technologies into our operations.

Maintaining a strong feedback loop with customers, using surveys and direct communication aims to gather detailed information about their delivery experience. This feedback is valuable for continuous improvement, allowing businesses to identify areas for enhancement and adjust their strategy accordingly.

Result of question 6 shows The challenges such as adapting to real-time changes, complying with environmental regulations, and managing costs pose high demands for last-mile delivery systems. To overcome these challenges, the strategy focuses on specific solutions. They are using telecommunications technology and dynamic routing software to adjust routes and ensure timely deliveries in all situations. At the same time, integrating environmentally friendly vehicles into the fleet and employing cost management techniques such as route optimization and data analysis to control expenses efficiently. Establishing feedback loops with drivers and customers also helps businesses gain a better understanding of the delivery process and continuously improve operations.

Result of question 7 shows that many technological factors identified from the experts' perspective demonstrate the crucial role in a successful last-mile system. Complicated algorithms are used to calculate the most efficient delivery routes, considering factors like traffic conditions and delivery time windows.

In the recommendation, implement route optimization platforms enhanced with real-time traffic data and machine learning to improve over time. In the role of Real-Time Tracking and Display Tools, Provide real-time updates on delivery locations for customers and managers.

In the recommendation, Deploy GPS tracking systems integrated with mobile apps or websites to provide real-time delivery tracking. In the role of Electronic Proof of Delivery (ePOD) Systems, digitally confirm delivery and reduce paperwork. In the experts' recommendation, ePOD solutions with order management systems and customer portals should be integrated. In the role of Autonomous Delivery Vehicles and Drones, reduce labor costs and increase delivery efficiency.

The experts' recommendation should equip the pilot with autonomous delivery robots or unmanned aerial vehicles for small, lightweight packages. In the role of AI and Machine Learning, improve decision-making through analysis of large datasets and accurate delivery time predictions. In the experts' recommendation, Utilize AI to predict demand and optimize delivery schedules.

The role of the Internet of Things (IoT) is to monitor in real-time conditions of goods and vehicles. In the experts' recommendation, they will utilize IoT devices to track cargo status and vehicle conditions. Role of Customer Interaction Tools to facilitate direct communication between customers and delivery personnel. They recommend deploying mobile apps or SMS systems for customers to interact directly with delivery teams.

Based on the results from Group 2, it is evident that operational efficiency and resource management are critical aspects of successful last-mile delivery systems. Businesses employed key strategies to overcome challenges including route planning, local distribution centers, fleet diversity, communication tools, flexible delivery options, research and technology development, and maintaining a feedback loop with

customers. Challenges such as adapting to real-time changes, complying with environmental regulations, and managing costs are addressed through telecommunications technology, dynamic routing software, environmentally friendly vehicles, and cost management techniques. Technological advancements play a crucial role in optimizing last-mile delivery, with recommendations including route optimization software enhanced with real-time data, real-time tracking tools, electronic proof of delivery systems, autonomous delivery vehicles, drones, AI and machine learning, IoT devices, and customer interaction tools. Implementing these strategies and technologies can significantly enhance the efficiency and effectiveness of last-mile delivery operations.

6.2.3 Group 3 - Administrative and Compliance Considerations

Results of question 8, based on the characteristics of Finland, in addition to supporting the Finnish language and some other common languages, experts suggest many points that need continuous improvement.

The last-mile systems are enhanced by utilizing more sophisticated route optimization software considering weather conditions, road closures, and real-time traffic updates tailored specifically for Finland. This should benefit from increasing the efficiency of delivery routes, reducing fuel consumption, and improving delivery times, even in adverse weather conditions or remote locations.

The last-mile systems should be deployed or enhanced customer-oriented technologies, such as mobile apps and SMS notifications, providing real-time tracking, scheduling delivery rearrangements, and direct communication with drivers. This makes benefit from enhancing transparency and control over the delivery process, meeting high consumer expectations.

The last-mile process should establish partnerships with local businesses and logistics service providers, especially in remote areas, to leverage their knowledge and infrastructure for last-mile delivery. This should benefit from expanding access and efficiency in distribution to remote locations, optimizing resources, and leveraging local expertise.

In addition, there are flexible delivery options such as precise delivery times, self-service parcel lockers, and alternative pickup points. Customers' convenience needs are addressed, providing solutions tailored to their schedules and preferences, thus enhancing satisfaction.

Another suggestion is using data analytics to gather detailed information on customer preferences, distribution performance, and operation bottlenecks, enabling continuous improvement. Data analytics support to identify trends and areas for optimization, and supporting strategic decisions to enhance overall efficiency and customer service quality.

The result of question 9 for administrative perspectives, effectively managing drivers, vehicles, and delivery personnel is crucial to ensure on-time delivery and compliance with regulations. This involves a multifaceted approach, focusing on several key aspects.

First is Workload Planning and Management. Ensuring drivers are efficiently scheduled and not overloaded is crucial to maintaining high service levels and driver satisfaction. Overworked drivers can lead to delivery errors, accidents, and violations of driving time regulations. Implement advanced scheduling software to optimize shifts, balance workloads, and ensure compliance with legal working hours. Regular monitoring and adjustments based on real-time data help efficiently manage unexpected changes.

Second is Training and Compliance. Continuous training on safety standards, customer service, and compliance with local and international transport regulations is essential. This ensures drivers are updated on the latest regulations and best practices, reducing the risk of violations. Develop a structured training program including regular updates on regulations, defensive driving courses, and protocols for interacting with customers. Utilize e-learning platforms for easy access and tracking of completion progress.

Third is Vehicle Maintenance and Safety. Regular vehicle maintenance is crucial to prevent breakdowns and ensure safety. Compliance with environmental and safety regulations also depends on the condition of the fleets. Implement preventive

maintenance schedules based on vehicle usage and manufacturer recommendations. Use telematics to monitor vehicle status in real time and address issues promptly. Ensure vehicles meet emission standards and safety regulations.

Forth is the Integration of Technology for Efficiency. Using technology to optimize routes, track real-time data, and communicate helps improve operational efficiency and compliance. It enables better planning, quick adjustments, and transparency. Invest in integrated backend platforms combining route optimization tools, tracking, and communication. Ensure user-friendly systems provide actionable insights for continuous improvement.

Last is Feedback and Performance Monitoring. Monitoring driver and vehicle performance is essential to identify areas for improvement, enhance efficiency, and maintain high service standards. Deploy performance metrics and KPIs to assess punctuality, safety, fuel efficiency, and customer satisfaction. Use feedback from customers and drivers to communicate continuous improvement efforts.

The insights provided by Group 3 shed light on various administrative and compliance considerations crucial for optimizing last-mile logistics in the Finnish supply chain sector. Recommendations centered on climate-adaptive logistics solutions, advanced route optimization technology, customer-centric technology integration, collaboration with local partners, flexible delivery options, and data-driven decision-making highlight the importance of adapting to local dynamics and leveraging technology for efficiency gains. Managing drivers, vehicles, and delivery personnel effectively requires a multifaceted approach encompassing workload planning, training, vehicle maintenance, integration of technology, and feedback mechanisms. By addressing these critical aspects, businesses can ensure on-time deliveries, comply with regulations, enhance customer satisfaction, and maintain a competitive edge in the evolving logistics landscape.

6.2.4 Group 4 - Technology Adoption and Integration

Result of question 10 shows that integrating new technologies or software solutions into the last-mile delivery system has been instrumental in improving efficiency,

enhancing customer experience, and staying competitive in the market. However, addressing challenges such as regulatory compliance, data security, and operational adjustments is crucial to realizing the full potential of these technologies. New technologies need employee adoption, and not every employee can easily adopt new technologies; it takes time to learn a new system and new processes. Implementing GPS tracking systems and real-time monitoring software can provide enhanced visibility into the delivery process, allowing for better route optimization, accurate delivery time estimates, and improved customer satisfaction. With the adoption of new technologies comes the need to safeguard sensitive customer data, including addresses, contact information, and purchase history. Balancing the benefits of new technologies with the need for regulatory compliance and data security is essential for ensuring the overall efficiency of operations.

The findings from Group 4 insist on the importance of adopting and integrating technology. Utilizing technology requires not only prominent features but also the security of business information and customer data.

7 Optimization plan

7.1 Outline Plan

Based on the survey and interviews results, Logisoft needs to focus on technical factors to optimize the last-mile system to address bottlenecks in delivery operations. Based on experts' insights and the characteristics of Finland, the authors of this study propose a list of features to be developed and optimized based on Logisoft's existing capabilities and leveraging technologies from other technology partners.

Besides current features, below is the list of features needed and their priority in development based on the importance derived from the survey's findings.

#	Feature group	Priority	Challenges
1	Routing planning integrated with GPS, map, weather forecast, traffic information	High	Traffic, area, weather
2	Communications features: automatic message pushing, push to talk, sound notification, quick report/feedback	High	Delay, change route, change time window
3	Delivery process with optional for drivers and customer	Medium	Customer satisfaction
4	Data analyzing	Low	Improving customer satisfaction, delay in delivery process
5	Data security	Medium	Protecting customer privacy information, business information

7.2 Development Plan

A comprehensive development plan is proposed to enhance the last-mile delivery system based on research findings. Firstly, routing planning integration with GPS, maps, weather forecasts, and traffic information will be a key focus. This involves developing or integrating route optimization software that leverages real-time GPS data, maps, weather forecasts, and traffic updates. The aim is to dynamically adjust routes based on changing conditions, optimizing delivery efficiency. Additionally, ensuring drivers can easily access and navigate optimized routes on their mobile devices is essential for seamless execution.

Communication enhancement is another critical aspect of the development plan. Implementing automatic message pushing for real-time updates to drivers regarding route changes, delivery instructions, and customer requests is imperative. Incorporating push-to-talk functionality facilitates instant communication between drivers and dispatchers, enhancing coordination. Moreover, sound notifications for urgent messages prevent drivers from missing critical information. A system for drivers to quickly report issues or provide feedback on delivery processes will be developed, facilitating continuous improvement.

Flexibility in the delivery process is vital for both drivers and customers. The plan includes designing the delivery process to offer options such as preferred routes, delivery schedules, and communication methods for drivers. Likewise, customers will have various delivery options, including choosing delivery times, safe locations, or alternative pickup points. This flexibility aims to cater to diverse needs and preferences, ultimately enhancing satisfaction.

Data analysis plays a pivotal role in optimizing the last-mile delivery system. Robust data analytics tools will be implemented to analyze various aspects of the delivery process, including route efficiency, driver performance, customer preferences, and delivery trends. These insights will inform decision-making, enabling the identification of areas for improvement and optimization. Leveraging data-driven insights will be crucial for enhancing operational efficiency and customer satisfaction.

Ensuring data security is paramount in handling sensitive business and customer information. Stringent measures will be implemented, including encryption techniques for secure data transmission and storage. Access controls and authentication mechanisms will restrict access to authorized personnel only, mitigating the risk of data breaches. Regular security audits and updates to protocols will be conducted to address vulnerabilities and maintain robust data security.

Continuous improvement and monitoring are integral parts of the development plan. Establishing a process for ongoing review of system performance, analysis of feedback from drivers and customers, and identification of optimization opportunities is essential. Monitoring mechanisms will track key performance indicators related to delivery efficiency, customer satisfaction, and data security. Insights gathered from monitoring and analysis will drive refinements to system features, ensuring alignment with evolving customer needs and technological advancements.

From this overall plan, Logisoft will proceed to execute a project according to the Project Charter (see Appendix 4). This is the formal document that fully describes the objectives, scope, and goals, as well as the comprehensive plan to execute the project. This document needs to be reviewed and approved by stakeholders before proceeding with further decisions.

8 Conclusions

This thesis has developed an optimized plan for the last-mile delivery system developed by Logisoft. This plan is based on the needs of the e-commerce industry outlined in this thesis. Data from surveys conducted with drivers, and couriers, and interviews with experts in the logistics field were used to create this plan. The plan targets the challenges and opportunities identified during the data analysis phase. From there, essential features were developed and synthesized into a cohesive development strategy.

The plan has five feature groups recommended to optimize communication features, routing plan features, weather situation on map or routes, automatic message pushing on progress, and customer optional deliveries. Although there are priority levels for each group based on importance and resources, as well as the customer's ability to adopt and deploy, the features should be developed according to the PDCA (Plan-Do-Check-Act) process and delivered in phases based on priority level. The plan does not include the next steps proposed to stakeholders for implementation phases. The plan also does not mention the cost of development and how resources are allocated.

These findings are challenges, obstacles, and specific issues from current processes and are identified to hurt the current operations. The development actions created have been demonstrated by information obtained from drivers and couriers. Findings from logistics expert interviews also supported it. This plan will be presented to Logisoft's stakeholders and investors to assess the feasibility of a unified last-mile system with options to provide customers with deployment options as well as meet cost criteria (see Appendix 5).

Finally, the research was not the easiest journey but has achieved objectivity and met all the objectives outlined in the project plan. Personally, this has been a period of practical learning where all the theoretical skills imparted by knowledgeable professors on campus have been beneficial for both the research process and thesis writing. Conducting surveys is a crucial stage of research, helping to illuminate the methods used in the questionnaire and during the result analysis process.

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10 Appendices

Appendix 1. The questions in the survey

Q1: How satisfied are you with the current last-mile delivery services you use for your business or your personal?

Highly dissatisfied <input type="checkbox"/>	Dissatisfied <input type="checkbox"/>	Neutral <input type="checkbox"/>	Satisfied <input type="checkbox"/>	Highly satisfied <input type="checkbox"/>
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Q2: How often do you encounter delays in the last-mile delivery process for your shipments?

Daily <input type="checkbox"/>	Weekly <input type="checkbox"/>	Monthly <input type="checkbox"/>	Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
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Q3: In your opinion, to what extent does the current last-mile system contribute to high delivery costs?

Not at all <input type="checkbox"/>	Slightly <input type="checkbox"/>	Moderately <input type="checkbox"/>	Significantly <input type="checkbox"/>	Extremely <input type="checkbox"/>
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Q4: On a scale of 1 to 10, how would you rate the level of technological integration in the last-mile delivery services you currently utilize?



Q5: How frequently do you experience issues related to incorrect or damaged deliveries in the last-mile process?

Almost Never <input type="checkbox"/>	Rarely <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Frequently <input type="checkbox"/>
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Q6: On a scale of 1 to 5, how important is real-time tracking information for your business in managing last-mile logistics?

Not at all <input type="checkbox"/>	Slightly <input type="checkbox"/>	Moderately <input type="checkbox"/>	Significantly <input type="checkbox"/>	Extremely <input type="checkbox"/>
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Q7: To what extent do you believe that a well-optimized last-mile delivery system contributes to overall customer satisfaction for your business?

Not at all <input type="checkbox"/>	Slightly <input type="checkbox"/>	Moderately <input type="checkbox"/>	Significantly <input type="checkbox"/>	Extremely <input type="checkbox"/>
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Q8: In your opinion, how effective are current last-mile delivery systems in meeting delivery time expectations set by your customers?

Very Ineffective <input type="checkbox"/>	Ineffective <input type="checkbox"/>	Neutral <input type="checkbox"/>	Effective <input type="checkbox"/>	Very Effective <input type="checkbox"/>
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Q9: Which specific features do you find most useful in the current driver mobile application? (Select all that apply)

GPS Navigation	<input type="checkbox"/>
Route Optimization	<input type="checkbox"/>
Real-time Tracking	<input type="checkbox"/>
Proof of Delivery	<input type="checkbox"/>
Delivery Confirmation	<input type="checkbox"/>
Other (Specify)

Q10: How important do you consider real-time communication features (e.g., messaging, alerts) in the last-mile delivery process?

Not Important <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Very Important <input type="checkbox"/>
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Q11: Do you encounter any issues with communication features in the mobile application? (e.g., messaging, alerts, notifications)

Yes <input type="checkbox"/>	No <input type="checkbox"/>
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Q12: If yes, please specify the nature of the communication issues you face.

Q13: Are there any challenges or obstacles you face in using communication features while on the road? Please describe.

Appendix 3. Interview Questionnaire

Group 1: Customer Satisfaction and Experience

Q1: What specific challenges do you face with the existing last-mile delivery systems in the Finnish market? Please provide details.

Q2: In your experience, what are the key benefits of the last-mile delivery system you currently use?

Q3: How do you think customer expectations in Finland influence the design and efficiency of last-mile delivery systems?

Q4: In your opinion, how does the last-mile delivery experience impact overall customer satisfaction for your business? Can you share any specific customer feedback or trends you've observed?

Group 2: Operational Efficiency and Resource Management

Q5: Can you share any successful strategies or practices employed by your business to overcome last-mile delivery challenges?

Q6: What operational challenges, if any, do you encounter in managing and optimizing the performance of your delivery drivers and vehicles? Are there specific strategies you employ to enhance resource efficiency?

Q7: From your perspective, what role do technological advancements play in optimizing last-mile delivery, and what specific technologies would you recommend for improvement?

Group 3: Administrative and Compliance Considerations

Q8: Considering the local dynamics of the Finnish Supply chain sector, what improvements would you suggest for last-mile logistics?

Q9: From an administrative standpoint, what aspects of managing drivers, vehicles, and delivery personnel do you find most critical for ensuring on-time deliveries and compliance with regulations? How do you navigate these administrative challenges?

Group 4: Technology Adoption and Integration

Q10: Can you describe any experiences or challenges in integrating new technologies or software solutions into your last-mile delivery system? How do these technologies contribute to or hinder the overall efficiency of your operations?

Appendix 4. Interview Results

No	Group	Question	Answer 1	Answer 2	Answer 3
1		What specific challenges do you face with the existing last-mile delivery systems in the Finnish market? Please provide details.	<p>As a Logistics and Distribution Manager focusing on the Euro market, several unique challenges arise in the last-mile delivery systems, particularly due to Finland's distinctive geographic and demographic characteristics. Here are some of the specific challenges:</p> <ol style="list-style-type: none"> 1. Seasonal Weather Conditions The Finnish climate, with harsh winters and short summers, greatly impacts delivery operations. Snow, ice, and limited daylight hours in winter can slow down deliveries and affect the safety of the delivery personnel. Adapting to these conditions might involve using specialized vehicles, which increases operational costs, and implementing flexible delivery schedules. 2. Urban Congestion and Regulation In urban areas like Helsinki, congestion and strict regulations regarding vehicle emissions and delivery times can complicate last-mile deliveries. The trend towards more eco-friendly urban environments means that logistics operations must adapt by incorporating electric or low-emission vehicles and optimizing delivery routes to minimize environmental impact. 3. High Customer Expectations Finnish consumers, like those in many developed markets, have high expectations for delivery speed, convenience, and reliability. Balancing these expectations with the logistical challenges of the market requires leveraging technology for implementing an advanced last-mile delivery system in a logistics company, especially one dealing with the 	<p>Finland is known for its extensive forested areas and sparse population distribution, especially in the northern regions. This geographic dispersion presents a significant challenge for last-mile delivery, as delivering to remote areas can be less efficient and more costly. Ensuring timely deliveries while managing costs in these regions requires sophisticated route optimization and sometimes partnerships with local delivery networks. Sometimes assigning the parcel in a delivering point in too far from the customer</p>	<p>Integrating advanced logistics software with existing systems can be challenging. The technology must be robust enough to handle route optimization, inventory management, and customer communication in a seamless and user-friendly manner. This is particularly challenging when dealing with the varied demands of urban and rural deliveries.</p>
2		In your experience, what are the key benefits of the last-mile delivery system you currently use?	<p>complexities of nationwide dry food product distribution, brings several key benefits that directly impact operational efficiency, customer satisfaction, and overall business performance. Here are the main advantages of the system we currently use:</p> <ol style="list-style-type: none"> 1. Enhanced Efficiency and Productivity Our system's ability to automate route planning and distribution lines according to order volume and geographic territory significantly optimizes drivers' routes. This means we can do more deliveries in less time, with reduced fuel consumption and lower operational costs. The automation of task generation for drivers also streamlines the distribution process, making our operations more efficient. 2. Improved Customer Satisfaction With real-time tracking and dynamic scheduling capabilities, customers receive accurate delivery times and can track their orders in real-time through a mobile application. This transparency and reliability enhance the customer experience, leading to higher satisfaction levels and repeat business. 3. Increased Flexibility and Scalability The system's dynamic nature allows for quick adjustments based on real-time data, such as traffic conditions, weather, and last-minute order changes. This flexibility ensures that we can maintain service quality under varying conditions. Additionally, the system can scale with our business, accommodating increases in order volume and geographic expansion without sacrificing performance. 4. Reduced Environmental Impact Optimized routing and distribution lines mean our trucks spend less time on the road, leading to lower emissions. When combined with the potential integration of electric vehicles, our system contributes to a reduced carbon footprint, aligning with both corporate sustainability goals and increasing regulatory requirements for environmental protection. 5. Data-Driven Decision Making 	<p>the key benefits of our last-mile delivery system revolve around operational efficiency, customer satisfaction, environmental sustainability, and the strategic use of data. These advantages position us competitively in the logistics and distribution sector, enabling us to meet the evolving demands of the market and our customers effectively.</p>	<p>Optimizing routes and delivery schedules leads to significant cost savings in fuel, vehicle maintenance, and labor. By maximizing the efficiency of each delivery, we can reduce overhead costs and improve our bottom line.</p>
3	Customer Satisfaction and Experience	How do you think customer expectations in Finland influence the design and efficiency of last-mile delivery systems?	<p>Customer expectations in Finland, as in many advanced economies, significantly influence the design and efficiency of last-mile delivery systems. These expectations shape how logistics companies approach the challenges of delivery in unique geographic and demographic contexts. Here are some ways in which customer expectations impact the design and operation of these systems:</p> <ol style="list-style-type: none"> 1. Demand for Speed and Reliability The customers expect fast and reliable delivery services. This necessitates last-mile delivery systems that are not only efficient but also adaptable to various challenges, such as Finland's diverse geography and seasonal weather changes. Systems must incorporate advanced routing algorithms that consider the fastest and most reliable routes, factoring in urban congestion, remote area accessibility, and weather conditions. 2. Preference for Eco-Friendly Solutions There's a growing preference for environmentally sustainable options among consumers. This influences the design of last-mile delivery systems to incorporate eco-friendly vehicles, like electric or hybrid models, and optimize routes to reduce carbon emissions. Companies are also encouraged to use sustainable packaging and reduce waste, aligning their operations with the environmental values of their customers. 3. Expectation for Real-Time Communication and Flexibility Customers in Finland value transparency and flexibility in delivery. They expect to be informed about their order status in real-time and appreciate the ability to modify delivery times or locations as needed. This requires last-mile delivery systems to include customer-facing technologies, such as mobile apps and SMS notifications, that provide up-to-date tracking information and flexible delivery options. 4. Desire for Personalized Delivery Experiences There's an increasing desire for personalized delivery experiences, where customers can specify delivery instructions, choose environmentally friendly delivery options, or select time windows that suit their schedule. This has led to the development of more sophisticated customer interface systems that allow for a high degree of personalization in the delivery process. 5. High Standards for Quality and Safety Especially relevant for the delivery of dry food products, customers have high standards for the quality and safety of the items they receive. This impacts the design of delivery systems to ensure that food products are transported under the right conditions, maintaining their quality and safety from warehouse to doorstep. Technologies for temperature control, secure packaging, and efficient handling are integral to meeting these expectations. 	<p>Efficient last-mile delivery systems must balance the need to meet high service standards with the necessity of keeping delivery fees reasonable. This requires optimizing operational efficiency to reduce costs without compromising service quality.</p>	<p>In response to these customer expectations, logistics companies in Finland and similar markets are investing in technology-driven solutions, including AI and machine learning for route optimization, IoT for vehicle and cargo monitoring, and sophisticated customer engagement platforms. These technologies not only improve the efficiency and resilience of last-mile delivery systems but also enhance the overall customer experience, meeting or exceeding the high expectations of consumers.</p>

<p>4</p>	<p>In your opinion, how does the last-mile delivery experience impact overall customer satisfaction for your business? Can you share any specific customer feedback or trends you've observed?</p>	<p>The last-mile delivery experience is a critical component of overall customer satisfaction for any business involved in logistics and distribution, especially in sectors like dry food products. This phase of the delivery process is the most visible to customers and often determines their final impression of the service. Here's how it impacts customer satisfaction and some trends observed:</p> <p>Impact on Customer Satisfaction</p> <ul style="list-style-type: none"> -Timeliness: The punctuality of deliveries plays a significant role in customer satisfaction. Delays can lead to dissatisfaction, whereas on-time deliveries often result in positive feedback. Customers value reliability and consistency in delivery schedules. -Condition of Goods: For dry food products, the condition in which items arrive is paramount. Any damage or signs of mishandling can negatively affect customer trust. Ensuring products arrive in pristine condition reinforces the quality of service. -Communication and Transparency: The ability for customers to track their deliveries in real-time and receive timely updates about any changes or delays significantly enhances satisfaction. Customers appreciate being kept in the loop and value transparency. -Delivery Flexibility: Offering customers the ability to choose delivery times, easily reschedule, or provide specific delivery instructions caters to their convenience and increases their satisfaction with the service. -Customer Service: The responsiveness and helpfulness of customer service, especially in resolving delivery issues or answering queries, are crucial for a positive last-mile experience. Efficient problem resolution can turn potentially negative experiences into positive ones. <p>Customer Feedback and Trends</p> <ul style="list-style-type: none"> -Increasing Expectations: There's a clear trend of rising customer expectations regarding delivery speed and flexibility. Same-day or next-day delivery options are becoming more sought after, pushing companies to optimize their last-mile logistics further. -Preference for Sustainable Options: Feedback often shows a growing customer preference for eco-friendly delivery options. Customers are more likely to choose services that demonstrate environmental responsibility, such as using electric vehicles or minimal packaging. -Desire for Personalization: Customers increasingly expect the delivery process to accommodate their specific needs and preferences. This includes options for green delivery, precise delivery slots, and safe drop-off points, indicating a shift towards more personalized delivery experiences. -Positive Feedback on Transparency: Customers consistently express high satisfaction with services that offer real-time tracking and updates. The certainty and control provided by these features significantly enhance the delivery 	<p>Impact of Delivery Experience on Loyalty: Customers are more likely to repeat business with companies that provide a seamless and positive last-mile delivery experience. Negative experiences in this final step can deter future purchases, while positive ones can enhance brand loyalty and encourage recommendations.</p>	<p>In response to these insights, our company continually refines our last-mile delivery strategies to enhance customer satisfaction. We prioritize investments in technology for better tracking and communication, explore sustainable delivery practices, and train our customer service teams to handle inquiries and issues promptly and effectively. The goal is to ensure that the last-mile delivery not only meets but exceeds customer expectations, fostering long-term loyalty and positive word-of-mouth for our business.</p>
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<p>5</p>	<p>Can you share any successful strategies or practices employed by your business to overcome last-mile delivery challenges?</p>	<p>To manage the complexities of last-mile delivery, especially within the home delivery sector, our business has adopted a variety of strategies and practices that have proven to be successful. These strategies are designed to enhance efficiency, reduce costs, and improve customer satisfaction. Here are some of the key approaches:</p> <ol style="list-style-type: none"> 1. Advanced Route Optimization We leverage sophisticated route optimization software that incorporates real-time traffic data, weather conditions, and delivery urgency to determine the most efficient routes. This technology helps in reducing delivery times and fuel consumption, even in challenging weather conditions or in remote areas. 2. Use of Local Distribution Hubs To address the challenge of geographic dispersion, we've established local distribution hubs in strategic locations. This approach shortens the distance to the final delivery points, reducing delivery times and costs. It also allows for quicker response times to last-minute orders or changes. 3. Diverse Vehicle Fleet Understanding the diverse terrain and weather conditions of Finland, our fleet includes a variety of vehicles suited for different environments, from urban electric vans for congested city areas to all-terrain vehicles equipped for rural and harsh winter conditions. This flexibility ensures that we can maintain service quality year-round. 4. Customer Communication and Transparency We've implemented a mobile app and SMS notification system that offers customers real-time tracking of their deliveries and the ability to communicate with the delivery personnel. This transparency and open line of communication significantly enhance customer satisfaction and trust. 5. Flexible Delivery Options Recognizing the importance of convenience for customers, we provide flexible delivery options, such as choosing delivery windows, safe place deliveries, and easy rescheduling. These options cater to the varying needs of customers, ensuring a positive experience. 6. Sustainability Initiatives In response to growing environmental concerns, we focus on sustainability by optimizing delivery routes to reduce carbon emissions, employing electric vehicles in urban areas, and using eco-friendly packaging materials. These practices not only reduce our environmental impact but also resonate well with eco-conscious customers. 7. Training and Support for Delivery Personnel We invest in comprehensive training programs for our delivery personnel, focusing on safe driving practices, customer service skills, and efficient delivery methods. Equipping our staff with handheld devices for real-time updates and communication further enhances delivery efficiency. 8. Collaboration with Technology Startups To stay ahead in the fast-evolving logistics sector, we partner with technology startups that offer innovative solutions for last-mile delivery challenges, such as drone deliveries or autonomous delivery vehicles. These collaborations allow us to pilot and potentially integrate cutting-edge technologies into our operations. 9. Feedback Loop We maintain a robust feedback loop with our customers, using surveys and direct communication to gather insights on their delivery experience. This feedback is invaluable for continuous improvement, allowing us to identify areas for 	<p>Asking the customer for the most appropriate delivery point by an email or sms. In that case the customer is aware of the parcel status and less worried about the his parcel</p>	<p>In Corona times we provided contactless delivery and using many local distribution hubs to store and delivery to customers around.</p>
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<p>Operational Efficiency and Resource Management</p>	<p>Managing and optimizing the performance of delivery drivers and vehicles presents a set of operational challenges that require strategic thinking and innovative solutions. Here are some of the challenges and the strategies we employ to address them:</p> <p>Challenges:</p> <ol style="list-style-type: none"> 1. Driver Retention and Satisfaction One of the significant challenges is maintaining a motivated and satisfied workforce. Delivery drivers face long hours, traffic congestion, and sometimes difficult delivery conditions, which can impact their job satisfaction and retention. 2. Vehicle Maintenance and Optimization Ensuring that vehicles are well-maintained and efficiently used is another challenge. Vehicles that are not in optimal condition can lead to increased fuel consumption, more frequent breakdowns, and delivery delays. 3. Adapting to Real-Time Changes Traffic conditions, weather, and last-minute order changes can disrupt even the most well-planned delivery routes, requiring quick adjustments to ensure timely deliveries. 4. Environmental Regulations Compliance with environmental regulations, especially in urban areas where restrictions on emissions and delivery times are becoming stricter, poses a challenge for managing a fleet of delivery vehicles. 5. Cost Management Balancing the need to provide efficient and timely deliveries with the goal of minimizing operational costs, including fuel, maintenance, and labor costs, is a constant challenge. <p>Strategies:</p> <ol style="list-style-type: none"> 1. Driver Incentive Programs To improve driver retention and satisfaction, we implement incentive programs that reward drivers for on-time deliveries, positive customer feedback, and efficient fuel usage. Providing regular training and opportunities for feedback also helps in keeping drivers motivated and engaged. 2. Regular Vehicle Maintenance and Telematics Implementing a strict vehicle maintenance schedule ensures that all vehicles are in good condition, reducing the risk of breakdowns. Using telematics technology helps monitor vehicle health in real-time, as well as optimizing fuel efficiency and identifying any issues early. 3. Dynamic Routing Software To adapt to real-time changes efficiently, we use dynamic routing software that can adjust routes based on current traffic conditions, weather, and last-minute order changes. This technology helps drivers avoid delays and ensure timely deliveries. 4. Eco-Friendly Fleet Management To address environmental regulations, we are gradually incorporating electric and hybrid vehicles into our fleet, especially for urban deliveries. This not only helps in complying with regulations but also aligns with our sustainability goals. 5. Cost Management Techniques We employ various cost management techniques, such as route optimization to reduce fuel consumption, strategic 	<p>We were facing to absence issues of drivers or vehical require splitting there parcels to several different drivers that will cover for the driver absence.</p> <p>We aim to optimize the performance of our celivery drivers and vehicles, enhancing overall operational efficiency and customer satisfaction. Continuous evaluation and adaptation of these strategies are essential as market conditions and technologies evolve.</p>	<p>The drivers always require good income and better working conditions but they don't follow the hygiene rules.</p>
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<p>From your perspective, what role do technological advancements play in optimizing last-mile delivery, and what specific technologies would you recommend for improvement?</p>	<p>Technological advancements play a pivotal role in optimizing last-mile delivery, revolutionizing how logistics companies manage their operations, interact with customers, and tackle the challenges of delivering goods in the final stretch to the customer's doorstep. The integration of these technologies not only enhances efficiency and reduces costs but also significantly improves customer satisfaction. Here are some key technologies and their roles in optimizing last-mile delivery:</p> <ol style="list-style-type: none"> 1. Route Optimization Software - Role: Utilizes algorithms to calculate the most efficient delivery routes, taking into account traffic conditions, delivery windows, vehicle capacity, and other variables. This significantly reduces delivery times and fuel consumption. - Recommendation: Advanced route optimization platforms that incorporate real-time traffic data, machine learning to improve over time based on historical data, and flexibility to adjust routes on-the-fly. 2. Real-Time Tracking and Visibility Tools - Role: Provides customers and logistics managers with real-time updates on the location of their deliveries. This transparency increases customer satisfaction and allows managers to quickly address any issues that arise during transit. - Recommendation: Implementing GPS tracking systems integrated with customer-facing apps or websites, offering real-time delivery tracking and estimated arrival times. 3. Telematics and Fleet Management Solutions - Role: Monitors vehicle health, driver behavior, and fuel efficiency. These systems help in maintaining the fleet in optimal condition, ensuring safety and reducing operational costs. - Recommendation: Solutions that offer comprehensive analytics on vehicle performance, predictive maintenance alerts, and driver performance monitoring to encourage safe and efficient driving practices. 4. Electronic Proof of Delivery (ePOD) Systems - Role: Digital confirmation of delivery, capturing signatures, and even photos of the delivered goods. This reduces paperwork, speeds up the delivery process, and provides a verifiable record of delivery. - Recommendation: ePOD solutions that easily integrate with existing order management systems and customer portals, enhancing the post-delivery customer experience. 5. Autonomous Delivery Vehicles and Drones - Role: Offers a futuristic solution to reduce labor costs and increase delivery efficiency, especially in urban environments or for delivering to hard-to-reach locations. - Recommendation: Piloting autonomous delivery robots or drones for small, lightweight packages, particularly in areas where traditional vehicle delivery is less efficient. 6. AI and Machine Learning - Role: Improves decision-making by analyzing vast amounts of data to predict delivery times more accurately, optimize routes continually, and manage inventory levels dynamically. - Recommendation: AI-powered logistics platforms that can predict demand, automate warehouse operations, and optimize delivery schedules based on historical data and predictive analytics. 7. Internet of Things (IoT) - Role: IoT devices can monitor conditions in real-time, such as temperature and humidity for perishable goods, 	<p>The role is very important, the most important technology are GPS and online positioning of the driver, in order to change the driver route even after the driver started is route. GPS-based tracking systems allow both delivery companies and customers to monitor the location of packages in real-time. This enhances transparency, reduces the incidence of lost packages, and provides customers with accurate delivery time estimates.</p>	<p>Technological advancements are a future competitive advantage for companies. In there, Mobile apps, SMS notifications, and online portals provide customers with real-time updates on their deliveries, as well as options for rescheduling, redirecting, or customizing delivery preferences. These technologies enhance customer satisfaction and loyalty.</p>
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<p>8</p>	<p>Administrative and Compliance Considerations</p>	<p>Considering the local dynamics of the Finnish supply chain sector, what improvements would you suggest for last-mile logistics?</p>	<p>From an administrative standpoint, managing drivers, vehicles, and delivery personnel effectively is crucial for ensuring on-time deliveries and compliance with regulations. This involves a multifaceted approach focusing on several critical aspects:</p> <ol style="list-style-type: none"> 1. Driver Scheduling and Workload Management - Criticality: Ensuring drivers are scheduled efficiently and not overburdened is vital to maintain high levels of service and driver satisfaction. Overworked drivers can lead to delivery errors, accidents, and non-compliance with driving time regulations. - Navigation: Implement advanced scheduling software to optimize shifts, balance workloads, and ensure compliance with legal work hours. Regular monitoring and adjustments based on real-time data help in managing unexpected changes efficiently. 2. Training and Compliance - Criticality: Continuous training on safety standards, customer service, and compliance with local and international transport regulations is essential. This ensures drivers are up-to-date with the latest regulations and best practices, reducing the risk of violations. - Navigation: Develop a structured training program that includes regular updates on regulations, defensive driving courses, and customer interaction protocols. Incorporate e-learning platforms for easy access and tracking of completion. 3. Vehicle Maintenance and Safety - Criticality: Regular maintenance of vehicles is crucial to prevent breakdowns and ensure safety. Compliance with environmental and safety regulations also depends on the condition of the fleet. - Navigation: Implement a preventive maintenance schedule based on vehicle usage and manufacturer recommendations. Use telematics to monitor vehicle health in real-time and address issues promptly. Ensure vehicles meet emission standards and safety regulations. 4. Technology Integration for Efficiency 	<p>Providing customer communication in the Finnish language can enhance customer experience and ensure clarity in delivery notifications, tracking updates, and customer support interactions. Leveraging advanced route optimization software, real-time tracking systems, and customer-facing technologies can enhance transparency, efficiency, and customer satisfaction in last-mile logistics operations.</p>
<p>9</p>	<p>Administrative and Compliance Considerations</p>	<p>From an administrative standpoint, managing drivers, vehicles, and delivery personnel effectively is crucial for ensuring on-time deliveries and compliance with regulations. This involves a multifaceted approach focusing on several critical aspects:</p> <ol style="list-style-type: none"> 1. Driver Scheduling and Workload Management - Criticality: Ensuring drivers are scheduled efficiently and not overburdened is vital to maintain high levels of service and driver satisfaction. Overworked drivers can lead to delivery errors, accidents, and non-compliance with driving time regulations. - Navigation: Implement advanced scheduling software to optimize shifts, balance workloads, and ensure compliance with legal work hours. Regular monitoring and adjustments based on real-time data help in managing unexpected changes efficiently. 2. Training and Compliance - Criticality: Continuous training on safety standards, customer service, and compliance with local and international transport regulations is essential. This ensures drivers are up-to-date with the latest regulations and best practices, reducing the risk of violations. - Navigation: Develop a structured training program that includes regular updates on regulations, defensive driving courses, and customer interaction protocols. Incorporate e-learning platforms for easy access and tracking of completion. 3. Vehicle Maintenance and Safety - Criticality: Regular maintenance of vehicles is crucial to prevent breakdowns and ensure safety. Compliance with environmental and safety regulations also depends on the condition of the fleet. - Navigation: Implement a preventive maintenance schedule based on vehicle usage and manufacturer recommendations. Use telematics to monitor vehicle health in real-time and address issues promptly. Ensure vehicles meet emission standards and safety regulations. 4. Technology Integration for Efficiency 	<p>Having more driver than needed, so when one driver will not be present, then his parcels will be delivered by the others drivers.</p>	<p>Ensuring that drivers are properly trained and certified in relevant areas such as safe driving practices, vehicle operation, and handling of hazardous materials is essential for compliance with regulations and maintaining safety standards. Utilizing GPS tracking systems and vehicle immobilization technology helps administrators monitor vehicle locations, deter theft or unauthorized use, and recover stolen vehicles quickly. This enhances security and ensures the integrity of deliveries. Ensuring that delivery personnel comply with regulations related to working hours, rest breaks, and safety standards is essential for both legal compliance and ensuring employee well-being.</p>
<p>10</p>	<p>Technology Adoption and Integration</p>	<p>describe any experiences or challenges in integrating new technologies or software solutions into your last-mile delivery system? How do these technologies contribute to or hinder the overall</p>	<p>Integrating new technologies or software solutions into our last-mile delivery system has been instrumental in improving efficiency, enhancing customer experience, and staying competitive in the market. However, addressing challenges such as regulatory compliance, data security, and operational adjustments is crucial to realizing the full potential of these technologies.</p>	<p>New technologies need employees to adopt new technologies easily and it is taken time to learn a new system and new system processes. systems and real-time monitoring software can provide enhanced visibility into the delivery process. This allows for better route optimization, accurate delivery time estimates, and improved customer. With the adoption of new technologies comes the need to safeguard sensitive customer data, including addresses, contact information, and purchase history.</p>

Appendix 4. Project Proposal

Project LastMiles - Optimization				
<p>Participants</p> <p>Development team Nguyen Hoa Khanh - Leader Backend Developer Frontend Developer Mobile Developer Platform DevOps</p> <p>Product owner Nati Cabti</p>	<p>Goals</p> <p>Deployment Deploy the system on cloud computing and transfer it to the IT admin of clients.</p> <p>Customization Provide a Lastmile solution that covers demands in Objectives to partners and businesses in Finland and other countries.</p>	<p>Users</p> <p>End-users Delivery Department Fleet team Order Process team IT-Admin Third parties: drivers and Couriers</p> <p>User Benefits</p> <p>Main processes 1. Upload sales order with a template 2. Automatic routing with truck and driver assignment. Over-weight warning supported 3. Driver application with GPS and routing on map</p>	<p>Activities</p> <p>Web application Create UI/UX design Detail Design for BE & FE Update Database QC on QC environment Demo and UAT on demo environment</p> <p>Mobile Application Create UI/UX design Detail Design BE & mobile Update APIs QC on QC environment Demo and UAT on demo environment Migrate data Create report templates</p>	<p>Deliverables</p> <p>Features 1. Routing 2. Mobile App 3. Vehicle Loading 4. Truck Capacity Optimization 5. Fleet management 6. Direction & Time Management 7. Scheduling 8. Driver performance 9. POD 10. Payments 11. Communications</p> <p>Deployment Full system deployment on cloud computing; Database server Web application server Docker server</p>
<p>Risks</p> <p>Risk1: Driver application on Android ver 10-13. Not cover older versions. Recommends on phones and tablet over 5 inches. Mitigation: request the customer equips mobile devices to drivers.</p> <p>Risk2: Unmet requirements Mitigation: involve end-user review UI/UX design, UAT and training</p>	<p>Milestones</p> <p>Planning 01.09.2024-Kickoff knowledge transfer workshop. 01.09.2024- Projects Team building and starting. 30.01.2025- Demo and Start QC phase 1 12.03.2025 QC phase 2 20.06.2025 Deploy demo and staging env. 22.08.2025 UAT and training 15.09.2025 Deploy production env - Golive 20.10.2025 Project Closing and starting maintenance service</p>	<p>Constraints</p> <p>All UI/UX must be confirmed and approved by the customer</p> <p>Import Templates/ reports template must be confirmed and approved by the customer</p> <p>All test case of UAT must be passed and fixed if any defect.</p> <p>All defects in scope must be fixed during 1 year contract. After that, other defects will be executed as change request process</p>	<p>Scope</p> <p>Processes Full process end-2-end GUI Freeze period for changes between Kickoff and go-live. The solution provided in English & optional languages. Barcode and QR must be implemented Functionalities or elements Which are not included in this document are not included in the Project. New requirements will be executed as part of the change request process.</p>	

Appendix 5. Project Charter

Project Charter					
PROJECT TITLE	Lastmile Solution	DESCRIPTION	A Lastmile solution to automate processes on Cloud-based platform		
BUSINESS NEED		CORE TEAM MEMBERS		KEY STAKEHOLDERS	
Routing planing integrated with GPS, map, weather forecast, traffic infomation Communications: automatic message pushing, push to talk, sound notification, quick report/feedback Delivery process with optional for drivers and customer Data analyzing Data security		Name	Role	Name	Role
		Khanh Nguyen	Project manager	Mr 1	CTO
		PD	Project delivery	Mr 2	CEO
		Mr A	BA leader	Mr 3	HR manager
		Mr B	Tech Leader	Mr 4	Development Manager
		Ms C	QC Leader		
		Mr D	Platform leader		
		Development team, QC team, QA team 30 -50 skill resources			
OBJECTIVES			Critical Success		
Improving customer satisfaction, delay in delivery process			Project manager is required: PMP, soft skills, experiences in similar projects		
Automatic identifying situations of Traffic, area, weather			Communication plan: daily, weekly, milestones		
Notification from system to devices: mobile app, handhled, email, alarm to handle immergency cases			Risk management: weekly review, plan for risk		
Using routing, direction, point on map to monitor and tracking trucks/fleets			Project scope is understanding by WBS		
Defect range < 1%			Define goal setting by SMART mothod (Specific, Measurable, Achievable, Relevant, Time-bound)		
Protecting customer privacy information, business information			Progress Report to key stakeholders everyweek		
GOALS			SUMMARY PROJECT STATUS		
Provide a Lastmile solution that covers demands in Objectives to partners and businesses in Finland and other countries.			Project Start		1.9.2024
			Project Completion		1.4.2025
			Overall Process Impacts		Changes from partners, integration issues
			Potential Financial Budget		TBD
SCOPE	OPPORTUNITY	MILESTONES	STATUS	DUE	DONE
Update and optimize a Lastmile solution including mobile applications and handheld applications to automatically all	Provide to customers in Finland that have business in e-commerce, retaile, or delivery	Workshop	Not Started	TBD	0%
		Agreement	Not Started		0%
applications to automatically all processes	retails, or delivery	Analysis & Configuration	Not Started		0%
		UAT	Not Started		0%
		Training & Pilot	Not Started		0%
		Go-Live	Not Started		0%
CONSTRAINTS			ASSUMPTIONS		
Freeze period for changes between kickoff and go-live.			Main resources will not change during the project cycle		
The solution provided in English & optional languages.			The scope (functional) of the project will not change throughout the project cycle.		
Barcode, QR code must to implement			Enough qualified resources to complete the project		
Functionalities or elements which are not included in this document are not included in the Project.			All devices, software, tools, licenses, test materials are provided on time during the project cycle.		
New requirements will be executed as part of the change request process.			New requirements or changes will be consider in appendix contracts.		
SUPPORT			ACTIVITIES		
HR			Support training, recruiting, promoting employees for the project		
HR & Admin			Support weekly teambuilding activites : sports, musics		
Admin & Finance			Support buying devices and material as the project requirements		
IL sales and pre-sales team			Collect data and support QC & UAT environments for testing		
DELIVERABLES					
The Party A			The customer		
Web application system			Master data clean-up if required		
Mobile Application			Data availability to support the proposed processes		
Data analysis Dashboard			Timely delivery of all databases for migration		
			Two (2) super-users for training and support		
			Super-users available 2 weeks before and after go-live		
			Office space with projectors to conduct training sessions		
			Employees availability for training sessions		
			Equipment for network installation (sky jacks)		
			A secured area with electric power to store and recharge the RFID mobile readers		
SPONSOR(APPROVER) NAME			SIGN & DATE		