The Collection of Organic Waste in City Logistics – A Case Study in the City of Utrecht, The Netherlands

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Preface

I am delighted to present this master's graduation thesis, which is carried out at The Company, marking the end of my studies at both the University of Twente and the Technische Universität Berlin. My research focused on improving the logistics processes of couriers and I am grateful to have had the opportunity to work with The Company and contribute to their mission of creating a positive impact on the world.

I would like to express my sincere gratitude to The Company for providing me with this opportunity and for their support throughout my research. The employees of The Company were always willing to assist me and were very friendly and welcoming, creating an enjoyable work environment. I would like to thank my supervisor at The Company, who provided me with both guidance and valuable feedback to help me stay organised. Furthermore, I would like to extend my gratitude to the couriers who participated in my research, allowing me to observe their work and conduct interviews for data collection. Their insights and experiences have been incredibly helpful and informative.

I would also like to thank my supervisor at the University of Twente, Eduardo Lalla, for all the support I have received. As I switched a lot between supervisors during the process, I am very grateful for Tamara Oukes helping me a lot during this process and the rest of my research. I am also very grateful for Patricia Rogetzer to last minute step in with becoming my second supervisor. I would also like to thank Jan Kratzer for being my supervisor at TU Berlin and helping me graduate from the IMES master's.

In conclusion, I hope that this research contributes to the improvement of logistics processes for couriers. I thoroughly enjoyed conducting this research and hope that you also find it informative and engaging.

Linda Schepens, 2023

Managerial summary

The researched company is due to confidentially reasons called “The Company” in this entire report. This research has been done at The Company, a Dutch start-up focused on combatting wasting valuable urban resources, through properly separating organic waste streams at the client, which collects the organic waste and delivers products that are made with or from these waste streams. The Company is responsible for the CO_2-neutral pickup service of the organic waste flows and selling and delivering the products made from or with these organic resources to their clients, in and around the City of Utrecht. The logistics processes of The Company are changing and required to change all the time.

Introduction Research

The logistics processes of The Company are constantly changing due to ongoing client growth, and a blueprint of the current logistics processes is needed to prepare for further company expansion. The research problem that is tackled is the unreliable driving hours of the couriers and the core problem is the lack of research on the problems that occur in and around the logistics processes of collecting organic waste and delivering products and what improvements should be done. Therefore the research objective is to improve the logistics processes of The Company. The data that is required to find the causes of the research problem is collected through literature analysis, content analysis through the programs, SmartRoute, Zoho, Teamleader, Shiftbase, The Company App and the client photo feedback and courier group chats, observations of the tasks of the couriers and interviews with the employees that are involved in the logistics processes of The Company.

Current Situation

In the current situation of The Company, the couriers use electric vehicles and an app called SmartRoute to create the best schedules to deliver their services, based on the data that is known in this app. The financial, internal business, innovation and learning, and customer perspectives on the logistics processes represent the improvements that can be made and the modifications that are needed. The current logistics processes present a range of operational inefficiencies that are at the root of the research problem of the unreliable driving hours of couriers.

Complications

The measures of the KPIs derived from the logistics processes point to various bottlenecks, including the delivery of products during regular daytime hours, which enhance uncertainties. In addition, the transport infrastructure, demand requests and the flow of delivered products and collected organic waste are insufficient. Furthermore, there are unclear expectations regarding communication and task assignments for the stakeholders of the logistics processes, and accurate processing and departure times are absent. The lack of optimisation data particularly concerning departure times, routes, demand requests, pickup locations, decision-making, awareness of route and task agreements, and prioritisation, as well as the limitations of equipment and staff and the unpredictability of human behaviour, also further enhances the bottlenecks. Additionally, the differing experiences of employees, service inconveniences and the different added value opportunities further complicate the logistical challenges of The

Company. Factors that contribute to the limitations of the logistics processes include client behaviour, the availability of required equipment and staff, and uncertainties.

Research Question

To tackle the detected bottlenecks of the logistics processes, the research problem is formulated in the following research question:

"What improvements in the logistics of collecting the organic waste and delivering the products by The Company could solve the problem of unreliable driving hours?"

Answer

Based on primary and secondary research the most feasible and impactful improvements are listed as followed based on the recommendations. The improvements are prioritised from one as most important to five as least important. The prioritisation is explained below the improvements.

1. The couriers' supervisors should implement the departure times of 8:44 in SmartRoute as this is the average detected departure time. The departure times of each courier should however differ at least five minutes after each other.
2. The couriers' supervisors should implement the correct processing times of the clients in SmartRoute that on average take longer and adjustments to the pickup locations are not possible.
3. The couriers' supervisors should schedule monthly training sessions for the employees involved in the logistics processes, which should be very detailed and include discussion-based and operations-based exercises. The training should cover the visualisations, tips and tricks, communication expectations, task expectations, responsibilities developed in this research, and the prioritisations in decision-making.
4. The supervisors should increase courier equipment, increase staffing by utilising existing employees to find new employees and investment in two-speed transmission vehicles when new vehicles are required and there is a budget to invest.
5. The supervisors should optimise the pickup locations when possible.

Improvement one is prioritised as the most important improvement as the shift to later and more reliable departure times in the schedules in SmartRoute, instantly improves the reliability of the finishing time of the shift of the couriers. Improvement two is prioritised after this as the implementation of longer processing times that are required to help clients, improve the schedules as this is more accurate data for SmartRoute to create the most reliable schedules. For both improvements one and two, the observations and content analysis show that more reliable data in SmartRoute creates more reliable driving hours.

Improvement three is prioritised after this as the literature suggests that monthly training sessions should be held to discuss and implement new adjustments to the communication, tasks, and responsibilities. They also help to reduce the time required for the morning chats between the couriers, which decreases and improves the reliability of the departure times. Improvements in the prioritisations of the courier's decision-making and clarifying decision-making through visualisations, tips and tricks, communication expectations, task expectations and responsibilities developed in this research, create more uniform behaviour of the couriers. The interviews and observations show this training improves the work of the couriers, and therefore also improves the schedules.

Improvement four is prioritised after this as an investment in two-speed transmission vehicles is very expensive and requires a lot of budgeting and planning. These considerations are outside the scope of this research, but interviews show it is required in the short term. Observations show that increasing the other courier equipment increases the feasibility for couriers to do their job, and increasing the occupation of couriers also solves the shortage of couriers to fill in the shifts. Improvement five is prioritised after this as the feasibility of the optimisation of the pickup locations is depended on the cooperation of the clients. Observations, interviews and content analysis show that for some clients the optimisation is easily done, but other clients could be more resistant to the adjustments. As both improvements four and five have their difficulties, the literature does show the major benefits of these improvements in cases such as The Company.

Practical and Theoretical Implications

The research also provides the current situation of the logistics processes, the causes of the unreliable driving hours of the couriers and the solutions for these causes to help the employees of the logistics processes of The Company in their decision-making process regarding improvements of the logistics processes. The results of the interview of the stakeholder assessment provide an overall positive response to the solutions. The employees of The Company are most positive about the expected impact of the solutions to improve the couriers' performance of tasks, the expected perceived importance of implementing solutions from others, and the intention to implement the suggested solutions. They were somewhat positive about the simplicity of using the solutions and the expected potential of implementing the solutions in the current infrastructure. This provides the internal motivation and feasibility of the assessment of the stakeholders to adopt the improvements. The solutions are easily modifiable and can be used as a source of information for future research and improvements. The investment in two-speed transmission vehicles requires a direct financial investment, whereas the other solutions require an indirect financial investment through time and work for the employees to make the changes.

The five recommended improvements are solutions for the short term as they fit into the current infrastructure of The Company. The solutions created in the primary and secondary research that are not recommended, are not interesting in the current infrastructure of The Company. These solutions are created for the long-term, but as The Company changes constantly, these solutions are not recommended yet as the benefits are not known in the case of The Company changes and are not similar to the researched situation anymore.

This research also has theoretical implications as this research also contributes to the literature by identifying underlying causes of inefficiencies in logistics processes and providing insights into new research areas. The case study on The Company’s logistics processes is a unique contribution to the literature on city logistics in the Netherlands.

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Glossary of Terms and Abbreviations

(20 GL RH) crates	The organic waste crates for the coffee grounds, orange peels and swill streams
BI	Behavioural intention to use the solutions
Boxes	The cooling boxes and red crates for the product deliveries
BSC	Balanced scorecard
C	Content analysis
Clean clothes	Clothes from the couriers that do not contain any organic waste stains that could be worn once or twice before
Dirty clothes	Clothes from the couriers that contain organic waste stains
EE	Effort expectancy
ETA	Estimated time of arrival
Extra tasks	The couriers' tasks that are required besides the deliveries and services Provided at the clients
FC	Facilitating conditions
FIFO	First in first out principle
Goupil	A type of vehicle model used by the couriers
I	Interviews with the employees involved in the logistics processes
KPIs	Key performance indicators
L	Literature research
Main tasks	The collection of organic waste and delivery of products by the couriers
O	Observations
PE	Performance expectancy
Pickup descriptions	The demand requests and collecting location of a service client
PMD	Plastic
Product client	A client that buys the products of The Company
Processing times	The time it takes to drive to a client and collect their organic waste and/or deliver the products
Service client	A client that pays for the service of The Company collecting the organic waste crates
SI	Social influence
SMART	Specific, measurable, achievable, relevant, and time-bound criteria
Swill	All the organic waste scraps from the kitchen, canteen or restaurant
UTAUT	Unified theory of acceptance and use of technology method

1. Introduction

The first chapter of this thesis introduces The Company as a company, the problem context, and the research methodology. Section 1.1 introduces The Company, Section 1.2 provides the problem and research context, Section 1.3 provides the research description and problem, Section 1.4 provides the core problem, Section 1.5 provides the research objective, Section 1.6 provides the research questions, and Section 1.7 shows the research design in combination with an overview of the thesis.

1.1 The Company

The researched company is due to confidentially reasons called “The Company” in this entire report. The clients discussed in the cases of Figure 6, Figure 7 and Appendix B have also been made confidential due to privacy reasons. What can be shared is that The Company is a start-up in the city of Utrecht in the Netherlands, that combats wasting valuable urban resources. Several organic resources from restaurants and cafés, such as coffee grounds, cuttings, and food leftovers, are thrown out with non-recyclable waste. This means that the potential of a large part of the organic resources is barely utilised. The Company helps with properly separating the organic waste streams at the source, through which the streams can be reused as resources for new products. The Company provides the service of collecting the organic waste at the client, creating new products with these organic streams or supplying these streams to third parties to create new products from, and selling these products back to their clients, thus closing the cycle. Through the network of local third partners that handle the processing of the organic waste streams, the products like tea, beer, bread, oyster mushroom products, animal feed, and compost, are produced.

The Company is a fast-growing company that looks for ways to improve the current situation and looks for ways how they could expand in the future. There are numerous logistics processes, as The Company is responsible for the CO_2-neutral pickup service of the organic waste flows, creating new products with these organic resources or outsourcing them to external partners, and selling and delivering the new products to their clients. Through this, it is also the goal of The Company to reduce empty vehicle mileage by always driving with a full vehicle of products to their clients and with a full vehicle of organic waste from their clients.

1.2 Problem and Research Context

As presented in Section 1.1, the logistics processes of The Company are changing all the time, to comprehend the current ongoing client growth. To prepare for further growth of the company, a blueprint of the current logistics processes of the couriers should be made. The logistics processes for this research are defined as the processes of collecting the organic waste crates and delivering The Company’s products, to their clients in or around the City of Utrecht. This research helps to provide a view of the current logistics, the bottlenecks that occur, the limitations that exist, and what could improve the logistics process flow and improve the predictions and expectations from the logistics processes. The problems with the current logistics processes need to be tackled to help the reliability of the couriers' schedules. Therefore, after researching the current situation at The Company, the causes of these problems need to be researched and solutions for these causes to improve the current situation. This helps to improve the current logistics processes of The Company.

When looking at the couriers that fulfil the logistics processes of this research, they like their jobs for different reasons. Some enjoy the freedom they have, and others enjoy that they can just drive around all day. Some like that they get to speak with the clients and chat with them

and others like that you can just be on your own. What some couriers currently do dislike is the fact that it is difficult to make plans after their job. The unreliable driving hours make them not finish on time creating problems in their work-life balance. The unreliable driving hours also display the problems of the schedules of the logistics processes and are therefore the main driver of this research.

City logistics is defined as the process of optimising the logistics activities in cities while implementing the different aspects of economy, environment, society and safety (Taniguchi et al., 2001), which is the objective of this research. Optimisation to create sufficient schedules implement locations, routing and other scheduling plans, and also behavioural factors. Implementing behavioural factors is difficult as behaviour is different in every situation, which makes it hard to compare the behaviour of the couriers at The Company with other case studies. This creates uncertainties in the regular optimisation processes (Gruler, Armas & Juan, 2016). Optimisation of the logistics processes is always the objective of logistics as this makes city freight transportation a more responsive system that can adapt to new social and industrial demands (Punte & Bollee, 2017). Optimisation of a logistics schedule not only creates the optimal route for couriers but also produces diverse alternative scenarios for potential future circumstances (Widbom et al., 2013). Optimising logistics processes in a city requires implementing the optimal number of locations in combination with the scheduling approach and management, that correspond with the company's capacity, client demand and the minimum amount of costs (Stopka, Jeřábek, & Stopková, 2020).

1.3 Research Description and Problem

This thesis focuses on improving the logistics processes of the couriers at The Company. Several data are missing on the opinions and perspectives of the couriers on the current logistics processes. This research looks at the exact problems in the logistics processes are, and what potential solutions could solve these problems and improve the logistics processes. There are several aspects of the logistics of collecting the organic waste and delivering the products that show that the current working method is not optimised, see Chapter 2. This makes scheduling the couriers' work complicated and unreliable. This has created the research problem, which is formulated as follows:

"What improvements in the logistics of collecting the organic waste and delivering the products by The Company could solve the problem of unreliable driving hours?"

1.4 Core Problem

Sections 1.2 and 1.3 provide the required information to create the overall action problem of this research, which is formulated as followed:

"The current schedules of the logistics processes of the couriers of The Company are unreliable".

This action problem has several causes see Chapter 3, and the main cause that is solved in this research is by solving the core problem:

"There is no research done on what problems occur in and around the logistics processes of collecting the organic waste crates and delivering The Company's products, and what improvements should be done".

The core problem influences the aspects of The Company as the couriers are the employees collecting the crates and the people of The Company need these crates to further process and distribute the organic waste. The couriers provide the services of The Company according to the agreements made by both the sales and the client services employees and the couriers are the employees that only have eyes on the situation at the client, to see if the agreements are fulfilled by the clients. The couriers also create the main view that clients have of The Company. For that reason, the couriers' opinions and perspectives on the solutions are also considered. The different aspects like the perspectives of the customer, internal business process, learning and growth and financial dimensions need to be taken into account when improving these logistics processes (Del-Rey-Chamorro et al., 2003). This results in well-researched and underpinned decision-making, improved understanding of the situation and considers the aspects that are involved in the logistics processes. Therefore, this thesis implements these four perspectives throughout the entire research, to research the causes, solutions and opportunities to the problem.

1.5 Research Objective

This research is practice-oriented as the objective is created through an organisation and knowledge developed in this research improves the organisation (Andriessen, 2014). To realise the research, the research objective is to create the following deliverables:

- An overview of the key performance indicators (KPIs) and their measures from the current and the desired situation from the perspectives of the involved stakeholders.
- An overview of the causes that are detected by the observations, interviews, content analysis, and literature research that create unreliable driving hours.
- An overview of the solutions that are shown by the observations, interviews, content analysis, and literature for the detected causes of unreliable driving hours.
- An implementation plan of the solutions is evaluated by the employees that are involved in the logistics processes of the couriers.
- Recommendations on the causes of the unreliable driving hours of the couriers and other detected problems that require further research.

The objective is realistic as providing the missing knowledge on the current situation of the logistics processes and the missing knowledge on related scientific literature, helps to find a solution. This objective is feasible because the required data can be easily achieved from their data collecting programs: SmartRoute, which is their scheduling app, Zoho, which collects the data from the scanned crates, Teamleader, which contains the contracts and information of the clients, and Shiftbase, which contains the time employees registered. The objective is also feasible as numerous scientific articles can be found on this topic and the individual interviews with the employees of The Company are done during the observations.

1.6 Research Questions

Multiple research questions have been formulated to solve the core problem and propose answers to the main research question.

2. Current Situation at The Company

The first research question focuses on the current and desired situation of the logistics processes at The Company. The objective of this question is to analyse the problem context based on the identified key performance indicators and define the gaps between the current and desired situation.

What is the current and desired situation of the logistics processes?

2.1 What are the key performance indicators for the logistics processes?
2.2 How do the logistics processes look like?
2.3 How do the desired logistics processes look like?

3. Causes of the Unreliable Driving Hours of the Couriers

To solve the research problem and close the gap between the current and desired situation, the next research question finds the causes of the problem context that should be researched. Multiple qualitative research methods are used to find the different causes that are linked to the previously defined problems. Primary research is done to collect original data for this case study, secondary research helps structure the primary data and compare it with the secondary data. The research methods used for primary data are observations, content analysis and employee interviews and for secondary data, a literature review is done.

What are the current bottlenecks and limitations in the logistics processes?

3.1 What are the primary research causes of the differences between the desired and the current situation of the logistics processes?
3.2 What are the secondary research causes of the differences between the desired and the current situation of the logistics processes?

4. Solution Design

After the analysis of the causes of the problems, the solution method is created. The next research question provides insight into the ideal solutions based on the considerations between advantages, disadvantages and the opinion of the couriers. This creates assumptions, requirements and limitations on the logistics processes.

What changes need to be made to improve the current situation of The Company?

4.1 What primary research improvements of the logistics processes can be done?
4.2 What secondary research improvements of the logistics processes can be done?
4.3 What are the different advantages and disadvantages of the improvement options in the logistics processes?

5. Implementations and Evaluations

Based on the solutions, assumptions are made on the effect of these solutions on the primary and secondary causes. The employees' opinions are also researched here as these also determine the implementation of the solutions and the difficulty of adaptivity.

What are the expectations of the impact of the solutions?

5.1 What primary and secondary causes are solved when implementing the solutions?
5.2 How do relevant stakeholders assess the solutions?

1.7 Research Design

This case study is distinguished by the limited domain with a little number of research units, through data generation, and in-depth research through a small-scale approach that reduces the risk of uncertainties, the research is selective, and the research is done through open observation and uses qualitative research methods. An important aspect of case study

research is that the case is studied in an everyday situation. For the data collection, methodological triangulation is used, which is an approach that uses various methods of data collection and analysation to improve the validity and reliability of findings (Hassan, 2023). The benefits of a case study are that it collects a comprehensive view of the research process, it is flexible which provides the opportunity to change course during the research, and it is easier to adapt in practice. A potential downside is that the external validity has more constraints as it is more challenging to adapt the results in a similar case (Verschuren, Doorewaard & Mellion, 2010).

The knowledge that should be collected in the data collection is the current and preferred performances of the logistics processes, the causes of the unreliable driving hours, and the solutions to help solve the unreliable driving hours with their expected effects. For the data collection, the research objects, the data sources, and the research methods are defined and explained. The category of research objects that are chosen for this research is situations, objects and processes, where the information could be collected from both data and knowledge sources. Data sources focus on the characteristics of research objects and knowledge sources focus on existing insights and theories. The required data and knowledge for this research can be found through three types of sources. The first source that is used for this research is people as they provide a large variety of information, and it can be collected quickly. A person delivers personal information as a respondent and information about the situation as an informant, which is data sources. A person also delivers knowledge of the situation as an expert, which is a knowledge source. The main disadvantage of using people as a source is that the answers are mostly subjective. The second source that is used is reality, because of the possibility to directly measure the research object and to collect indirect information through situations, objects and processes of people, as opposed to the people source. The main benefit of reality as a source is to obtain objective information and a disadvantage is that it can only provide data sources and not knowledge sources. The third source that is used for this research is literature, which provides knowledge sources through theoretical insights. The benefit of literature as a knowledge source is that it provides already existing and helpful insights, and a disadvantage is that the user cannot be guaranteed what requires the creation of new knowledge and insights.

The research methods of this research are connected to data sources, as visible in Figure 1. For individual people, a face-to-face interview has the benefit of observing the body language of the interviewee for a better understanding of the answers. The benefit of using a group interview is to obtain information about the people they might not have thought about, and it could provide the same information as several individual interviews which saves time. One of the observation methods that is used is the ethnographic study, where data is collected by participating in the process itself without interference. This creates depth in this research and important insights. Content analyses collect data from reality and provide the opportunity to collect qualitative characterisations of reality. Content analyses collect diverse, consequent and durable research material. Search methods are the approach to selecting the relevant literature for this research, through the correct use of keywords and from bibliography to bibliography. The results from the data collection create conclusions. Figure 2 provides an overview of the connections between the different research questions, what input from the research methods is required for these questions, what the output is and what chapters target these research questions (Verschuren, Doorewaard & Mellion, 2010).

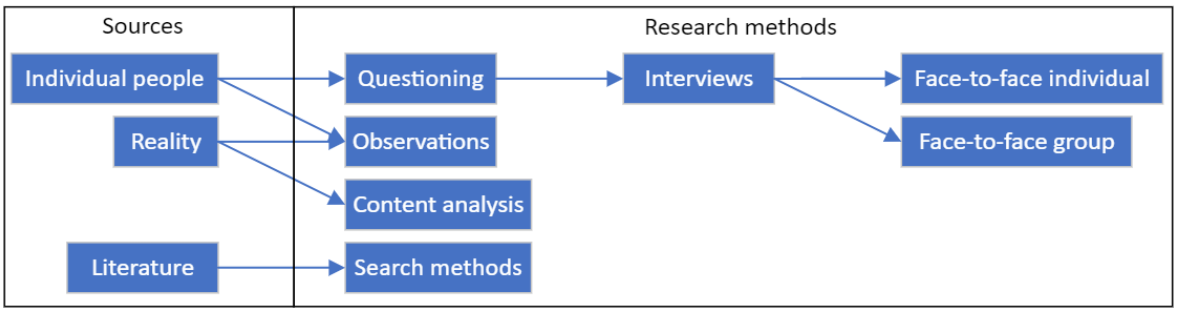

Figure 1. The research sources and research methods used to collect the required data for this research.

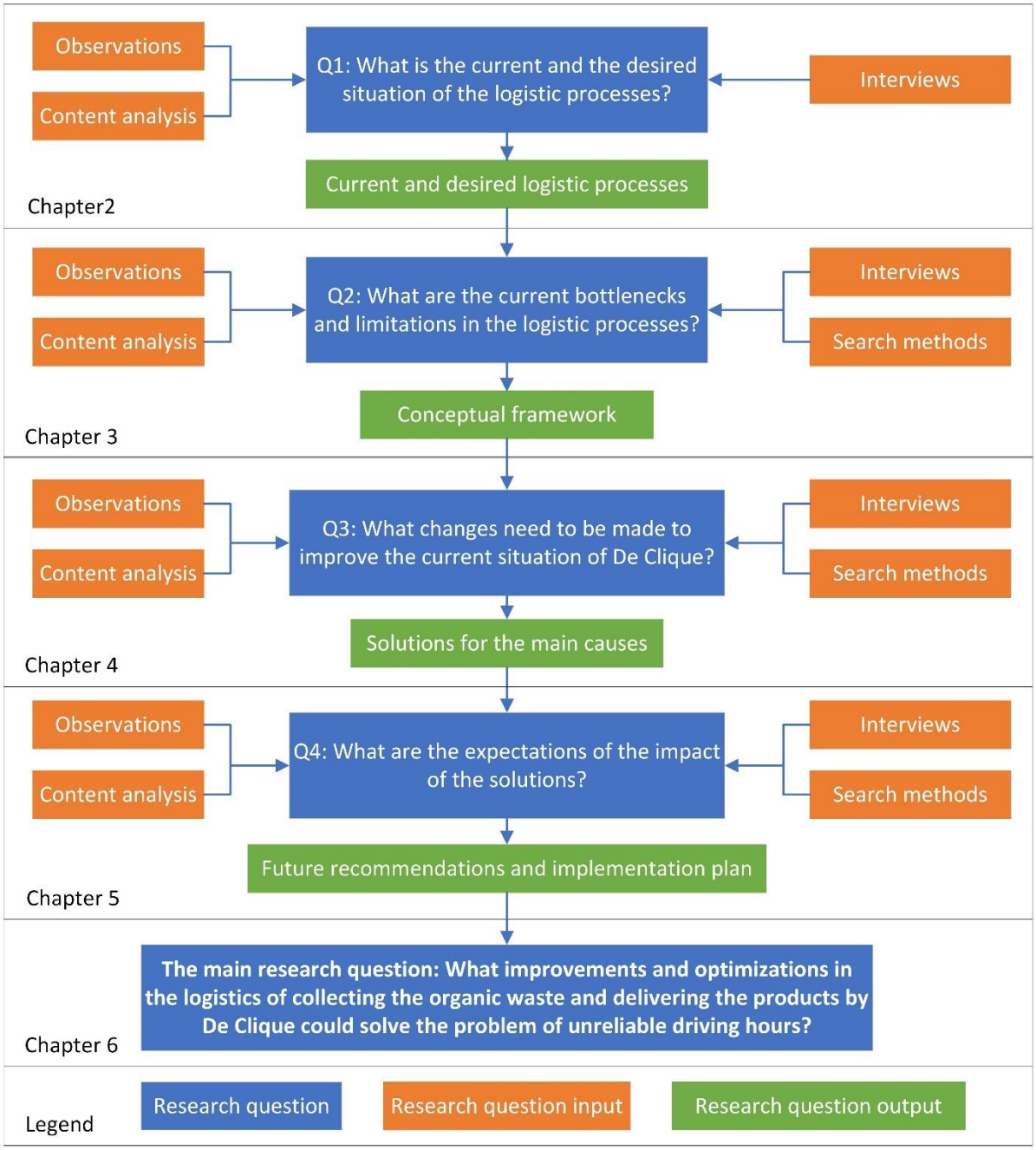

Figure 2. The research design shows the connection between the research questions (blue), the required input from the methods (orange), and the created output (green). The chapters on the sideshow are where these research questions are answered.

2. Current and Desired Situation at The Company

This chapter shows the current and desired situation of the logistics processes of The Company. Section 2.1 introduces the logistics processes of the couriers, Section 2.2 introduces the Key Performance Indicators of the logistics processes of The Company, Section 2.3 provides the current situation in the measures of these Key Performance Indicators, Section 2.4 provides the desired situation in the measures of these Key Performance Indicators, and Section 2.5 summarises this chapter. This chapter answers the question **"What is the current and desired situation of the logistics processes?"** by answering the following sub-questions:

- What are the key performance indicators for the logistics processes?
- How do the logistics processes look like?
- How do the desired logistics processes look like?

2.1 The Logistics Processes of the Couriers

The logistics processes of this research are the processes of collecting the organic waste crates and delivering The Company's products, to their clients in or around the City of Utrecht. The collection of organic waste and delivery of products at the same time is the cross-servicing potential of The Company which creates added value. These are the main tasks of the couriers and these tasks have priority over the other tasks the couriers are expected to do, such as cleaning the coolboxes or weighting the containers. These tasks are further referred to as the extra tasks of the couriers. The concept processing times are used for the time it takes for a courier to drive to a client and help them collect the organic waste crates and/or deliver the products, which is on average 10 minutes for each client. The other concepts that are important for this research are swill and the difference between boxes and crates. Swill is the name that is used for the trimmings from the kitchen that appears when cooking. When there is contamination of other food remains in both coffee grounds and/or orange peels this also fits the swill category. The reason for this is that this resource cannot be used for either the coffee grounds or its orange peel purposes as these streams need to stay clean. The crates in this research are used to collect the organic waste from the clients and the boxes are used for the cool boxes and red crates that are used to deliver the products to the clients. The couriers of the logistics processes can make use of three electric vehicles currently, which are described with their most important characteristics in Table 1. The batteries of these vehicles should be charged enough to drive around, and when it occurs that the battery is almost empty, the courier should return to The Company to charge the battery.

Vehicle models	Crate capacity with driver's license B	Crate capacity with driver's license B+ or BE	Separate plastic, metal and drinking cartons compartment
Goupil G4L	60	60	Yes
Goupil G4 + Saris FW2000	40 + 75	40 + 140	Yes
Peugeot E Expert L2H1	100	100	No

Table 1. The electric vehicles of The Company with their crate capacity and plastic, metal and drink cartons (PMD) compartments.

The couriers have a phone from The Company, which is also known as the "zebra", to use The Company app, SmartRoute and the group chats. These and the other communication and/or data collecting programs that are used by the couriers and the employees of The Company

that are an in- and/or output for the logistics processes are explained in Table 2. When a courier has an uncertain situation, the communication goes directly to their supervisor or the office for advice. For general questions and conversations, communication is done in a Signal group where the employees of The Company are added. For communication of product deliveries, the communication platform Monday is used. The last communication option is to speak with the employees face-to-face at The Company itself.

Communication and data collecting programs	Description and purpose
Client photo feedback group chat	Group chat where the couriers send a picture of signed delivery documents for product deliveries, of a situation where a client does not leave the waste the appropriate way or of a situation where the pickup descriptions require adjustments.
Courier group chat	Group chat where the couriers get the message on which vehicle they are going to drive in, what their product orders are and what their SmartRoute code is to connect their mobile phone with their routes and clients of the day.
The Company App	The Company app is used to connect the client to the empty crates that are delivered to them, the (number of) crates that are picked up, the estimated amount of PMD that is picked up, and comments when needed when clients do not follow the agreements that are made. The data from The Company app is collected in Zoho.
Shiftbase	Shiftbase is where employees can register their shifts and work time.
SmartRoute	SmartRoute provides the couriers with their routes and the pickup descriptions of the clients for collecting the organic waste. SmartRoute also provides data on the couriers' work as it shows when the couriers scan the client barcodes and if they had crates or not. SmartRoute creates schedules based on the client information from Teamleader, the couriers and the available vehicles.
Teamleader	Teamleader contains the information on the clients, where they are located, their average delivered crates, and their preferred pickup day, with a timeslot if they prefer one.
Zoho	Zoho is the website that collects the data from the collected crates and delivered crates at each client, and when the quality of the crates is scanned and checked at The Company, this is also added to Zoho.

Table 2. The communication and data collecting programs that are part of the in- and or output of the logistics processes.

All organic products are collected in 20 GL RH crates. The data from scanning and weighing the crates on Zoho shows that on average each crate weighs about 8.42 kilograms, see Appendix A. The location of most crates is outside of the client's company area, ready to be picked up, and when there are several crates, they are on roller containers and in combination with their hand strollers, it is easy for the couriers to bring the crates to their vehicles. The specific description of the pickup locations is briefly explained in SmartRoute and comprehensive in the courier handbook.

At the beginning of the couriers' shift, the courier takes the booklet with the barcodes of the clients of their schedule that day or they could use the link in the courier group chat of these client barcodes. These barcodes are required to connect the collected and delivered crates to a client in The Company app. During the research, due to employee shortages, the decision is made not to scan all crates anymore as most clients pay per crate and not its weight. When

couriers have product deliveries, they collect the delivery documents from the printer. These documents are both used for checking which products need to be loaded in the couriers' vehicle and for when the products are delivered, as these delivery documents need to be signed by the client as the confirmation of receiving the products. Based on the delivery documents the orders are picked, they are picked based on the First In First Out principle (FIFO). Frozen and refrigerated products are transported in cool boxes to keep the products chilled. Light non-refrigerated products are also transported in these cool boxes as these are the only closed clean boxes The Company has which makes the processes more hygienic. Only heavy non-refrigerated products, like lemonades, are transported in red crates for easier carrying. The picked orders are labelled with stickers on the box and the same sticker on the delivery document, to link the boxes to the order. After delivering the products the cooling boxes and/or red crates are brought back to The Company.

Every client that makes use of the services of collecting their organic waste is called a service client. Every service client has a personalised contract with agreements made with The Company, that has written down how often The Company is collecting their organic resources and how many crates they provide each time. The regular contracts are that the client pays for the number of times The Company picks up the organic resources. This also means that a client is still charged for the drive of the couriers, even if they do not have any crates ready to be picked up. When creating the contract an estimation is done on how many crates are needed for a new client, which is adjusted after seeing the reality of the use of the crates. The quality of the crates is not checked by the couriers as this is done by The Company, which means that all filled crates are collected. The delivery of the products to a client makes the client a product client which requires a different contract than the service clients as product deliveries are not standard. The deliveries of service clients and product clients are always scheduled to be combined. At the clients, Klepierre, UU, HU and UMCU instead of crates, The Company uses containers to collect the coffee grounds, orange peels, and/or swill. These containers require weighting as The Company is paid for kilograms and not for the number of containers.

The schedules of the couriers are created by the planner in SmartRoute. SmartRoute implements the data from Teamleader to know what clients should be helped that day. SmartRoute creates the best schedules based on the data that is implemented in Teamleader and SmartRoute. It divides the clients over the three vehicles and based on the average collected crates of each client and the crate capacity of each vehicle, see Table 1, it creates its schedules and implements returns to The Company. As SmartRoute also implements the indicated timeslots of the clients and through optimisations makes some schedules start later than 8:00. The planner adjusts the schedules by implementing the product orders and changing the client sequence when demand requests require this. For example, if a courier has a lot of products to deliver it is easiest to start with these clients as it is best for the chilled products and easiest for arranging the vehicles with the organic waste crates and the coolboxes. When the schedules are made, the planner sends to the scheduled couriers which vehicle they will drive in, the product order they have and what the code for SmartRoute is to open the correct schedule on The Company phone. The couriers are always requested to start driving their shift between 7:45 and 8:00.

2.2 Smart Key Performance Indicators

This section investigates the variables to analyse the logistics processes of The Company. The logistics processes of the couriers have different kinds of Key Performance Indicators

(KPIs). During this research, it is important to consider the SMART criteria (Specific, Measurable, Achievable, Relevant, and Time-bound) because of a few reasons. SMART criteria help to create and achieve goals, as making the KPIs specific makes it easier to have clear goals, to concentrate on the goals and to be driven to complete them. Making the KPIs measurable helps to record the progress that is made and makes it clear when the goals are completed. Making the KPIs achievable makes the goals practical and feasible to be successful. Making the KPIs relevant makes the goals meaningful, and important and aligns with other relevant goals. Making the KPIs time-bound gives the goals a deadline to meet and work towards (Hancock & Bell, 2020). KPIs help to reach business objectives and are created according to these objectives (Del-Rey-Chamorro et al., 2003).

Improvements in the schedules are done through improvements in the performance of the logistics processes. Performance management can be seen as the improvements that help to achieve the vision of the company, as the continuous process of setting objectives and as the logistics processes improve the service on a standardised basis (Shane, 1998). Performance management uses the Balanced Scorecard (BSC) that implements the customer, internal business process, learning and growth, and financial perspectives, and links these to the business objectives (Kaplan & Norton, 2005).

Calculating SMART KPIs starts with formulating both the business objective and the business strategy (Del-Rey-Chamorro et al., 2003). The business objective in this research is to offer The Company recommendations on improvements for the logistics of collecting organic waste and delivering the products in the city of Utrecht to solve the problem of unreliable driving hours, by providing an analysis of the gap between the desired and the current situation on these processes. The business strategy to reach this objective is to make use of the case study research with the logistics processes of The Company as the research object.

The second step is to develop a BSC. The BSC contains the customer perspective that answers the question: “How do customers see us?”, the internal business process perspective that clarifies the question: “What must we excel at?”, and the learning and growth perspective, which is also called the innovation and learning perspective, that answers the question “Can we continue to improve and create value?”, and the financial dimensions that answer the question: “How do we look to shareholders?”. The BSC provides the objectives, the measures, and the created KPIs that are linked to each of these perspectives (Kaplan & Norton, 2005). The BSC of The Company is created in Figure 3 providing the goals, the measures and the KPIs from the four different perspectives. These KPIs are specifically designed for this research, they are measurable as they are all used in this research, which also made it achievable and time-bound, and the relevance of these KPIs is shown by their use of them in the other parts of this research. The developed KPIs show if the research objectives are reached.

2.3 Current Situation

This section investigates the courier tasks from the four perspectives of the BSC, which are the customer, internal business, innovation and learning, and the financial perspective. Each of the measures from the BSC in Figure 3 is discussed to measure the current situation from these perspectives as it is, but also the problems within these tasks from different aspects. The measures of the KPIs are used to measure the current situation to make it specific, measurable, achievable, relevant, and time-bound.

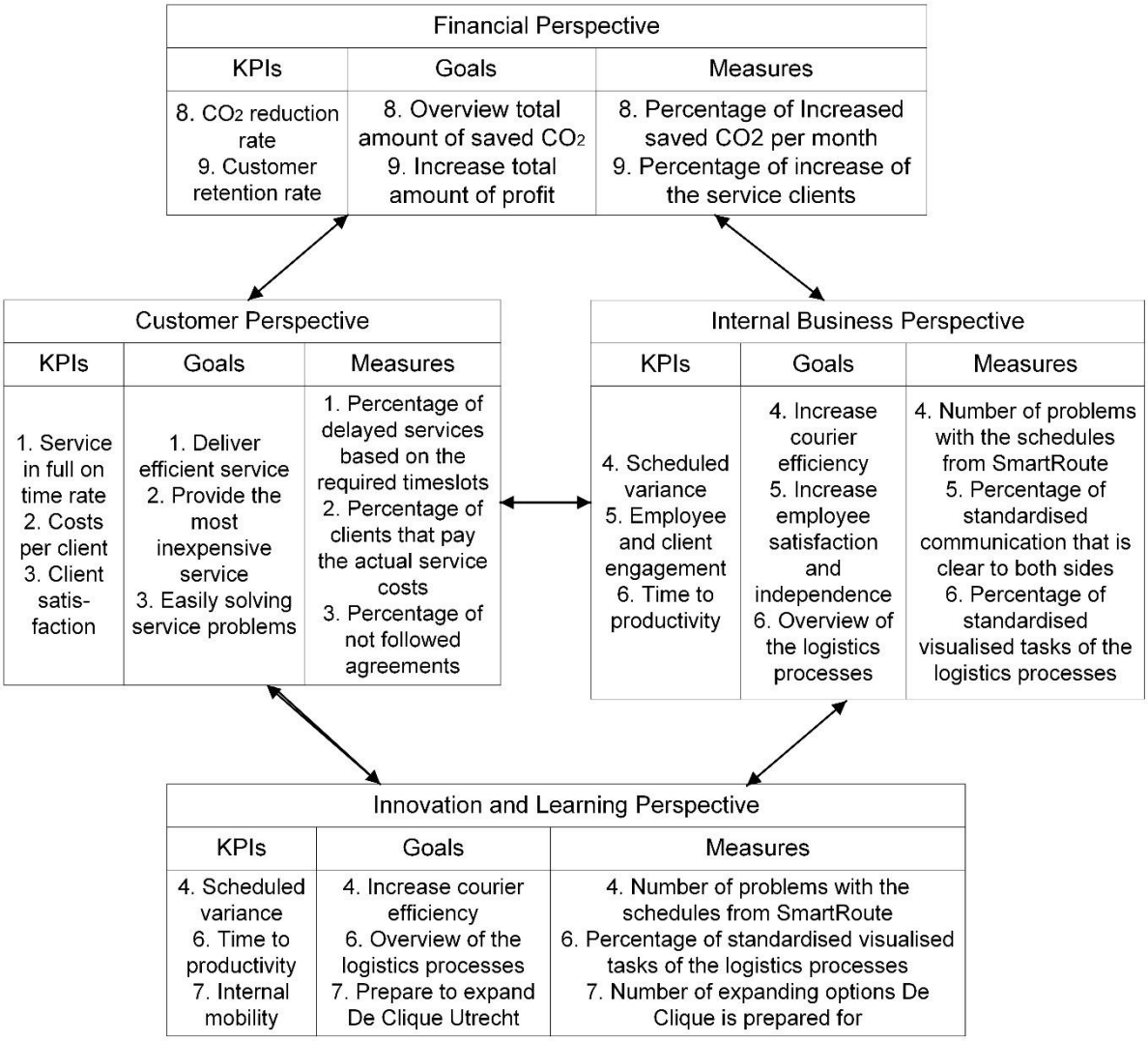

Figure 3. The balanced scorecard of The Company with the key performance indicators of the logistics processes.

2.3.1 Customer's Perspective

Measure 1: Percentage of delayed services based on the indicated timeslots. From the customer's perspective in the current situation, the data on helping the clients in their indicated timeslots are currently not collected. In this research, this data is collected and the delayed times of service from November 19th 2022 until February 19th 2023 are shown in Appendix B. Of the 2,985 clients helped in this period, 281 clients were helped outside of the requested timeslot with more than five minutes, which is a percentage of 9.4% of the total amount of helped clients. Of these 281 clients, 231 clients were helped later than the indicated timeslot with an average of 1 hour and 21 minutes, and 50 clients were helped earlier than the indicated timeslot with an average of 1 hour and 31 minutes.

Measure 2: Percentage of clients that pay the actual service costs. The income and costs associated with the logistics processes based on the material flow are visualised in Appendix C. The costs of the logistics processes of this research are the costs for product deliveries and the costs of bringing, replacing and collecting the crates. There are always extra costs when equipment breaks down or needs to be invested in to improve the execution of the logistics processes, but these are unforeseen costs, that are not in the scope of this research. The

scope of this research implements the courier costs. Through the data that is collected from SmartRoute, an average time to help a client can be calculated. This means that the courier costs of the tasks before and after each shift are not considered here. As the different types of clients take different times to be helped, in these calculations the clients are differentiated by the type of client. Some clients are contracted by the central government and are located mainly in Rotterdam and Den Haag, see Figure 4. The clients located in Hoog Catharijne are classified as Klepierre clients, while clients at the university ground are categorised as Uithof clients. Clients located in the city centre of Utrecht are classified as city-centre clients, while those outside the city centre are categorised as beyond-the-centre clients, see Figure 5.

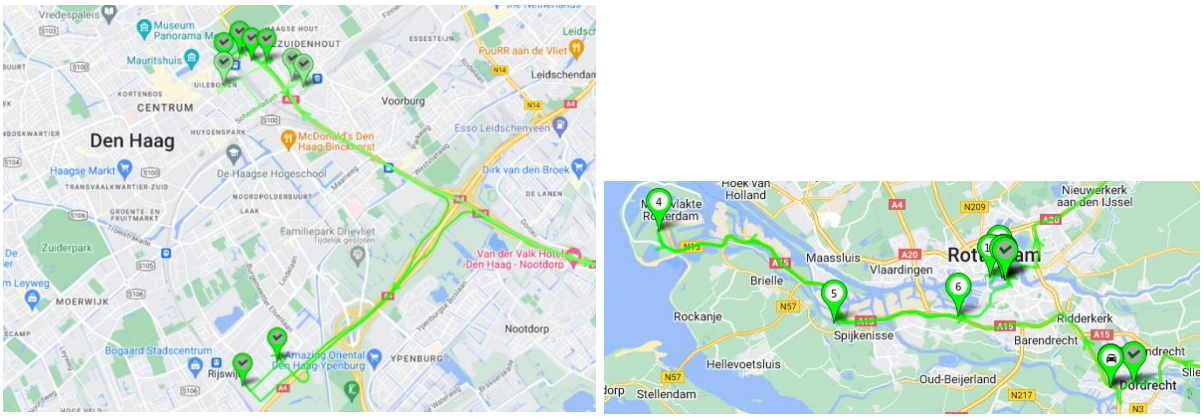

Figure 4. A visualisation of the current central government clients of The Company in both Den Haag and Rotterdam.

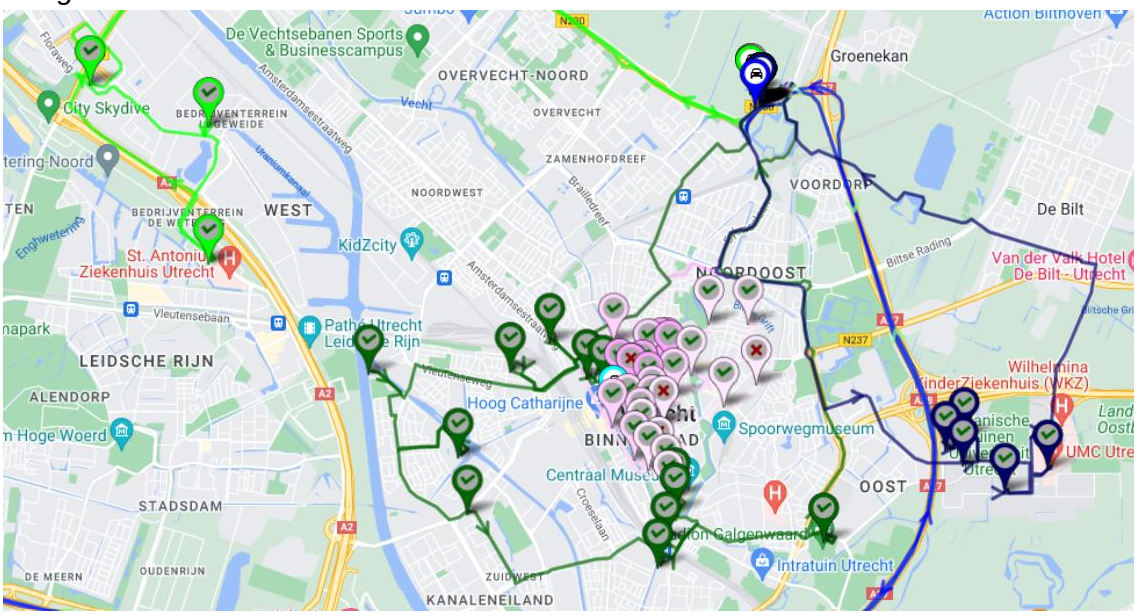

Figure 5. A visualisation of the average Uithof, city centre, and some beyond-the-centre clients of The Company.

Table 3 summarises information about each type of client, including the average planned driving hours, actual average driving hours, average time spent on a client (including driving and processing crates), shortest and longest time measured for helping clients, courier costs with an hourly rate of €18.90/hour, the average number of clients helped each week and the costs of these clients in an average week. The data used to create Table 3 is collected in Appendices D and E. According to Table 3, the cost for an average week with a total of 224 clients is €1,603.01. Since all clients pay the same price for The Company's services, the

average cost of helping each client is €7.16. Table 3 shows that 53 clients pay less than what they cost, and 171 clients pay more than what they cost. This shows that in the current situation, 23.7% of the clients pay less than what they cost and 76.3% of the clients pay more than what they cost. Overall, Table 3 provides valuable information about the costs associated with each type of client and their impact on The Company's profitability.

Type of client / KPI	Central government	Klepierre	Uithof	In the city centre	Beyond the city centre
Average planned driving hours	7:33	1:16	1:49	3:52	3:38
Actual average driving hours	7:31	1:54	2:19	4:53	3:58
Average time spent on a client	0:37	0:20	0:24	0:20	0:19
Range of average time spent on a client	0:18 to 1:03	0:06 to 0:59	0:11 to 0:53	0:07 to 0:36	0:04 to 0:47
Average costs for these clients	€11.65	€6.30	€7.56	€6.30	€5.99
The average amount of clients each week	36	11	17	89	71
Average costs of these clients each week	€419.20	€69.30	€128.52	€560.70	€425.29

Table 3. An overview of the time and costs spend on each type of client based on the data of Appendices D and E.

Measure 3: Percentage of not followed agreement. The last measure from the customer perspective is the percentage of not following the agreements that are made with The Company. Clients do not follow agreements when for example there are no crates to collect, organic waste is delivered in different containers than The Company crates, the pickup location is a mess, or a courier is required to enter a building and the client is not available to let the courier in. From November 19th 2022 to February 19th 2023, there were a total of 353 situations where clients did not follow the agreements. This data is collected from the client photo feedback group chat and The Company app. This represents 11.8% of the total amount of 2,985 clients helped during this period. These situations where clients do not follow the agreements can be difficult for both the clients and the couriers.

2.3.2 Internal Business Process Perspective

Measure 4: The number of SmartRoute schedule problems. From the internal business process perspective in the current situation, the five observed problems with the schedules from SmartRoute are: unclear pickup descriptions, differences between the expected and actual number of crates, manual implementation of product deliveries, incorrect departure times for scheduling, and inability to adjust processing time for clients.

The problem with not having clear pickup descriptions for each client in SmartRoute and/or in the courier handbook is that it requires the courier to ask for help or figure it out themselves, leading to inefficiencies. When this solution for the situation is not added as a new description after the courier figures out where the crates are collected, the next person struggles with the same issue. It could also occur that because of unclear pickup descriptions and companies close to each other, it is difficult to indicate which crates are from which company. That could

result in a situation where the couriers accidentally charge the wrong clients for the crates that they collected, and this could create further problems along the line with lost crates and deposits.

The SmartRoute app considers on average how many crates are picked up at a client. It predicts when the courier needs to return to The Company and calculates this time as well, but as the average number of crates is differentiating much, this is also causing some issues. When the courier reaches the crate capacity of Table 1 earlier than expected it takes more time when the courier needs to travel more to The Company which is not expected in the schedules. When the courier reaches the crate capacity of Table 1 later than expected, the courier might need to travel to a client that is far away, need to go to The Company afterwards and return to another client that is also far away and could have been combined with the client before. Appendix F shows how in the period between November 19th 2022 and February 19th 2023 of the 2,985 clients planned, 2,507 clients had crates and of the planned 14,985 crates, 20,029 crates were collected. This shows the unreliability of the current data in SmartRoute when compared to actual information.

The problem with SmartRoute is that product deliveries are not implemented automatically and have to be adjusted manually, which takes more time for the planner. This can lead to schedules that overlook product delivery times. Product deliveries take up more time for the client that is not added. On average, delivering products and collecting waste takes 15 minutes, while only delivering products takes five minutes.

Another problem with SmartRoute is that it calculates the best schedules assuming that couriers leave on time, but in reality, the couriers start at different times of the day for the different routes, which may not make the planned route the most efficient. Appendix G shows that of the 230 courier shifts, only 14 are detected to have left before 8:05, which is the scheduled departure time. This is not completely reliable as this time is calculated based on the standard travelling times to the first client and not the actual travel time. There could have been traffic jams so it could be the case that some couriers do leave on time, but they just took way longer than expected before arriving at their first client. Of these 230 courier shifts, 50 shifts were done by the same courier that already started with another shift before and these departure times are excluded as they are no real departure times. Of the remaining 170 courier shifts, the couriers left on average at 8:44 at The Company. As a result, the couriers sometimes help their clients in a different order than SmartRoute suggests and changes are not communicated with the planner or with the couriers' supervisors. This could lead to missed indicated timeslots, where the crates were not available yet or the client removed the crates again to prevent stealing.

SmartRoute sometimes creates a schedule for a courier that suggests a later departure time, but the couriers are not notified leading to ignoring the timeslots. Figure 6 shows examples of couriers that started earlier as they are not notified to start later, and because of that, they missed the indicated timeslot. In Figure 6 the stop represents the route of the courier with their first client.

The collection time is for each client on average of ten minutes and the pickup descriptions are in the comments in SmartRoute. However, this average collection time is often not updated for clients who take longer, making the schedules less reliable. Another processing times problem is that SmartRoute fails to implement the processing times for clients in the schedules, also making less reliable schedules. Examples of this can be seen in Figure 7. This means that

although the processing time is currently only able to be added automatically, it is sometimes not added at all.

Figure 6. Examples of schedules that suggest the courier start later which is not communicated.

Measure 5: Percentage of communication that is clear to both sides. Clear communication is measured through communication from the involved parties as a response that the communication came through. Clear communication is created when the involved parties can check and know what the further procedures are for the different situations. From the internal business process perspective, the amount of clear communication procedures could also be a measure of the current situation. Of the twelve standard communication procedures, there are, six of them are not clear for both The Company and their clients, 50% of the communication procedures. Table 4 shows the clear and unclear communication procedures, and the six unclear communication procedures are explained further below.

Figure 7. With the average processing time of ten minutes between these clients the expected estimated time of arrival (ETA) to the next client cannot be less than ten minutes after arriving at the first client, which is shown in the observed cases.

The first unclear communication procedure is that when looking at the course of their tasks, the couriers are responsible to collect the organic resources and PMD waste from the clients and deliver these to The Company, deliver the products to the clients, checking if the clients comply with the agreements are made and comment this to the supervisors. Besides their regular courier tasks, extra tasks besides the collection of crates and delivery of products are expected from them, that are not known to the couriers. The courier handbook itself is currently lacking the actual working method and the couriers do not always follow the handbook. After onboarding through driving and helping with existing couriers and reading the couriers handbook, the tasks of the couriers are not checked unless problems are occurring.

Clear communication procedures	Unclear communication procedures
Communication between the couriers and the planners about information about their routes and vehicles of the day	Communication of the extra tasks descriptions, which is not done in the courier handbook as standard tasks
Communication about product deliveries	Communication of vehicle struggles
Communication when there are uncertainties	Communication on arranging clean clothes
Communication of creating agreements with clients	Communication on the responsibility of arranging the pickup descriptions
Communication of standard task description through the courier handbook	Communication about adjustments to the couriers' schedules
Communication through the communication and data collecting programs of Table 2	Communication between the couriers

Table 4. The clarified and not clarified communication procedures in the logistics processes.

Communication about struggles with vehicles also has its problems. The couriers currently sometimes struggle with having enough battery to follow the schedules, and recharging takes them plenty of time. When to recharge is up to the couriers, as there are no clear decisions on how to assess the situation. When the vehicles need repairs, this could take a while before they are done when they are not urgent. Another reoccurring problem is that the vehicles are still dirty from the day before.

When it comes to communication about arranging clean clothes for the couriers, there is not much communication. The couriers drop their dirty clothes in the laundry room and when this stacks up these clothes are cleaned by their supervisor. Currently, when the couriers arrive at the clients for product deliveries, they wear the same dirty clothes from picking up the organic resources. The Company improves their image when the couriers arrive in clean clothes, but according to the couriers, finding clean clothes to work in is already difficult sometimes.

When it comes to communication of pickup descriptions, before the courier visits a new client, agreements are made to make sure the clients know what is expected from them. The pickup descriptions should be made after these agreements. The couriers always read these pickup descriptions properly before driving to these clients. Currently, as the client number is growing, the pickup descriptions are not strictly added to the handbook and SmartRoute. Currently, it is also not made clear when somebody is responsible for creating the pickup descriptions in SmartRoute and the courier handbook. The communication with the clients is done by the sales team of The Company, but the couriers notify them when the pickup descriptions or the created agreements are not followed. Couriers currently use both the client picture feedback group chat and The Company App to make comments about clients that do not follow the agreements, but the supervisors expect the comments in the client picture feedback group chat as comments made in The Company App are only visible in Zoho. This results in a situation where there is not a clear overview of what goes wrong every day and how often actions in the logistics processes go wrong. When a client is added to SmartRoute for just a product delivery and not the service, and there is not a pickup description yet no crates to pick up. It should be clear to the couriers when there is only a product delivery and it is not a mistake of missing a pickup description.

When adjustments to the schedules are made after the courier has started its shift, these adjustments are sent through the courier group chat, even if these messages are very important. This creates a situation where couriers are on the road and cannot open their group

chats as there are driving, there is a delay in the messages which could cost the courier more time.

When it comes to communication between the couriers, some improvements should be made. Currently, couriers know shortcuts of the routes, tips for using the vehicles, using The Company phone, tips on avoiding roadwork, and other tips and tricks, which are not shared regularly with their fellow couriers. These tips and tricks are also not shared regularly with their supervisors which makes it more difficult for them to monitor the couriers.

Measure 6: Percentage of standardised visualised tasks of the logistics processes. From the internal business process perspective, the measure is the percentage of visualised standard tasks of the logistics processes. Currently, there is no visualisation of any of the logistics processes done at The Company. The courier handbooks explain the most standard tasks that are expected from the couriers but numerous extra tasks are not described here and there is also still a significant amount of open space for the courier to understand this information and to make their own decisions. As this is the case it is difficult for the supervisors of the couriers to know what they are doing and where they spend their time.

2.3.3 Innovation and learning perspective

From the innovation and learning perspective in the current situation, both the number of problems with the schedules from SmartRoute needs to be analysed and the logistics processes need to be visualised.

Measure 7: The number of expanding options The Company is prepared for. In the current situation, the number of expanding options is also a measure of the current situation from the innovation and learning perspective. The current situation of The Company is not ready for more clients as this creates more work from the couriers and therefore requires more vehicles and more employees. In the current situation, there are zero preparations for the different expansions that will be required with the growth of clients.

2.3.4 Financial Perspective

Measure 8: Percentage of increased saved CO_2 per month. As the financial perspective is looking from the perspective of how shareholders look at the logistics processes, the increased saved CO_2 per month is important. For this, the number of collected organic waste crates is calculated. Appendix F shows that in the period between November 19th 2022 and February 19th 2023 of the 2,985 clients planned, 2,507 clients had crates and of the 14,985 crates planned to be collected, 20,029 crates are collected. On average 65.46% of the organic waste is swill, 28.82% is coffee grounds, and 5.72% is orange peels. Another intern from The Company has done a life cycle assessment on the organic streams of coffee grounds, orange peels, and swill based on the current processing of the organic waste streams. This created the data on the amount of CO_2 that is saved for every kilogram of these organic streams. The saved amount of CO_2 per kilogram for the period from November 19th 2022 until February 19th 2023, see Table 5.

Organic waste stream	Saving CO_2/kg	Total kg	Total saved CO_2
Coffee grounds	4.615 CO_2/kg	5,773.35 kg	15,951.28 CO_2
Orange peels	0.705 CO_2/kg	1,145.00 kg	483.27 CO_2
Swill	0.643 CO_2/kg	1,311.70 kg	5,046.98 CO_2
Total	5.963 CO_2/kg	20029,00 kg	21,481.53 CO_2

Table 5. The amount of CO_2 that is saved in the period from November 19th 2022 until February 19th 2023 with the current number of clients and organic waste.

Appendix I both shows the total amount of kilogram collected organic waste for the months from February 2022 until November 2022, and it also shows the increased amount of kilograms each month. As the amount of collected kilogram is shown to be increasing with an average of 16.73% each month, the total amount of saved CO_2 is also increasing with an average of 16.73%.

Measure 9: Percentage of increase of service clients. From the financial perspective, the current number of service clients is also calculated. Currently, The Company has 196 service clients, and each client has a different number of pickup days. The number of service clients is always fluctuating as new contracts are created and clients leave. In the six months from July until December, there is an overall increase of 29 service clients, which is an increase of 17.4% of the service clients.

2.4 Desired Situation

This section investigates the desired situation of the logistics processes of The Company from the four perspectives described in the BSC in Section 2.2. In the desired situation the problems from Section 2.3 should be solved where feasible. In the end, the changes made to the current situation should solve the unreliable driving hours of the couriers and create the desired situation described below.

2.4.1 Customer's Perspective

From the customer's perspective in the desired situation, the service of The Company is efficient, the costs are minimised and service problems are easily solved. In the desired situation, only 1% of the clients are helped outside their indicated timeslot, 95% of the clients pay the actual service costs, and 95% of the clients follow the agreements or problems are solved quickly and for the long term.

2.4.2 Internal Business Process Perspective

From the internal business process perspective in the desired situation, the courier efficiency should be increased, employee satisfaction and independence should be increased, and there should be an overview of the logistics processes. As the desired situation requires to be realistic, in the best-case scenario, 4 of the 5 SmartRoute problems are solved. The reason for this is that the problem of not knowing the expected number of crates does not fit the scope of this research. The remaining SmartRoute problems should be tackled during this research.

In the desired situation, 91.67% of the standard communication procedures are clear for the involved parties. This means that in every situation where communication is required from either the couriers, their fellow employees or the clients, the other side of the communication is aware of the situation and knows what is expected from them. In some situations, there is communication required that cannot be foreseen, but these communications are not considered here.

In the desired situation, 100% of the couriers' standard tasks are visualised, as the flowcharts of standard tasks are created and take the actions into account in the average situations. This also means when improvements on the tasks are made, these changes are implemented in the flowcharts. In some situations, there are tasks required that cannot be foreseen, and these are not considered here.

2.4.3 Innovation and Learning Perspective

From the innovation and learning perspective in the desired situation, the predictions on the courier trips should be improved, preparations to expand to more cities should be created, and preparations to expand The Company Utrecht should be created. This means that in the desired situation, The Company is prepared for at least three different expanding options.

2.4.4 Financial Perspective

From the financial perspective in the desired situation, the percentage of the total amount of saved CO_2 continues to grow with an average of 16.73% each month. In the desired situation, the number of service clients is continuing to grow with the same increase of 17.4% of the service clients for the next six months. Through the improvements that are done during this research and afterwards, when implementing the recommendations from this research, it is realistic for the desired situation to continue to look like the current situation when even more improvements are done.

2.5 Conclusion

The current situation of The Company has been evaluated in terms of financial, internal business, innovation and learning and customer perspectives. The desired situation provides possible adjustments to improve the current situation. Table 6 below shows the KPIs from the BSC with the measures used to calculate the goals from different perspectives, in combination with the current and the desired situation. The couriers face several problems that need to be solved by the employees of The Company and their clients. The couriers are satisfied with their work, but several small improvements could make it better. Currently, the couriers' supervisors lack visibility of the couriers' work, making it difficult to create reliable schedules. In the desired situation, there is more communication, visibility of tasks, and quick problem-solving.

KPI	Measure	Current	Desired
Service at a full-on-time rate	Percentage of delayed services based on the indicated timeslots	9.4% of the clients are helped outside of the indicated timeslot	1% of the clients are helped outside of the indicated timeslot
Costs per client	Percentage of clients that pay the actual service costs	23.7% of the clients pay less than the actual service costs	95% of the clients pay the same as the actual service costs
Client satisfaction	Percentage of not followed agreements	11.8% of the time clients did not follow the agreements	95% of the time clients follow the agreements
Scheduled variance	Number of problems with the schedules from SmartRoute	5 SmartRoute problems keep occurring	1 SmartRoute problem keeps occurring
Employee and client engagement	Percentage of standardised communication that is clear to both sides	50% of the standard communication procedures are clear to both sides	91.67% of the standard communication procedures are clear to both sides
Time to productivity	Percentage of standardised visualised tasks of the logistics processes	0% of the couriers' standard tasks are visualised	100% of the couriers' standard tasks are visualised
Internal mobility	Number of expanding options The Company is prepared for	Prepared for zero different expanding options	Prepared for three different expanding options
CO_2 reduction rate	Percentage of the increased amount of saved CO_2 each month	The total amount of saved CO_2 each month increases by 16.73%	The total amount of saved CO_2 each month increases by 16.73%
Customer retention rate	Percentage of increase of the service clients	An increase of 17.4% in serving clients in the past six months	An increase of 17.4% in serving clients in the next six months

Table 6. The overview of the key performance indicators, the measures of the goals of the customer, internal business, innovation and learning and financial perspectives, in the current and the desired situation over the period from November 19th 2022 until February 19th 2023.

3. Causes of Unreliable Driving Hours

This chapter shows the causes found by either primary and/or secondary research of the unreliable driving hours, which are the bottlenecks of the logistics processes. This chapter researches the causes of the problems in the logistics processes that are indirectly causing unreliable driving hours of the couriers of The Company. Some causes are detected through the primary research of observations, content analysis and interviews with the employees in Section 3.1. Other causes are detected through the secondary research of literature research in Section 3.2. There is a differentiation between primary and secondary research as the primary research is specific to the case of The Company and the secondary research is from similar cases as The Company. Section 3.3 summarises these causes and groups them into bottlenecks and links their limitations, which helps to understand the difficulties in solving these problems. This chapter answers the question: **"What are the current bottlenecks and limitations in the logistics processes?"** by answering the following sub-questions:

- What are the primary research causes of the differences between the desired and the current situation of the logistics processes?
- What are the secondary causes of the differences between the desired and the current situation of the logistics processes?

3.1 Primary Research Causes

This section investigates the causes of these performance differences detected during the observations, the content analysis and the interviews with the employees. The causes are researched from the four perspectives of the BSC. There are several different causes of having unreliable driving hours, as well as causes of these causes. The primary cause is the detected origin of each regular cause. The figures that are created in each section show the primary causes and the regular causes according to the legend in Figure 8. The reasoning for the shape of the primary cause is that in regular flowcharts this is the element for the beginning and the end of a process, whereas the small cause is presented as a step of the process. The prioritised causes that should be tackled are coloured orange in the figures used in this chapter, but the reasoning for the prioritisation of the causes that should be tackled is explained in Sections 4.1 and 4.2.

Figure 8. The elements used for the visualisation of the different causes are either collected through observations (O), interviews (I), or content analysis (C).

3.1.1 Customer's Perspective

Figure 9 shows the detected causes of the problems from the customer's perspective and is expanded in Appendix J. This section explains the effects of the causes of this figure.

Measure 1: Percentage of delayed services based on the indicated timeslots. The first detected cause is when couriers are sick or want to go on holiday, this creates struggles at The Company. The problem is created by the limited amount of couriers. When other employees do the tasks of the couriers, they are not able to do the entire shift as they also have to do their tasks. When couriers need to substitute their colleagues' shifts, they should be working in their spare time, which is not preferred by most couriers. Another cause for a delay by the couriers is when they need to wait for help from their supervisors or other couriers when they are

struggling with the “zebra” or the applications. This is caused by the fact that the solutions for the problems with the “zebra” and the applications are not written in the courier handbook, which means the couriers are not able to look up how to fix the situations. This problem is not even detected as the data from SmartRoute, which is the information on the routes and the clients helped by The Company, does not get collected. The reason why the data from SmartRoute of the delayed times of service in Appendix B is usually not collected is that this data is not stored automatically. After a few days, the data gets deleted because not deleting the schedules creates problems of incorrect client lists in the SmartRoute application of the couriers. To collect more data on this KPI, the required data is stored manually in this research, see Appendix B.

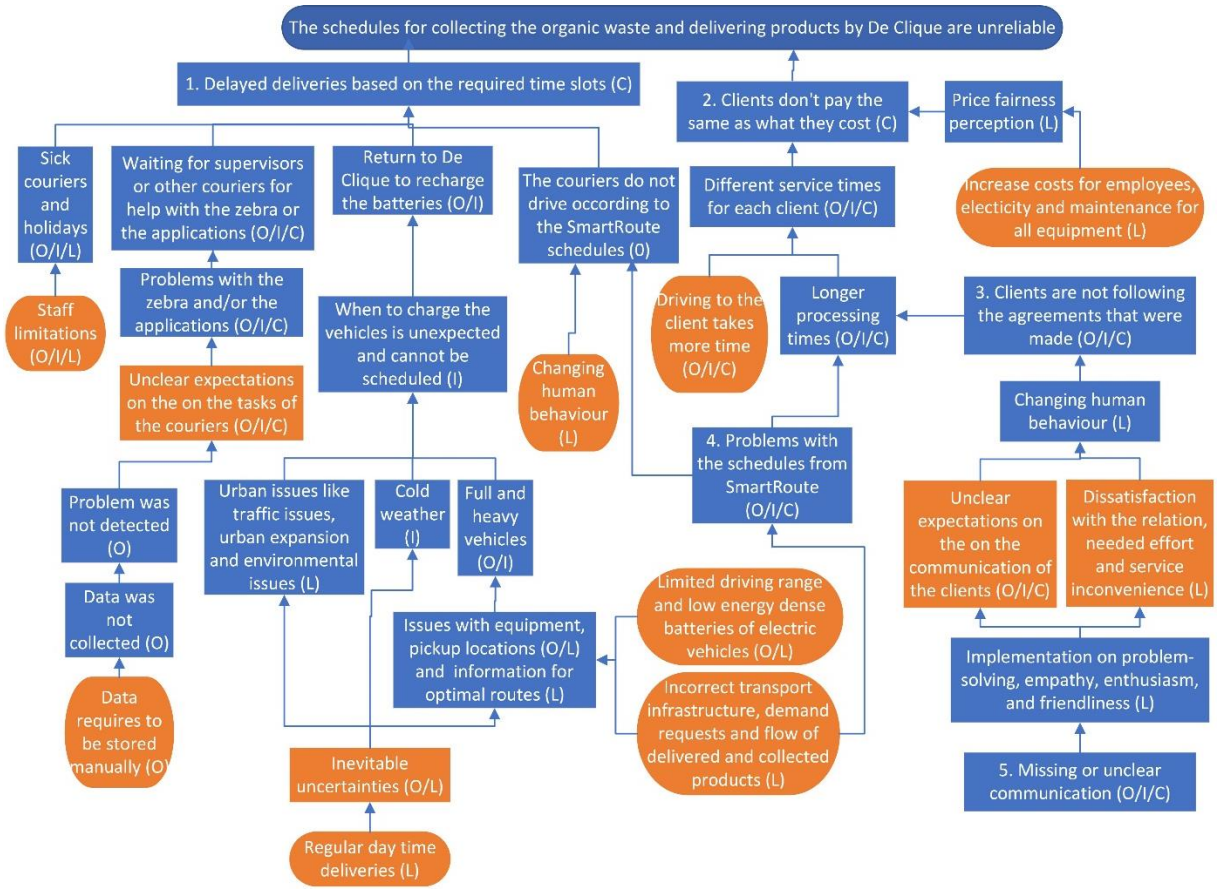

Figure 9. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the customers' perspective.

Another cause creating delayed services is that the batteries of the vehicles require to be recharged during a shift and the couriers of the vehicle models goupil G4 and G4L need to return to The Company for that. The Goupils cannot be charged at a different place but just at The Company because of the connection. A cause of needing more energy could be because of the weather as the batteries are not as effective in cold weather as in warm weather. A cause of needing more batteries could also be because there were more crates with more organic waste. This creates full and heavy vehicles that require more energy to drive, and they also require more trips to The Company and back. This can be seen as issues with the equipment from the couriers due to the limited driving range and low energy-dense batteries of electric vehicles. As several aspects influence the duration of the battery there is also currently no clear sight of what decisions need to be made in what situation. These are observed as inevitable uncertainties as these are aspects The Company is not able to control,

as the technology is not prepared for weather changes. Another observed cause is that the couriers do not drive according to the SmartRoute schedules which are created through the problems with the schedules from SmartRoute. This is further explained in measure 4, which also shows the different causes of these problems that make the couriers not able or choose not to follow these schedules.

Measure 2: Percentage of clients that pay the actual service costs. The costs of the logistics processes are the costs for product deliveries and the costs of bringing, replacing and collecting the crates, which are the courier costs. The courier costs consist of the time it takes to help the clients, where the costs of helping each type of client differ. The causes for the different service times are created by the different driving times and different processing times. Some clients require the couriers to drive longer distances to get to them and some clients require more tasks. Table 3 shows that especially the central government clients take longer and are more expensive for The Company. This can be shown in the detected causes as most of the central government clients are in Rotterdam or Den Haag, which is far from The Company, and these clients of Den Haag also have security that needs to help the couriers to get into the buildings, as these buildings are protected. These tasks could be created through the other causes that are creating problems with the schedules from SmartRoute which are further explained in measure 4 and through the problem that clients are not following the agreements, see measure 3.

Measure 3: Percentage of not followed agreements. The clients that do not follow the agreements that are made are causing longer processing times at the client. The average processing times for each type of client are shown in Appendices D and E. For example, a client could have agreed to have the pickup location behind their fence. They promised to have this fence open at the time the couriers are picking up the crates. When this is not the case and the couriers are in front of a closed gate, they look further and enter the client's place to ask for them to open the gate. Searching and waiting for the client’s employees is not part of the agreements and it increases the processing times, but it does create client satisfaction. Some causes of the clients that do not follow the agreements are created by The Company, others by the client and others between The Company and the client. These causes are different and require different solutions, but they are communication problems. Further details on these causes of missing or unclear communication are shown in measure 5.

3.1.2 Internal Business Process Perspective

Figures 10 and 11 show what the detected causes are when looking at the internal business process perspective and are expanded in Appendix J. The problems shown in these figures are further explained in this section.

Measure 4: The number of SmartRoute schedule problems. There are different causes for the different problems that occur in SmartRoute. The problem of unclear, missing and unreliable route and task agreements is caused when they do not get updated. One cause for that is that the couriers do not comment on the problems they have with the descriptions when these are unclear, missing or inefficient. Another cause of this is when there is no clear description, the couriers fix the situation at that time but do not create a description for the next time. This takes up much time for the first time this client is helped, and every other time after that. The primary cause for this problem of having unclear pickup descriptions is created by the fact that the couriers, the planners and the supervisors are responsible for creating the pickup descriptions. It is generally known that “shared responsibility is no responsibility”, and this is a perfect

example of it. It is currently not assigned to the couriers to create the pickup description, it creates a situation where nobody feels responsible, and the task is not done.

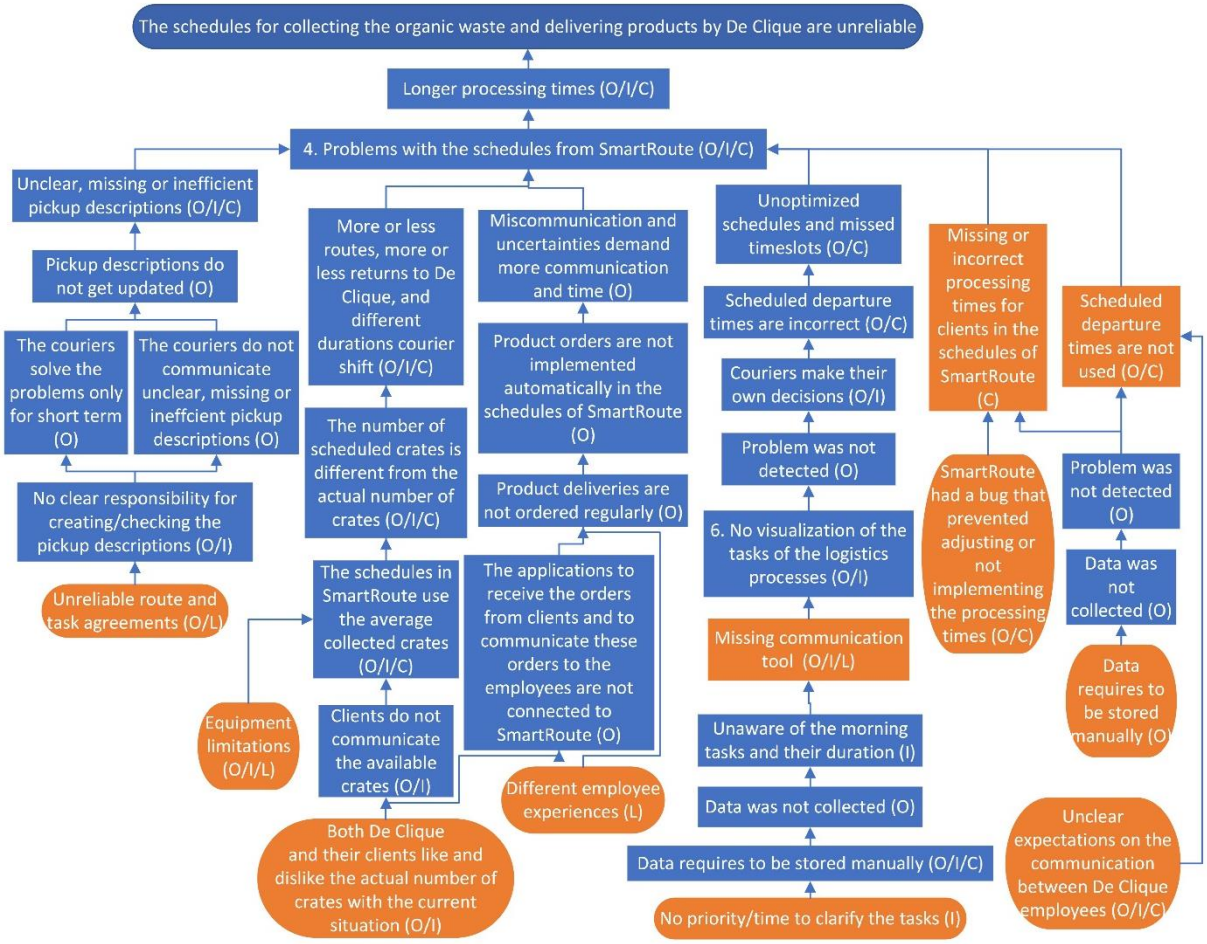

Figure 10. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the internal business process perspective.

The problem of using the average amount of crates for the schedules instead of the actual number of crates is created by the fact that the actual number of crates that can be collected is unknown at The Company. The cause of this is that it is not requested by the clients to communicate the number of crates that are ready to be collected by The Company as they pay for the agreed number of times The Company visits. The clients pay per pickup for at least five crates and extra for every extra crate. The reason why communication about available crates is lacking is that the client does not see the benefit of putting in the extra effort and The Company does not have an incentive to solve the problem because they still get paid regardless of whether there are crates to be collected or not. The reason why it is still seen as a problem in this research is that the schedules cannot become accurate as the number of collected crates determines the number of routes, the number of returns to The Company, and the duration of the couriers' shift.

The cause of not having the product deliveries implemented automatically in SmartRoute is that the product deliveries are not done regularly. If the product deliveries are ordered regularly, these could have been implemented automatically with the scheduled service of the clients as that could be added to Teamleader. Currently, the different applications that are used in the

process of product ordering look as followed. The product orders enter The Company through different channels. When these orders are received by The Company, they are added to Monday to create an overview of the orders. After that, the product delivery documents are created and printed for the couriers and the time to deliver the products is added manually to the schedule in SmartRoute. The notification about the product deliveries the couriers have is done in the couriers group chat. When product deliveries are delivered the photo of the signed delivery documents is sent to the client photo feedback group chat. This shows that the problem with the product deliveries is mainly caused by using these different applications that are not all connected to SmartRoute.

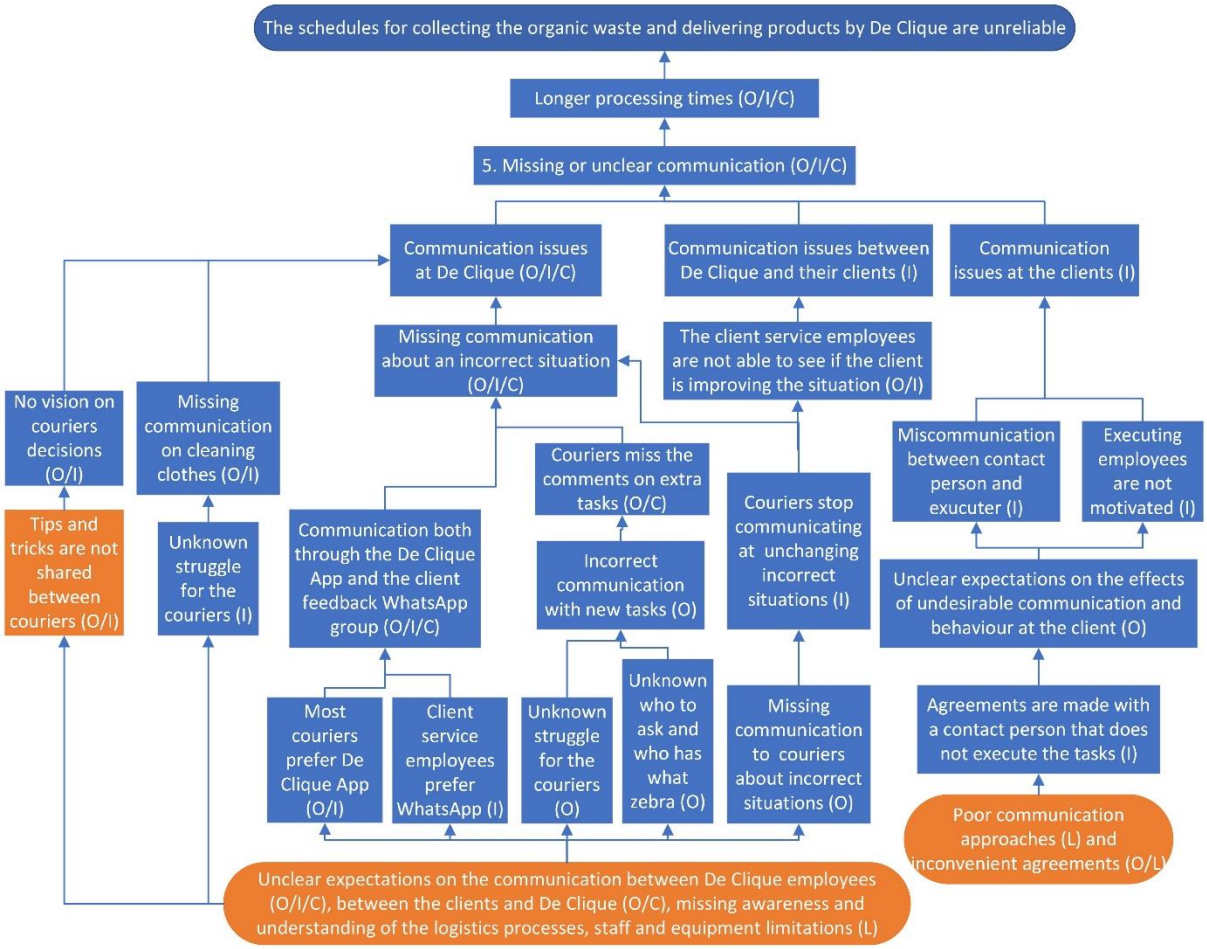

Figure 11. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the internal business process perspective.

Another cause for problems with the SmartRoute schedules is the problem of not having a visualisation of the tasks made by the supervisors of the couriers. The primary cause for this problem and what problems this creates for the schedules in SmartRoute are discussed in measure 6. The problem of no or incorrect processing times in SmartRoute is not detected before, because this data is not collected, and this is required to be stored manually. Currently, the scheduled processing time of the client is a standard ten minutes as this is the average processing time. When a client takes longer than this, this is not added to SmartRoute, and this automatically delays their shift. Adjusting these processing times of the clients is also not possible because of the settings of SmartRoute as the primary cause for this problem appeared

to be a bug in SmartRoute that prevented adjusting or not updating the processing times once it is in the system.

SmartRoute creates preferred departure times for the couriers to use, but these preferred departure times are not communicated and for that reason not used. This problem is also not detected before, as the data is not collected, and it is required to store it manually. Another primary cause is the unclear expectations regarding the communication between The Company employees. The planner that creates the schedules is not the supervisor of the couriers and for that reason does not manage the couriers. It is expected that the planner communicates these different departure times for the correct use of the SmartRoute schedules. The supervisors of the couriers are not aware of different departure times created in SmartRoute and are not informed of the different scheduled departure times and for that reason do not communicate this to the couriers.

Measure 5: Percentage of standardised communication that is clear to both sides. The clients that do not follow the agreements that are made are causing longer processing times at the client. Some causes for this are created at The Company, others at the client, and others between The Company and the client. The Company created the causes of missing communication about an incorrect situation at a client. The reason for that is unclear communication through The Company app and the client photo feedback group chat. The couriers explained that The Company phone makes it easy to comment on specifications in both the group chats and The Company app, whereas some couriers prefer The Company app as they are already using this app with the clients. Opening and communicating in group chats is more effort for the couriers. According to the supervisors of the couriers, the reason why the option to comment in The Company app is not deleted from this app is as it requires an investment as the app is created by an external party and there is no possibility of customisation. Communication is also missing when couriers stop communicating when they do not see the situation changing and do not know what the problem for that is. When client services are contacting the client to try to solve the problem, and the problems are not solved fast and the couriers are unaware of this contact, the couriers do not know if the problem is that the client is not contacted or that the client decides not to solve the problem. When the same problems occur multiple times with the same clients or the situation is not fixed and the couriers do not know why the situation has not improved, some couriers stop notifying the problem as the situation is not changing from their perspective and they do not feel heard.

The cause for the communication problem where employees request adjustments for the couriers through the courier group chat, is that they are not aware of the struggle they create for the couriers. This problem is not known to the employees as the couriers have not made comments about it. What is also partially a cause for this problem is that the request comes from an employee that does not know who the request is for. Another cause that makes communication difficult is that it is unknown which one of the “zebras” a courier took that day and is available on.

The causes of unclear communication regarding cleaning the couriers’ clothes are mainly because it is unknown to the supervisors of the couriers that the couriers are struggling with having an extra clean jacket to present themselves clean to the clients. The tips and tricks for the couriers by the couriers are not shared. Some tips that could be shared are when couriers sometimes know ‘shortcuts’ that are not notified in the SmartRoute app as the vehicle models goupil G4 and G4L fit on a bike lane and SmartRoute looks at the car route. SmartRoute can select bike lanes as it uses Google Maps, but as the goupils are not allowed on all bike lanes,

the settings cannot be set to biking routes. When the couriers do not follow SmartRoute, the supervisors of the couriers do not have a vision of what the couriers are doing and where and why they decide not to follow SmartRoute. The primary cause for these communication issues at The Company is that there are unclear expectations regarding the communication between The Company employees.

The detected causes for the communication issues at the client are the miscommunication between the contact person and the executor of the agreements and the executing employees are not motivated to do the extra work that is requested with these new agreements. These causes are created by the fact that the contact person that creates the agreements with The Company is not the same person that puts the organic waste in the crates at the assigned location. The primary cause of this is the fact that the expectations from the involved parties are not clear to the other involved parties.

Measure 6: Percentage of standardised visualised tasks of the logistics processes. One problem with the SmartRoute schedules is that the schedules are not optimised and couriers often miss the timeslots because the couriers do not start driving at the scheduled time from SmartRoute. Their schedules in SmartRoute are the most important ones as they implement the most reliable data, but these schedules are not prepared for this change and do not get adjusted based on this, which means that starting at the current times makes the couriers miss the early timeslots. The causes of the couriers not leaving in time are that it often occurs that the couriers still need to fill up their cars with the empty crates they need to bring, they need to collect the orders they have, they make and drink coffee, they need to change their clothes, they need to grab their “zebra” and put it in the right settings, grab the correct booklet, chat a bit with the other couriers, adapt irregularities or adjustments that are made to their shifts, and other small and unpredictable problems need to be solved by the couriers in the morning. This means that the morning tasks are not considered for the schedules. The tasks that are not managed by the supervisors are tasks created by the couriers as currently, couriers are making their own decisions on how to do the tasks. The reason why the couriers are making their own decisions is that there is no clear view of the tasks for the courier. The supervisors are unaware of the time it takes to do these tasks in the morning. The supervisors of the courier never had the time or made it a priority to start visualising the tasks. As The Company is a start-up, they always need to prioritise their tasks as the workload is high and visualisation was not prioritised before. What creates a difficulty in these visualisations is that there are always exceptions as it does not always go as planned. For that reason, only the standardised tasks require to be visualised.

3.1.3 Innovation and Learning Perspective

Figure 12 shows what the detected causes are when looking at the innovation and learning perspective and is expanded in Appendix J. The causes for the different SmartRoute problems and the missing visualisations of the standardised logistics processes are already discussed in Section 3.1.2 and visualised in Figure 10. The measure of expanding options The Company is prepared for is for that reason the only measure of the innovation and learning KPIs that is implemented in Figure 12 and is further explained in this section.

Measure 7: The number of expanding options The Company is prepared for. The first detected cause for the problem of having no preparation for expanding the option of The Company in the scope of this research is because currently there are already not enough couriers to do the work in the scheduled time. This requires some couriers to work longer shifts and The

Company employees to help with the regular courier tasks. The problem of not having enough employees for the work is caused by a higher workload as more CO_2 should be saved through the increase of organic waste that is collected by The Company. The causes for the increased saved CO_2 per month are further explained in measure 8.

Another cause for no preparations for expansion has created the phase that there are currently only three vehicles at The Company and therefore only three couriers can drive each day. The primary cause for this is that there is a delay in ordering electric vehicles in the sizes The Company prefers. This is a cause that is out of reach for The Company and its assumptions are made on how to still improve the current situation with this problem. Another cause for not being ready for expansion is that they have not done the required research to find the required preparations for expanding. This research found both the bottlenecks and the limitations of the logistics processes that require to be tackled to prepare for expansion.

3.1.4 Financial Perspective

Figure 12 shows what the detected causes are when looking at the financial perspective and is expanded in Appendix J. The causes shown in this figure are further explained in this section.

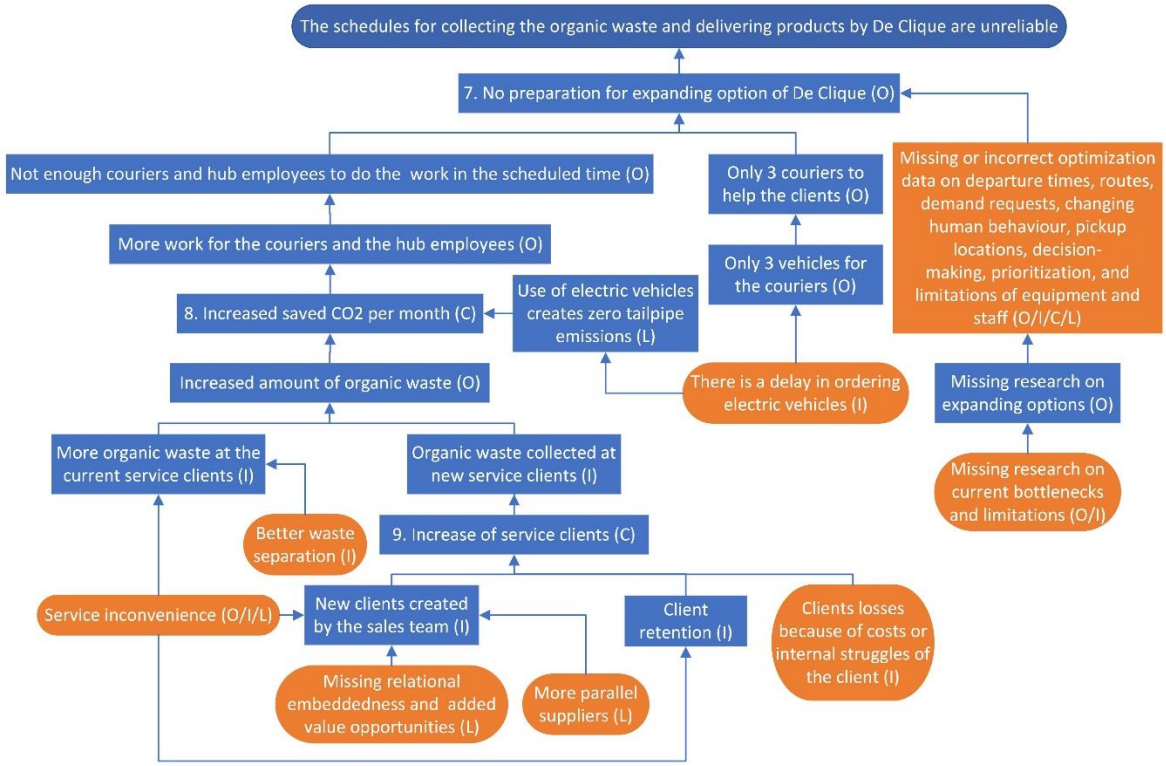

Figure 12. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the innovation and learning perspective and the financial perspective.

Measure 8: Percentage of increased saved CO_2 per month. As the scheduled amount of collected organic waste is not the actual amount of collected crates, an increase in waste could also be created by the same clients with better organic waste separation or more organic waste at these clients, and from organic waste from new service clients are causes for more organic waste at The Company, what causes more saved CO_2 for The Company. The percentage of increase in service clients is a cause for organic waste collected at new service clients. The causes for the increase in service clients are further explained in measure 9.

Measure 9: Percentage of increase of service clients. The causes for the percentage of increase in service clients are created by both the causes that create new clients and create client losses. New clients are created because the service clients that are helped each week are based on the clients the sales team is adding each week. A detected cause of client losses is the price increase because of inflation, which made clients more aware of their costs. Another cause is that the costs of waste collection are more than if organic waste is thrown with general waste. It could also be because of internal struggles with the organic waste separation system, other financial struggles of the client, change of mind when the owners change through acquisitions, lost sight of the benefits, and some clients felt like they did not generate enough waste but still needed to pay for the minimum of five crates, even when it could be scheduled to pick up less often.

3.2 Secondary Research Causes

This section investigates the causes that the literature suggests for the detected problems in the logistics processes based on similar case studies as The Company. These causes are also researched from the four perspectives of the BSC. The causes for the detected problems in these aspects are discussed. The figures from Section 3.1 are expanded here with the secondary causes from the literature research (L). To find the causes, a literature review is done to identify the causes for unreliable driving hours related to the KPIs, by using the Web of Science and the ScienceDirect databases and using the search terms from Table 7. The search terms are created based on the main elements of creating transportation schedules that consist of transport infrastructure, demand requests and the flow of delivered and collected products, which should be implemented in tactical scheduling models. The transport infrastructure consists of transport infrastructure, driving and service instructions, couriers, vehicles and their capacities and other service and efficiency criteria. The demand requests consist of the characteristics of the couriers, production, consumption, and transportation quantities. The times of departure, vehicle capacity, routes and demand requests are the most important elements to create the strategic analysis (Benjelloun & Crainic, 2009) and therefore also help create the required search terms. Some of the articles found in this literature review are also used for the literature review in Section 4.2.

The search terms used included the synonyms of the topic through different combinations of words, excluding terms that are too general, including both American and English spellings, and singular and plural forms. After searching and gathering the articles, the literature from the databases is studied and duplicates are taken out of the gathered articles. In this research, only peer-reviewed articles are used to guarantee high quality and coherence of the topics and sources, which is typical within logistics (e.g., Carter & Liane Easton, 2011; Mangiaracina, Song & Perego, 2015; Meixell & Luoma, 2015; Touboulic & Walker, 2015). The articles are selected based on title and abstract and excluded when the articles are outside the management or supply chain & logistics field of study, or not related to the topics of city logistics transportation optimisation courier or urban freight transportation optimisation courier. The next step is to check the relevance by reading the full text and the relevant information, implications and limitations on the topic from these articles to answer the research question of this chapter.

Search terms	Search results	Screened on title and abstract	Full-text review
"City logistics" AND "process route" AND "schedule analysis"	28	8	6
"City logistics" AND "transportation optimisation" AND courier	10	4	2
"Urban freight" AND "transportation optimisation" AND courier	2	1	1
"Willingness-to-pay" AND "service client"	8	5	3
"Customer behaviour" AND "service client" AND intention	12	5	5
Logistics AND "route agreement" AND scheduling	22	6	2
"Client satisfaction" AND problem-solving	10	6	4
"Service logistics" AND "process quality" AND "client satisfaction"	4	2	2
"Route choice uncertainty" AND transportation AND "city logistics"	2	1	1
"City logistics" AND "electric freight vehicles" AND barriers	19	10	6
"Last-mile logistics" AND "process challenges"	40	19	15
"Job satisfaction" AND "causes engagement" AND delivery	4	4	3
"Job satisfaction" AND courier	6	5	3
Reasons AND "client engagement"	10	6	4
Growth AND "steps start-ups"	20	6	2
"Client relationships" AND "logistics processes" AND service	28	6	2

Table 7. The search term results with the total amount of beneficial articles for the literature research for Section 3.2 and Section 4.2.

3.2.1 Customer's Perspective

Figure 9 also shows the detected causes found through the literature research of the problems from the customer perspective. This section explains the effects of the literature causes from this figure.

Measure 1: Percentage of delayed services based on the indicated timeslots. When couriers are sick or have holidays, the job demand increases which creates limited staff (Peter, 2020). The causes for no on-time service and deliveries are when the transport infrastructure, demand requests and the flow of delivered and collected products are incorrect or missing and when the elements for the strategic analysis are missing (Benjelloun & Crainic, 2009). As most decisions are made based on an uncertain situation and under time restrictions, the couriers' travel time characteristics are different from the expected ones (Avineri, & Prashker, 2006). This means that technical and physical elements, but also human behaviour has a significant impact on the incorporation and cooperation between various stakeholders and the schedules. The human factors as courier decisions for the routes are often not implemented or considered when it comes to improving the schedules (Gruler, Armas & Juan, 2016). According to Arvianto and others (2021), the primary causes of problems in city logistics deliveries are urban

expansion, traffic jams and environmental issues, and the infrastructure, the equipment, the policies and immaterial infrastructure are the main aspects of concern. According to Gayialis, Kechagias and Konstantakopoulos (2022), the primary causes of problems in city deliveries are the pickup locations, traffic issues, and missing information for optimal routes. When looking at different processing times of clients in cities, research by Holguín-Veras and others (2011), that the processing times rise in the regular daytime and reduce during off hours.

The environmental benefits of electric vehicles are that the vehicles produce zero tailpipe emissions (Anosike et al., 2021). Electric vehicles can save up to 30% of emissions compared to diesel vehicles, make less noise, and expected innovations improve sustainability even further (Ehrler, Schöder, & Seidel, 2021). The causes that create the challenges of making use of electric vehicles are the operational barriers with the focus on its small driving range, the infrastructure barriers with the focus on the available charging stations, and the battery technology that has a low energy density (Anosike et al., 2021).

Measure 2: Percentage of clients that pay the actual service costs. The costs of each client are calculated based on what it costs The Company to provide the services for their clients. One of the causes of the decrease in clients' willingness to pay these costs is because of service inconvenience. Service inconvenience is linked with less client satisfaction, behavioural motive and verbal recommendations (Jiang, Yang & Jun, 2013), requests to stay, and the background on the relationship of the service company (Saha et al., 2021). Another cause for the client's willingness to pay the costs are sufficient conditions with the service that consists of responsiveness and quality commitment (Lassala, Carmone & Momparler, 2016). Another cause is the client perception of the service which consists of price fairness perception, customer value, and product/value quality (Rondán-Cataluña, & Martín-Ruiz, 2010). According to the literature that is used in the research by Björklund and Johansson (2018), the main cost drivers for city logistics processes are the employees (Browne, Allen & Leonardi, 2011; Lin, Chen & Kawamura, 2014; Rao et al., 2015), electricity (Lin et al., 2014), growth of administration and management (Marcucci & Danielis, 2007; Escuín, Millán & Larrodé, 2012), lease (Lin et al., 2014; Zhou & Wang, 2014) and maintenance for the equipment, vehicles and the building (Lin et al., 2014). When it comes to the maintenance costs of electric vehicles, repair costs could become very large (Quak, Nesterova & Von Rooijen, 2016; Paddeu et al., 2018).

Measure 3: Percentage of not followed agreements. The clients' contribution to the relationship with brands is an important factor in the satisfaction of this relationship (Sung & Campbell, 2009). The connection between effort and satisfaction relies upon the communication channel (email or telephone) and the needed client effort (low, moderate, intense) (Ardelet & Benavent, 2023). This shows that when the clients need to do plenty of effort to acquire a reaction to their questions or comments, this causes less satisfied clients (Dixon, Freeman & Toman, 2010). When looking at the communication quality with clients, the causes for less satisfied clients are created based on four dimensions: problem-solving, empathy, enthusiasm, and friendliness. Where the problem-solving depends on the employees' manners and effectiveness when handling customers' requirements or problems, empathy depends on being able to look at the perspective of the client (Kuo, Chen & Lu, 2012), enthusiasm depends on determined and disciplined motivation (Peale, 1967), and effectiveness depends on a mood of being positive and happy to people (Kuo, Chen & Lu, 2012).

3.2.2 Internal Business Process Perspective

Figures 10 and 11 also show what the detected causes from the literature research are when looking at the internal business process perspective. The literature problems shown in these figures are further explained in this section.

Measure 4: The number of SmartRoute schedule problems. In Section 2.3.2 there are five SmartRoute problems explained but in this part of the research, literature is researched to find the different aspects that impact the schedules, and especially the uncertainties that exist when it comes to creating a schedule and being able to follow this schedule.

The Company is operating for most clients in and around the city of Utrecht, which contains a population of 367,984 people (GemeenteUtrecht, 2023). As this is the number of people living in the city and numerous people commuting to the city, it is not a surprise this city has jammed roads. These traffic jams disrupt the traffic flow, which increases the incident frequency and disrupts the traffic flow even more. This is shown to be one of the clear causes of uncertainties in the couriers' schedules (Lomax & Schrank, 2003). A study by Avineri and Prashker (2006) showed that providing couriers with information on travel times does not always increase the tendency for couriers to decrease their driving hours. It also showed that providing couriers with fixed information about the anticipated travel times eliminates the longest driving hours of the couriers. For the planners to comprehend this vulnerability to uncertainty, the information-receiving process helps to produce improved decision-support methods and tackle the different employee experiences due to the different employee experiences. The causes for city logistics challenges are according to Perboli and Rosano (2018) the limitations of vehicle capacity, time windows, and the arrangement of the routes to the clients. Other causes for the challenges of schedules in cities are the tasks that are assigned to the couriers, the routes of the courier, the geographical location, the freight capacity, and communication expectations. These challenges are decisive for the success of the schedules.

Measure 5: Percentage of standardised communication that is clear to both sides. The research by Rashidin, Javed, and Liu (2020) shows that awareness and understanding in the workplace have plenty of impact on employee engagement and job satisfaction. Their causes for less employee engagement are a decrease in the communication of the employees and an organisational mindset that relies on analytical control and knowledge. Other causes of less employee engagement and job satisfaction, is created increasing job demand (Nguyen et al., 2018) and a lack of job resources (Nguyen et al., 2018; Warr, & Inceoglu, 2012). Job demand is the physical and mental effort that a job requires, job resources are the required resources that assist the employees to obtain the job objectives (Demerouti et al., 2001). This means when job demand increases and job resources decrease, there is limited staff and equipment to do the required work. Causes for low client engagement could be the poor communication approaches from the company with its clients as this impacts their motivation. A company that creates unfavourable working agreements forgets to implement the client's goals and principles, does not empower self-dedication, and does not handle socially appropriate, has less engagement from its clients (Peter, 2020).

Measure 6: Percentage of standardised visualised tasks of the logistics processes. The Company has not taken the time before to visualise standardised tasks of the logistics processes and searching for the causes of this decision is difficult. None of the analysed articles shows a case study of a company that is in the exact situation to provide the reasoning

for not having taken the time to do this task. It was not a priority before and there is a lack of staff for this task. Visualising logistics processes is a communication tool that helps with understanding the logistics processes and creating relevant reasoning (Johansson, Cronquist & Kjellin, 2007). This means that not having the visualisation makes it difficult to understand the logistics processes and create relevant reasoning. The only and primary cause is found through interviews in Section 3.1.3.

3.2.3 Innovation and Learning Perspective

Figures 10 and 12 show what the detected causes from the literature research are when looking at the innovation and learning perspective. The causes for the different SmartRoute problems and the missing visualisations of the standardised logistics processes have already been discussed in Section 3.2.2. This section looks at the causes of the expanding options The Company is prepared for.

Measure 7: The number of expanding options The Company is prepared for. When researching the expanding options for The Company, internal mobility is required to adapt the expanding options. Picken (2017) showed that the cause for less internal mobility is that the crucial steps of maintaining profitable growth are familiar but not visible to most start-ups. The research by Wagner (2021) showed that supply chain resources and possibilities are critical in the growth stage of a start-up. When it comes to more specific causes for missing expanding options, the primary causes are explained in Section 3.2.1 and Section 3.2.2. This means that the causes of no preparation for expansion are missing or incorrect optimisation data on departure times, routes, demand requests, pickup locations, decision-making, prioritisation, limitations of equipment and staff, and changing human behaviour.

3.2.4 Financial Perspective

Figure 12 also shows what the detected causes from the literature research are when looking at the financial perspective. The literature causes shown in this figure are further explained in this section.

Measure 8: Percentage of increased saved CO_2 per month. The use of electric vehicles is producing zero tailpipe emissions (Anosike et al., 2021) and these are the logistics processes that fit in the scope of this research. The increased saved CO_2 per month is in Section 2.3.4. is calculated through a life cycle assessment that includes processing the organic waste after it is collected by the couriers and delivered to The Company. Researching other potential ways to increase the saved amount of CO_2 per month is out of the scope of this research.

Measure 9: Percentage of increase of service clients. Measure 2 already showed how service inconvenience is a cause for the decrease in willingness to pay to make (more) use of a service (Jiang, Yang & Jun, 2013). According to Mawdsley and Somaya (2021), the causes for less customer retention rate are created when there is no clear link between relational embeddedness and company growth. As a startup supplier, new opportunities are created from their relational embeddedness with their clients that make use of their services and/or buy their products (Elfenbein & Zenger, 2017). The research by Mawdsley and Somaya (2021) also shows that clients are less committed to staying when they initiate more parallel suppliers. Another cause for less customer retention is the lack of added value. A supplier requires added values to differentiate themselves from its competitors, like trustworthiness, common norms, and resources that enhance the total created value of their clients (Dyer & Singh, 1998; Elfenbein & Zenger, 2017; Jia, 2013). This means that the range of the different added value

opportunities is the most crucial factor for company growth as it symbolizes the scope of benefits for the future (Mawdsley & Somaya, 2021). Clients appear to be more accepting of inconveniences in case of a more sustainable and cheaper option (Buldeo Rai, Verlinde, & Macharis, 2019).

3.3 Conclusion

Both the causes of the differences between the current and the desired situation from the used research methods are the bottlenecks in the logistics processes. The primary and secondary causes are the bottlenecks shown in combination with the measures of the KPIs created in Section 2.2, in Table 8. The detected bottlenecks are also linked to limitations that determine the current situation. The limitations consist of the clients', availability and traffic limitations. With the clients' limitations of not following agreements, no notifications of available crates, inefficient crate locations, and miscommunication with the client, The Company is dependent on the behaviour of its clients. The behaviour of these clients can be managed but it stays out of reach of The Company, which does create limitations when it comes to solving these bottlenecks. The availability limitations are created by the availability of required equipment and staff, which also limits the potential to improve the current logistics processes. The traffic limitations are connected to urban traffic and traffic jams, which The Company can only try to avoid but not influence. The solutions for the causes that fit the scope of this research to solve the unreliable driving hours of couriers take these limitations into account.

Table 8 shows detected causes from both primary and secondary research that create the unreliable driving hours of couriers. Causes that are both detected through the primary research and also in the secondary research are causes that are given priority and are tackled during this research as both the original data from this research and the data that is collected by other researchers show the same problems and results. The findings from the primary research are therefore in some cases supported by the secondary research. The first cause that is detected in primary and secondary research is the inevitable uncertainties. The uncertainties through for example the weather and traffic happen in the case of The Company but impact the logistics processes everywhere and therefore in similar cases. The limited driving range and low energy dense batteries are a cause that is familiar in the literature as it is still a new technology, and several problems are known and shown in the case of The Company.

Other causes found in both primary and secondary research are the missing or incorrect optimisation data on departure times, routes, demand requests, pickup locations, decision-making, prioritisation, limitations of equipment and staff, changing human behaviour, missing communication and route and task agreements. These are the aspects that improve the schedules for the logistics processes as shown in the literature, and as this is the first research on how the logistics processes of The Company can be improved, these aspects are currently not optimised yet and literature shows that research and adjustments are required. The last cause found in both primary and secondary research is service inconvenience. Both the quality and the convenience determine the success of a service and therefore the number of clients who are interested in it.

KPI	Primary and secondary causes that require tackling
1. Service at a full-on-time rate	○ Data requires to be stored manually (O) ● Regular daytime deliveries (L) ● Inevitable uncertainties (O/L) ● Limited driving range and low energy dense batteries of electric vehicles (O/L) ● Incorrect transport infrastructure, demand requests and flow of delivered and collected products (L) ● Changing human behaviour (L) ● Staff limitations (O/I/L) ● Unclear expectations on communication and tasks for the involved parties (O/I/C)
2. Costs per client	○ Driving to the client takes more time (O/I/C) ○ Increase costs for employees, electricity and maintenance for the equipment (L)
3. Client satisfaction	● Unclear expectations on communication and tasks for the involved parties (O/I/C) ● Dissatisfaction with the relation, needed effort and service inconvenience (L)
4. Scheduled variance	○ Both The Company and their clients like and dislike the actual number of crates with the current situation (O/I) ● SmartRoute had a bug that prevented adjusting or not implementing the processing times (O/C) ● Missing or incorrect processing times for clients in the schedules of SmartRoute (C) ○ Data requires to be stored manually (O) ● Scheduled departure times are not used (O/C) ● Unclear expectations on communication and tasks for the involved parties (O/I/C) ● Unreliable route and task agreements (O/L) ● Equipment limitations (O/I/L) ● Different employee experiences (L) ○ The applications to receive the orders from clients and to communicate these orders to the employees are not connected to SmartRoute (O)
5. Employee and client engage -ment	● Unclear expectations on communication and tasks for the involved parties (O/I/C) ● Missing awareness and understanding of logistics processes (L) ● Staff and equipment limitations (L) ● Poor communication approaches (L) and inconvenient agreements (O/L)
6. Time to productivity	● No priority/time to clarify the tasks (I) ● Missing communication tool (O/I/L)
7. Internal mobility	○ Delay in ordering electric vehicles (I) ● Missing research on current bottlenecks and limitations (O/I)

	● Missing or incorrect optimisation data on departure times, routes, demand requests, pickup locations, decision-making, prioritisation, limitations of equipment and staff, and changing human behaviour (O/I/D/L)
8. CO_2 reduction rate	○ Better waste separation (I) ● Service inconvenience (O/I/L)
9. Customer retention rate	● Service inconvenience (O/I/L) ● Relational embeddedness and different added value opportunities (L) ○ More parallel suppliers (L)

Table 8. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) for the differences between the current and desired situation on the measures of the KPIs. The causes that fit the scope of this research and are tackled are presented by the black bullet points and the causes that do not fit the scope of this research and are not tackled are presented by the white bullet points.

4. Solutions for Reliable Driving Hours

This chapter provides potential solutions for the causes of the research problem that take into account the clients', availability and traffic limitations described in Section 3.3. Section 4.1 provides the primary research solutions for the causes, Section 4.2 provides the secondary research solutions for the causes, Section 4.3 provides the advantages and disadvantages of these solutions, and Section 4.4 concludes this chapter by presenting the feasibility of the solutions based on both the most impact and the easiness to implement. This chapter answers the question: **What changes need to be made to improve the current situation of The Company?** By answering the following sub-questions:

4.1 What improvements of the logistics processes from primary research can be done?
4.2 What improvements of the logistics processes from secondary research can be done?
4.3 What are the different advantages and disadvantages of the improvement options in the logistics processes?

As city logistics is defined as the process of improving the logistics activities in cities while implementing the different aspects of economy, environment, society and safety (Taniguchi et al., 2001), city logistics is used to research the solutions for the different aspects that require adjustments according to Chapter 3, see Table 8. Some solutions are detected through observations, content analysis and interviews with the employees, which is primary research, and other solutions are suggested by the literature, which is secondary research. The distinction is made between primary and secondary research as the primary research solutions are specific for The Company, but are not guaranteed to work as there is no previous research to underpin the impact and the secondary research solutions work for similar cases, but that does not guarantee the expected impact in this case as small differences could create large differences in the impact. The causes that are tackled in this chapter are shown as black bullet points in Table 8 and the causes that were not tackled as they do not fit the scope of this research are distinct from them through the white bullet points. After discussing the solutions, the advantages and disadvantages of each solution are considered, as well as the opinions of the employees involved in the logistics processes to validate solutions. For the implementation plan, the impact and ease of implementation are also considered.

4.1 Primary Research Improvements

This section investigates solutions for the causes based on primary research. Some causes cannot be tackled in this research when it does not fit the scope of this research. These causes are up for further research, see Section 6.3. The solutions consist of adjustments that are required from the couriers, the planners, the supervisors, the client services employees, SmartRoute, and the clients. Table 9 shows the created solutions from the primary research, which party should adjust, and what cause is tackled by this. Each of these solutions is explained in detail in the following sections on how they tackle the causes of Table 9 and what helps to solve the unreliable driving hours of the couriers.

4.1.1 Implementing the Correct Processing Times

During this research a bug in SmartRoute is detected, as it is not possible to adjust the processing times, sometimes the standard ten minutes of processing time is not implemented in the schedule, and sometimes the standard ten minutes of processing time is not visible in SmartRoute. When couriers take longer to help certain clients because of the agreements that are made, the correct average processing time should be implemented in the schedules in SmartRoute. The solution for this bug should be made by SmartRoute and implementing the

correct processing times to tackle the problems of unreliable route and task agreements and missing or incorrect processing times for clients in the schedules of SmartRoute. This solution also tackles delayed services and through that, it tackles the problem of incorrect demand requests and incorrect flow of delivered and collected products.

Solution	Involved parties	Solved causes
Implementing the correct processing times	Couriers, planners & SmartRoute	SmartRoute had a bug that prevented adjusting or not implementing the processing times, Missing or incorrect processing times for clients in the schedules of SmartRoute, Unreliable route and task agreements, Incorrect demand requests & Incorrect flow of delivered and collected products
Implementing the average/actual departure times	Couriers, planners & SmartRoute	Missing or incorrect departure times, Scheduled departure times are not used, Unreliable route and task agreements, Incorrect transport infrastructure, demand requests and flow of delivered and collected products & Missing or incorrect routes
Adjust client timeslots	Planners & client service employees	Incorrect demand requests & Incorrect transport infrastructure, demand requests and flow of delivered and collected products
Minimise internal struggle at the client	Couriers & client service employees	Dissatisfaction with the relation and needed effort & Service inconvenience
Training for clarified expectations on communication and tasks, and responsibilities	Couriers, planners, supervisors, client service employees and clients	Unclear expectations on communication and tasks for the involved parties, Poor communication approaches and inconvenient agreements, Missing or incorrect pickup locations, Service inconvenience, Changing human behaviour, Missing awareness and understanding of logistics processes & No priority/time to clarify the tasks

Table 9. The solutions from primary research with the impacted/involved parties and the tackled problems/causes.

4.1.2 Implementing the Average/Actual Departure Times

Through the content analysis of the departure times of the couriers, it is found that the couriers do not leave at the scheduled time due to unscheduled morning tasks. Observations and interviews suggest taking into account the average time it takes the couriers to perform these tasks and incorporating them into the schedules to improve them. Observations and interviews showed that some morning tasks, such as changing clothes, grabbing equipment and product orders, and drinking coffee cannot be removed. Preparing the vehicles for the next shift can be done the day before, but it may be difficult to prepare the vehicle for another courier. Order picking should be done in the morning due to the cooled products. The maximum number of crates vehicles can collect and deliver is decreased by the number of product deliveries because of the space occupied by the cooling boxes and red crates. This means that a courier with a vehicle filled with the maximum number of crates and with products to deliver needs to unload a part of the crates, creating unnecessary work. The data on the current departure times in Appendix G shows that the current average departure time is 8:44 which should become the new scheduled departure time. This data should be continued to be collected and adjusted when it changes. Implementing the average/actual departure times addresses the

problems of not using the scheduled departure times, missing or having incorrect departure times, unreliable route and task agreements, missing or incorrect routes and incorrect transport infrastructure, demand requests and incorrect flow of delivered and collected products.

4.1.3 Adjust Client Timeslots

The content analysis suggests The Company should investigate the timeslots that are created and whether they could become less specific in what is beneficial for the route and task agreements. By creating a larger timeslot, the chances of a courier being able to help a client the first time they visit them could be increased, shortening their routes. This also eliminates the possibility of a courier wanting to deviate from the SmartRoute schedule by helping a client the first time they visit them. Adjusting the indicated timeslots could therefore tackle the problem of delayed services and, as a result, address the problem of incorrect demand requests and incorrect transport infrastructure, demand requests and flow of delivered and collected products.

4.1.4 Minimise Internal Struggle at the Client

While providing clean and empty organic waste crates to clients who have incorrectly sorted their waste may temporarily solve the problem of the internal struggle, it does not address the root cause of the problem. The proposed solution may also create a disincentive for clients to properly separate their waste, as they know that their waste is collected regardless of whether it is correctly sorted or not. This solution could increase the operational costs which the client should be charged. A more sustainable solution is to educate and encourage clients to properly separate their waste at the source through workshops. This requires a long-term investment in education and awareness-raising, but it ultimately leads to more efficient and effective waste management and improves the company's reputation. These solutions help to solve the problem of client losses because of the internal struggle of incorrect waste separation and tackle the problem of dissatisfaction with the relation, needed effort and service inconvenience.

4.1.5 Training for Clarified Expectations on Communication and Tasks, and Responsibilities

While clarifying the responsibilities of creating and checking the pickup descriptions can help improve the current task agreements, it is important to ensure that there is clear communication and coordination among the employees that are involved. Assigning the responsibility solely to the couriers may not be sufficient, as they may not have the necessary information to create accurate pickup descriptions. A more effective approach is to create a collaborative process that involves the relevant employees, including client service employees, sales employees, planners, and couriers. This ensures that everyone has a clear understanding of their roles and responsibilities and that there is clear communication and coordination throughout the process.

The client service employees or the sales employees discuss the pickup location and the pickup descriptions with the clients and communicate these to the planner to adapt them in SmartRoute and the courier handbook. The couriers need to understand and use the pickup descriptions and they realise if the pickup descriptions are missing. The couriers should be responsible to make comments and adjustments on the incorrect or missing pickup descriptions. In a situation with inefficient crate locations with no solution for better locations for the crates, the processing times increase and need to be adjusted in the schedules of SmartRoute. By tackling the causes of the unreliable driving hours, The Company will be able to reposition itself to improve the service of the further located clients, which makes it easier

to improve the reliability of the schedules. Clarification of the responsibilities and the communication addresses the problem of poor communication approaches and inconvenient agreements, missing or incorrect pickup locations and service inconvenience.

Providing clear expectations for couriers through a courier handbook helps to improve communication and ensures that everyone understands their roles and responsibilities. However, the courier handbook should not be a static document, but rather a document that is updated regularly based on feedback from couriers, supervisors, planners, and clients. In addition, it is important to ensure that the couriers, planners, supervisors, and client service employees have the necessary training and support to make well-reasoned decisions. It is important to recognise that changing human behaviour is complex and requires more than a clarification of the expectations on communication and tasks. The underlying issues like motivation and persuasiveness should be addressed through training. This may involve providing additional training on communication and problem-solving skills, as well as regular check-ins and feedback sessions where everybody involved in the logistics processes are present. The clarification of the expectations on communication and tasks from the clients should be mentioned when creating the agreements with the clients of The Company. This helps with solving the clients' problem that does not follow the agreements that are made and help with creating convenient agreements. The solution of clarification of expectations on communication and tasks also solves the problems of service inconvenience and changing human behaviour.

Visualisation of the standard tasks in the logistics processes solves the problem of the missing knowledge on the tasks of the couriers for both the couriers themselves, their supervisors and for the planners. The visualisation of the standard tasks in the logistics processes is done through collecting observations, interviews and content analysis to create awareness of the tasks, the duration of these tasks, and implement these tasks, also the non-delivery related tasks, in the schedules of the couriers. The visualisations that are created of the logistics processes of the couriers are shown in Appendix H, as this research tackles the problem of not prioritising to visualise the standard tasks. The visualisations also include the extra required information for the couriers to understand what is expected from them. It also shows the regular struggles the couriers face and the new couriers should learn from it. It is considered here that there are always unforeseen tasks that need to be done, but this is outside of the scope of this research and that is the reason why these tasks are not considered here. This solution helps with tackling the problems of missing awareness and understanding of the logistics processes and the unclear expectations on communication and tasks for the involved parties. It also helps with changing human behaviour, as the visualisation of the tasks can serve as a reminder and guide for the couriers to follow the standard tasks consistently.

4.2 Improvements from the Literature Research

This section investigates the solutions for the prioritised causes from Section 3.1 that are not addressed in Section 4.1 and the prioritised causes from Section 3.2 through literature research. The same methodology as used in Section 3.2 is adapted to find solutions for these causes. Some articles that are used in Section 3.2 also provided solutions for the problems at The Company. However, some additional literature research is required using new search terms to find the solutions that fit within the scope of this research. Table 10 presents the extra search terms needed to find the solutions.

Search terms	Search results	Screened title and abstract	Full-text review
"Effective communication" AND "logistics processes"	24	7	4
"City logistics" AND "behaviour optimisation"	31	5	4
"Urban freight transportation" AND "logistics processes" AND optimisation	24	13	7
"City distribution" AND integration AND "logistics optimisation"	10	8	7
Improve AND "courier service" AND convenience	4	1	1
Decisions AND "freight transportation" AND "city logistics processes"	40	13	9
"Effective location" AND schedule AND "city logistics processes"	9	4	2
"Recruitment methods" AND attraction	36	9	6
Compare AND optimisation AND "electric vehicles" AND "logistics schedule"	23	7	4

Table 10. The search term results with the total amount of beneficial articles for the literature research for Section 3.2 and Section 4.2.

Some causes of the secondary research of Chapter 3 cannot be tackled in this research when it does not fit the scope of this research. These causes are up for further research, see Section 6.3. The solutions identified from the secondary research involved adjustments that need to be made by various parties that are involved in The Company's logistics processes, including couriers, planners, supervisors, client service employees, and clients. Table 11 summarises these solutions, specifying who should make the adjustments and which causes they address. These solutions are further elaborated on in the following sections.

4.2.1 Minimise Internal Struggle at the Client

Creating added value solves the problem of service inconvenience. Research by Mawdsley and Somaya (2021) shows how relations with clients under certain circumstances, like an increased relational commitment from clients and cross-servicing potential, can be beneficial for creating more company growth. Relational commitment increases through the clients' satisfaction with the company's knowledge, their potential and other characteristics. Relational commitment is also created when it is costly to change to other businesses (Williamson, 1985). Relational commitment is also created through a company's history of meeting clients' demands. Cross-servicing potential is described as the potential added value clients receive from making more use of a company's services or products (Mawdsley & Somaya, 2021). The Company is already creating this by charging less for every extra crate after the minimum of five crates is reached and charging no shipping cost for product deliveries when the clients are making use of their waste-collecting services at the same time. The cross-servicing potential creates important advantages when it comes to retaining clients (Chatain, 2011). This cross-servicing potential could create more business growth as obtaining a client in one area (e.g., the waste collecting service) increases the chances of obtaining this client in another area (e.g., the product delivery service). The Company also uses cross-docking as third parties deliver their products at The Company, where they temporarily store their products before delivering them to their clients (Akkerman et al., 2022). Creating different added value opportunities is crucial for company growth as this differentiates companies from their

competitors and tackles the problem of parallel suppliers. The current added value opportunities from The Company are their cross-servicing potential with both collecting organic waste and delivering local and sustainable products at the same time. Currently, The Company is the only company in the city of Utrecht that collects organic waste at restaurants and café that is also using it as high-value resources. This creates the solutions for working on relational commitment growth, the cross-servicing potential and other differentiation for providing added value.

Solution	Involved parties	Solved causes
Minimise internal struggle at the client	Couriers, client service employees & the clients	Relational embeddedness and different added value opportunities, Dissatisfaction with the relation, needed effort & Service inconvenience
Implementing and improving human behaviour	Planners & supervisors	Changing human behaviour, Incorrect transport infrastructure, Different employee experiences & Inevitable uncertainties
Implementing a charging strategy	Couriers, planners & supervisors	Limited driving range and low energy dense batteries of electric vehicles & Inevitable uncertainties
Working during off hours	Couriers, planners, & the clients	Inevitable uncertainties & Regular day time deliveries
Adjust client timeslots to off-peak hours	Couriers, planners, client service employees & the clients	Incorrect demand requests and flow of delivered and collected products, Inevitable uncertainties & Service inconvenience
Training for clarified expectations on communication and tasks, and responsibilities	Couriers, planners, supervisors, client service employees & the clients	Incorrect transport infrastructure, Changing human behaviour, Different employee experiences, Poor communication approaches and inconvenient agreements, Unreliable route and task agreements, Missing communication tools, Unclear expectations on communication and tasks for the involved parties & Missing or incorrect optimisation data on decision-making and prioritisation
Implementing improvement data on routes	Couriers, planners & supervisors	Missing or incorrect optimisation data on routes
Implementing improvement data on demand requests	Couriers, planners, supervisors & the clients	Missing or incorrect optimisation data on demand requests
Improvements in pickup locations	Couriers, planners & supervisors	Missing or incorrect optimisation data on pickup locations
Increasing courier equipment and staff	Couriers & supervisors	Limitations of equipment and staff, job demand & job resources

Table 11. The solutions from secondary research with the impacted/involved parties and the tackled problems/causes.

Improving the willingness to pay clients helps solve the problems of client losses because of service inconvenience. The problem of the increased costs for employees' electricity and

maintenance for the equipment cannot be tackled, besides always trying to reduce them when possible. The other solutions from this chapter help improve the logistics processes, which minimises the service costs where possible. Service convenience is seen by clients as a required advantage with their regular tasks and the struggles linked to them. Service convenience is linked to increased flexibility, reduced labour work, no compromises on quality, no mistakes left unresolved, and increased availability (Iqbal et al., 2019). Service quality and operation efficiency can be both measured through the waiting time of a client and the processing times of a client, as a short waiting time represents the quickness of a company and a short processing time represents efficient processes (Cheng, Liao & Hua, 2017). The willingness to pay is through a healthy relationship with a company (Saha et al., 2021) and responsiveness and quality commitment (Lassala, Carmone & Momparler, 2016). The willingness to pay is also created by the contribution to the customer's value and objectives (Rondán-Cataluña, & Martín-Ruiz, 2010), which align with the values and objectives of The Company if they have become a client of The Company.

4.2.2 Implementing and Improving Human Behaviour

Through implementing human behaviour and decision-making in the schedules in SmartRoute, the problem of changing human behaviour is tackled. According to Gruler, Armas and Juan (2016), implementing human factors in route and task agreements create more reliable on-time services and deliveries. Human factors like learning abilities and previous experiences are interesting, for example, a courier that has experience in driving around the city and is familiar with the area, is already more likely to deliver more reliable on-time services and deliveries. Another human factor like courier decisions should also be implemented in the creation of schedules. When collecting organic waste crates decisions are made and produced through requests or by the couriers. Request decisions create the indicated timeslots and courier decisions are made when a request decision should be queued for some reason and processed when there is time again (Cheng, Liao & Hua, 2017). Through the data in SmartRoute, the decisions that are made in the order of helping the clients and the driving times of the couriers can be analysed to see what choices they make. Based on the different courier profiles, schedules can be made. Couriers that always directly help clients the moment they visit them and look less at helping clients in the indicated timeslots might need a different schedule than couriers that focus more on the timeslots and do not mind visiting a client twice if this is in the schedule. When certain couriers tend to start a bit later, this should be addressed or implemented in the schedule. The decisions based on the different routes with regular client orders are not visible from a distance, which means this can only be detected during the onboarding and by asking the courier themselves. When couriers start to communicate the tips and tricks on driving routes, the different decisions they make can also be detected from a distance. The research by Galkin and others (2019) shows how besides implementing the route and vehicle parameters, the courier's state always impacts the schedules as well. Implementing these human factors helps with creating more reliable and responsible schedules. Improving the decision-making process solves the problems of incorrect demand requests, the incorrect flow of delivered and collected products and changing human behaviour. The decision-making process that comes with creating schedules is created by the urgency, experience, and knowledge of the travel times, travel speed, distances, and others, that are available at the time of creating the schedules (Ahn, & Rakha, 2008).

4.2.3 Implementing a Charging Strategy

The solution of implementing a charging strategy helps with coping with the limited driving range and low energy-dense batteries of electric vehicles. When aiming for the most reliable route and task agreements, incorporating realistic energy consumption is required that also integrates the speed, gradient and weight of the load as energy consumption is not a linear function of travelled distance (Goeke, & Schneider, 2015). Investing in large and energy-dense batteries creates more flexibility in route and task agreements, but a well-implemented charging strategy could also be beneficial for improved route and task agreements (Kin, Hopman, & Quak, 2021). Overnight charging at a depot is shown to be the most cost-efficient charging strategy in the case where all tasks fit in the battery capacity as this does not impact the regular operating process (Logistics, 2019), and charging during breaks to avoid waiting time (Kin, Hopman, & Quak, 2021). With the use of overnight charging, the location of the depot is all-important as the correct charging station and the locations of the clients require to be considered (Häll et al., 2019). Enroute charging is the second most efficient charging strategy in case of a limited driving range, the selection of smaller batteries decreases battery costs, occupied depot charging stations, and the allocation of peak demand at a depot, which decreases the required detour kilometres (Kin, Hopman, & Quak, 2021). The most efficient locations for en-route charging are locations that already require couriers to wait for a while (Häll et al., 2019; Miles & Potter, 2014). Electric freight schedules are improved by not only implementing timeslots, but also the potential recharging stations (Kin, Hopman, & Quak, 2021) by creating an urban charging system (Arvianto et al., 2021).

4.2.4 Working During Off Hours

The solution of working during off hours tackles the problem of inevitable uncertainties because of the uncertainties during the regular daytime deliveries. The research by Holguín-Veras and others (2011) shows financial reasons for couriers to work during the off hours (7 PM-6 AM) due to the faster couriers during these off hours. Driving off hours there are fewer restrictions as most city regulations only count during regular hours, making it easier to travel to clients, increased travel speeds due to less traffic during these hours, and it is easier to travel in larger vehicles reducing the required number of routes.

4.2.5 Adjust Client Timeslots to Off-Peak Hours

By changing timeslots to off-peak hours, the number of incorrect demand requests and incorrect flow of delivered and collected products are easier to reduce. The research by Cui, Sun and Zhang (2022) recommends the use of more vehicles during peak hours or encouraging clients to have timeslots in the off-peak hours, to enhance client satisfaction and redirect orders to the off-peak hours. This shows that the solution of changing the timeslots to off-peak hours also helps to solve the service inconvenience problem and the inevitable uncertainties problem as a buffer is created to compensate for the uncertainties. Peak hours include rush hours and the hours with the most service request and order deliveries. Avoiding rush hours increases the driving speed of the couriers and avoiding the hours with the most timeslots helps with increasing the chances of helping the clients in their indicated timeslots.

4.2.6 Training for Clarified Expectations on Communication and Tasks, and Responsibilities

The solutions of creating clear expectations on communication and tasks help with solving the problems of incorrect transport infrastructure, changing human behaviour and different employee experiences. According to research by Benjelloun & Crainic (2009), improving the transport infrastructure helps with providing more reliable on-time services and deliveries. The

transport infrastructure that requires improvements is the driving and service instructions, client communication, couriers, and vehicles. Other solutions for the correct implementation of these transport infrastructures and improving both human behaviour and tackling different employee experiences consist of training & evaluation of courier behaviour (Arvianto et al., 2021). Training could consist both of discussion-based and operations-based exercises. Discussions-based exercises focus on policy-oriented problems where new plans, procedures and solutions can be presented and through an open discussion, a feasible plan can be created. Operations-based exercises focus on validating agreements and procedures, providing training on new equipment, clearing up tasks and responsibilities, training skills, pushing critical thinking and provoking effective problem-solving. This training also creates the potential for both couriers to evaluate their behaviour and for supervisors to also evaluate that same behaviour (Calabrò, Iiritano, & Trecozzi, 2019). This training implies the use of both the method of presentation and the timing of presenting the information (Avineri, & Prashker, 2006). The research by Mahmassani (1996) and Hogarth (1987) implies that couriers are driven by simple heuristic strategies and restricted by a set of mental choice rules. Creating a guide that helps as a solution for this problem and providing couriers with fixed information about the anticipated travel times improves the heterogeneity of the couriers (Avineri, & Prashker, 2006).

When it comes to improving the expectations on communication and tasks to improve the poor communication approaches and inconvenient agreements, several aspects of communication are involved. By assuring the effectiveness of freight policies stakeholder engagement and communication improve and address inefficient route and task agreements (de Oliveira et al., 2019). The Company is required to look at the stakeholder objectives, like minimising costs or maximising service quality and prioritise based on this (Lebeau et al., 2018). The study by Nguyen and others (2018), shows that the adverse impact of adjustments in the work environment to improve the expected tasks can be improved by decreasing job demand and improving job resources by increasing the number of staff and equipment. It also helps to decrease the distrust of change for employees and helps with increasing work engagement and job satisfaction. The effectiveness of change is impacted by the doubt of the employees about the organisational change (Stanley, Meyer & Topolnytsky, 2005). This doubt increases when the employees are blamed for being unmotivated and incompetent (Wanous, Reichers & Austin, 2000). The critical aspects are uncertainties, information management, and communication (Li et al., 2006). Where communication network configurations the effective information flows are within a company and throughout the industry (Lai, Zhao & Wang, 2007; Wong, Lai & Cheng, 2009). Information flows are used to enhance the services and the position towards competitors. Improved communication through network configurations decreased the needed investments for useful logistics performances (Hwang, Hong & Lee, 2017). The logistics processes contain a consistent flow of information across different sectors within and between companies (Singh et al., 2007). The motivation for creating this information flow is created through reflections on the assigned situation and the ability to handle the dynamics of the schedules and complete the approximately real-time settings (Dorer & Calisti, 2005). This requires communication that can be reduced through clustering logistics entities, for the information to be connected. Clustering does require important communication and when the clusters are created, less communication is required as this can be done more centrally (Singh et al., 2007). To conclude, improving communication plays an essential role in improving logistics processes and accomplishing the organisation's goals. The information flows should both go through transactional systems, like communication of data, and analytical systems,

like optimisation, from different sectors of an organisation to enhance the overall process performances (Muñoz et al., 2011).

Guaranteeing the correct interpretation of tasks helps to create the demanded conceptual results. A visualisation is a communication tool for revealing problems and designing processes (Johansson, Cronquist & Kjellin, 2007). Improving the interpretation of tasks is done by visualising these tasks in the correct figure elements. The legend of geometrical figures that should be used for the visualisation and the semantics they indicate are shown in Figure 8. The characteristics of the geometrical figures represent the content and the interpretation of the content. The more straightforward a figure element is, the easier it can be understood and the easier the diagram is. Ambiguity should be avoided, recognisability should be endorsed, and geometrical complexity should be avoided, as the simpler, it looks, the easier it can be understood. Symmetry and consistency should be implemented through similarity in size, form, shape and arrangement where possible (Ding & Mateti, 1990). Visualisation is not a direct solution for improving a situation, just for the interpretation and understanding of a situation (Avison & Fitzgerald, 1999). This literature is implemented when creating Appendix H. The guarantee of correct interpretation of tasks solves the problem of missing knowledge on the tasks of the couriers and unclear expectations on communication and tasks for the involved parties. Visualisations are also helpful for prioritization in decision-making for couriers. The research by Picken (2017) suggests prioritization in decision-making for profitable growth through locating your products and services in such an extensive market, retaining clients, and creating a team with the needed skills. When scaling up more tasks is required, implementing the recommended solutions from the problems detected in this research, is what requires more suitable employees to do these tasks. Prioritization in decision-making is also suggested in creating efficient processes and an efficient foundation, which is the objective of this research, and controlling the potential risks.

4.2.7 Implementing Improvement Data on Routes

For improving the information on optimal routes, the research by Gayialis, Kechagias and Konstantakopoulos (2022) suggests focusing on implementing the main features of city logistics in web services. SmartRoute should implement an analysis of the processes to become a beneficial tool for scheduling and supervising the logistics processes. According to the research by Ren and others (2010), the fuzzy clustering method solves the problem of logistics centre location scheduling. Clustering is the method of categorising processes (Leizhi, 2004) and fuzzy clustering is a soft categorising as objective factors have no clear boundaries and have uncertainties. The factors that affect city logistics distributions are economic (like transport costs), social (like human resources), infrastructure (like road traffic), natural environment (like weather conditions), and business environment factors (like competitors) (Ren et al., 2010). These factors have been mentioned earlier in this research to underpin the importance of implementing them even though the impact is always uncertain. When it comes to expanding to different cities, the most important aspect of finding a suitable location is to minimise the potential of facing traffic jams. The new location should be easily reachable, well secured, reasonably priced, have a little environmental impact, be near available potential clients, has the potential for further growth and can assure convenient and reliable services to the clients (Awasthi, Chauhan & Goyal, 2011).

4.2.8 Implementing Improvement Data on Demand Requests

The solutions to improve the demand requests and collect the required optimisation data are done by improving the aspects of optimisation and scheduling, and policy (Patella et al., 2020).

Improvements in the route and task agreements are created through the flexibility of resources and processes, and consolidations are making the processes more efficient, even with inconsistent demand (Crainic, Errico, Rei & Ricciardi, 2016). The research by Crainic, Ricciardi and Storchi (2009) shows that the day before scheduling improves the service as demand is known and the operational costs can be decreased. Improvements in scheduling are done through coordination of the logistics processes as it produces decreased costs, better service quality, decreased lead times, improved productivity is more sustainable (Ekeskär, 2016), and avoids high transaction costs, which makes it crucial in scheduling (Nolz, 2021). The coordination of the logistics processes is done by implementing all the tasks that are required from the couriers to implement in their schedules. The research by Krityakierne and Laesanklang (2020) also recommends the day before scheduling to meet the varying demand. This research shows that the most effective route adjustments that should be done, are implementing the actual routes and vehicles' times and colling the time violation information. The clients on this list are prioritised more in the future to be able to remove them from that list. This research also shows that the time violations during traffic jams that decrease vehicle speed, can be best prevented by implementing the average travel speed in the schedules.

4.2.9 Improvements in Pickup Locations

The research by Gayialis, Kechagias and Konstantakopoulos (2022), showed that improving the pickup locations and collecting information for optimal routes could improve city logistics. The reason for inefficient pickup locations is a lack of space, which creates longer processing times due to the demand requests, increasing the costs of helping a client. Finding a solution of more space and a more optimal pickup location is not possible for several clients in the city centre and this is not solvable by The Company.

4.2.10 Increasing courier equipment and staff

The lack of personnel resources is a critical limitation for efficient logistics processes (Rogers & Tibben-Lembke, 1998). When looking at the literature that helps with recruiting employees for the logistics processes, the research by Breaugh (2013) shows that utilising existing employees is a successful recruitment method, as a more valid understanding is created for the job. Besides the recruitment method, a specific and realistic recruitment message, a descriptive recruiter, an effective organisational site visit, and the timing of recruitment activities are connected to the hiring results. The research by Baum and Kabst (2014) shows that recruitment advertisements on websites have more impact on the interest of respondents than printed advertisements, but printed advertisements enhance the positive impact of websites, which suggests a combination. Allen and others (2013) showed that text, especially with hyperlinks, appeals to more visual attention, and implementing the information on the launch of the job, company and location, and nice appearances appeal to more verbal attention on website advertisements. Detailed job information pleases respondents' requirements and enhances the perception of the company (Liu, 2020; Überschaer et al., 2016) and advertising of the organisational culture with flexibility aspects appeal to more highly resilient workers (Eschleman & Wright, 2016). Increasing the staff decreases the physical and mental effort that a job requires (Demerouti et al., 2001). The research by Chen and others (2019) shows regular recruitment of couriers focuses most on required skills, but it should also focus on training and improving both knowledge and skills. Training and preparations for couriers is a crucial aspect of the creation of qualified couriers, through improving their skills, interest and passion, to reach their goals (Lepak et al., 2006; Liao et al., 2009). This training also improves the company's position with competitors (Chen et al., 2019). Couriers should be empowered to improve their decision-making (Spreitzer, 1996), their job satisfaction, their accountability and their

achievements (Spreitzer, 1995; Spreitzer et al., 1997; Kirkman and Rosen, 1999; Seibertet al., 2004; Maloni et al., 2017), what makes it crucial for the expansion of an organisation (Broadhurst, 2012).

When looking at the literature that helps with choosing the vehicles for the logistics processes, the following considerations should be done. The recharging time of electric vehicles is a limitation that should be considered (Oda et al., 2018; Zuo et al., 2019), as Bac and Erdem (2021) show that recharging at multiple depots is beneficial. The research by He and others (2019) compares the usual single-reducer vehicles with the new two-speed transmission vehicles. The two-speed transmission vehicles consume 1.21% less electricity every 100 km, 44% fewer rotations per minute at the maximum motor speed, and 11.68% less of the maximum incline, which makes it more efficient than the single reducer vehicles. Increasing the equipment increases the required resources that assist the employees to obtain the job objectives (Demerouti et al., 2001).

4.3 Advantages and Disadvantages of the Solutions

This section discusses the advantages and disadvantages of the solutions proposed in Sections 4.1 and 4.2, as some of them overlap or need to be merged. The solutions, along with their advantages and disadvantages, are listed in Table 12 for a clear overview. The considerations that arise from these advantages and disadvantages must be taken into account when creating the recommended policy and implementing the solutions. The advantages and disadvantages are created based on the observations, content analysis, interviews and literature research that created these solutions. These research methods have both shown the effort and actions required to implement the solutions and the benefits after these actions.

4.4 Conclusion

In this chapter, primary and secondary research is conducted to find solutions for the causes listed in Table 5. Table 9 provides an overview of the advantages and disadvantages of these solutions. Based on these factors, the feasibility of the solutions is assessed in terms of impact and ease of implementation and summarised in Table 13. Further details on the preferred solutions and expected impact are discussed in Section 5.1. This impact and effort are determined after the effort and actions that are shown to be required by the research methods of observations, interviews, content analysis, and literature review, to implement the solutions and the benefits after these actions.

Based on the assessment of feasibility and impact, the solutions that are most recommended to implement are training for clarified expectations on communication and tasks, and responsibilities, the average/actual departure times, and the correct processing times. Additionally, solutions related to visualising the standard tasks of the logistics processes and clarified expectations on communication and tasks are also easier to implement as this research has already prepared the groundwork. The recommendations are feasible to implement in the short term. The other solutions are created for the long-term, but as The Company is constantly changing it is unknown if the future situation will be similar to the researched situation. The benefits of these solutions in a different situation are therefore unknown and therefore these solutions are not recommended to be implemented.

Solution	Advantages of the solution	Disadvantages of the solution
Implementing the correct processing times (O/C)	Improves the schedules made in SmartRoute and less delayed services	The processing times are varying, require extra work and time to track them, and cannot always be decreased
Implementing the average/actual departure times (O/I/C)	Improves the route and task agreements, fewer clients do not get helped the first time visiting and less delayed services	The average departure time requires to be updated as this might change, through changing tasks and couriers which requires extra work and time to track them, and when a courier is starting later, it is going to take them longer to drive to their clients through a more crowded road
Adjust client timeslots (C) to off-peak hours (L)	Less delayed services	Clients could prefer small timeslots and peak hours
Minimise internal struggle at the client (O/L)	Decrease client losses, Increase client satisfaction, service inconvenience and relational commitment	Incorrect waste separation continues to be a problem for The Company, as this problem is solved anyways, and it creates more difficult scheduling and requires more courier effort
Training for clarified expectations on communication and tasks, and responsibilities (O/I/C/L)	More corresponding behaviour, better decisions, more reflection on decisions, increased job satisfaction and work engagement, improved awareness and management of the tasks of the couriers	The new pickup description still needs to be detected by the planner to be updated. The expectations require extra time to be updated and when they are not followed, this is not visible, and many stakeholders are involved creating many uncertainties.
Implementing and improving human behaviour (L)	Faster and more reliable route and task agreements and improves decision-making	Requires extra time and requires to be updated through changing couriers
Implementing a charging strategy (L)	More efficient charging and does not require large batteries	Extra charging locations are required, extra costs, not completely reliable and only applicable for cold weather
Working during off hours (L)	More reliable route and task agreements, less delayed services, faster driving speed and fewer uncertainties	Most timeslots are during day hours, and couriers do not prefer off hours, the current situation is not prepared for this solution and requires adjustments
Implementing improvement data on routes (L)	More reliable routes and schedules, and fewer delayed services	Requires extra research, extra time and extra costs to find the requested data

Implementing improvement data on demand requests (L)	Decrease client losses, Increase client satisfaction & service inconvenience	Require couriers more effort, time, and therefore costs, and could not be beneficial for creating reliable driving hours
Improvements in pickup locations (L)	Shortens the indicated processing times	Requires adjustments at the client and more effort from their employees
Increasing courier equipment and staff (L)	Better scheduling and supervising, increased job satisfaction and work engagement	Requires budgeting, and limitations of unavailable equipment and staff could continue to be a bottleneck as that is not solved as uncertainties cannot be tackled

Table 12. The advantages and disadvantages of the primary and secondary research solutions found by the different research methods of observations (O), interviews (I), content analysis (C) and literature research (L).

	Most impact	Least impact
Easy to implement	- Training for clarified expectations on communication and tasks, and responsibilities - Implementing the average/actual departure times - Implementing the correct processing times	- Minimise internal struggle at the client
Somewhat easy to implement	- Increasing courier equipment and staff - Improvements in pickup locations	- Implementing a charging strategy
Difficult to implement	- Working during off hours - Implementing improvement data on routes - Implementing improvement data on demand requests	- Implementing and improving human behaviour - Adjust client timeslots to off-peak hours

Table 13. The expected impact and difficulty to implement the solutions are based on the advantages and disadvantages.

5. Implementation and Evaluation of the Solutions

This chapter shows the implementation impact and evaluation of the solutions to the logistics processes of The Company. Section 5.1 introduces the expected effect of the implementation of the suggested solutions on the logistics processes of The Company, Section 5.2 introduces the opinion of the employees on the logistics processes of the presented solutions, and Section 5.3 provides the results of this research by providing an implementation plan.

In this chapter, the couriers' supervisors and the planner are interviewed to review potential solutions and select the most important ones to implement. The couriers then evaluate this selection solution. The chapter examines the expected effect of these solutions and considers the opinions of the employees to assess the feasibility and develop an implementation plan. This chapter also analyses how the suggested solutions could impact the current situation and create the desired future situation. This chapter answers the question**: What are the expectations of the impact of the solutions?** By answering the following sub-questions:

5.1 What primary and secondary causes are solved when implementing the solutions?
5.2 How do relevant stakeholders assess the solutions?

5.1 Effect of the Primary and Secondary Solutions

This section examines the solutions created in the previous chapter and their impact on the detected causes of the research problem. Appendix S provides both the overview of the solutions, the detected causes they address, to what extent they are implemented during the research, and their benefits. Table 14 is showing the summary of this appendix by just presenting the solutions and the potential benefits. Detected causes of the unreliable driving hours that are not addressed by the solutions are further discussed in Section 6.3.1.

5.2 Stakeholder Assessment

This section describes the process of conducting two interviews, one interview with the couriers' supervisors and the planner to review and prioritise the solutions of Chapter 4, and one interview with the couriers to evaluate the selected solutions from the first interview.

5.2.1 Introduction Interviews

The first interview started with a PowerPoint presentation, presenting the detected current situation based on the created measures of the KPIs, the causes both from primary and secondary research that are causing the unreliable driving hours of the couriers and the suggested solutions with their advantages and disadvantages. After that, the interview of Appendix Q is presented with two questions to collect the stakeholder assessment. The first question reflects on the opinion of the supervisors and the planner on the most impactful and effective problems that require tackling and the other question is on their opinion on the most impactful and effective solutions to implement.

The second interview is conducted with the nine couriers to gather their perspectives and opinions on the solutions created in the first interview. This second interview also started with a PowerPoint presentation, presenting the detected causes both from primary and secondary research that are causing the unreliable driving hours of the couriers and the solutions chosen and prioritized by their supervisors to tackle these causes. To collect their opinion and perspectives on the solutions, the interview from Appendix R is presented to them. Their perspectives and opinions determine the implementation of these solutions and open feedback determines the difficulty of adaptivity.

Solution	Potential benefit
Implementing the correct processing times	All processing times are considered, fixed adjustments are made, and no manual changes are required anymore. Implementing the correct processing times improve estimated times of arrival, makes more reliable schedules and less delayed services.
Implementing the average/ actual departure times	Leaving The Company at the estimated and average time of 8:44 instead of 8:00 increases the possibility for couriers to follow the schedules and help the clients in the indicated timeslots.
Adjust client timeslots to off-peak hours	The schedules can be made more location efficient as it decreases the chances of visiting clients that cannot be helped yet. This shortens the routes as less driving between the clients is required, increases the possibility for couriers to follow the schedules and help the clients in the indicated timeslots.
Minimise internal struggle at the client	The couriers take the filled crates to the client, even the incorrectly filled crates, improve relational commitment from clients and increase cross-servicing potential where clients make use of both services and products.
Training for clarified expectations on communication and tasks, and responsibilities	Client service employees communicate the clients' expectations clearly to the clients. Couriers always notify pickup descriptions when missing in SmartRoute and/or the courier handbook, and the planner implements the pickup description in SmartRoute and/or the courier handbook, which decreases the required processing times. When implementing improvements, the opinions and perspectives of the employees involved in the logistics processes are implemented which increases the implementation potential. Decisions on what to do in different situations are clear to the employees, clarified prioritisation improves decision-making, and communication is open and clear to the involved parties. The visualisation of the standard tasks in the logistics processes is clarified in the operations-based exercises as this is part of the validation of the agreements and procedures. The visualisations are shared with new couriers during their onboarding and used in situations where couriers quickly check what tasks/decisions they could and should do.
Implementing and improving human behaviour	Implementing human behaviour prepares The Company for the inevitable uncertainties of changing human behaviour and different employee experiences and improves communication approaches through improved decision-making.
Implementing a charging strategy	Implementing a charging strategy tackles the inevitable uncertainty of cold weather which improves and clarifies the couriers' decision-making.
Working during off hours	Off-hours have less traffic which results in faster driving speed and fewer uncertainties, and that results in fewer delayed services.
Implementing improvement data on routes	Fuzzy clustering implements the factors that have uncertainties like economic, social, infrastructure, natural environment and business environment factors.

Implementing improvement data on demand requests	The flexibility of resources and processes, implementing all tasks that are required from the couriers in their schedules, and implementing the actual routes and vehicles' times make the processes and the schedules more efficient.
Improvements in pickup locations	Improving pickup locations improves the processing time of a client making the schedules more reliable.
Increasing courier equipment and staff	Increases in equipment and staff and investments in two-speed transmission vehicles increase the flexibility of the couriers, decrease job demand and increase job resources.

Table 14. The impact assumptions and reality of the solutions for the different causes of the unreliable driving hours of the couriers.

The second interview uses the Unified Theory of Acceptance and Use of Technology (UTAUT) method by Venkatesh and others (2003) for the first question of the interview. The first question collects makes use of the UTAUT method through statements based on four constructs (performance expectancy, effort expectancy, social influence & facilitating conditions) that are the direct determinants of behavioural intention to use the solutions and usage behaviour of the solutions, see Figure 13. Statements on these constructs directly represent the success probability for these solutions. These constructs can be described shortly as follows. Performance expectancy is the expected impact of the solutions that improve the couriers' performance of tasks. Effort expectancy is the simplicity of using the solutions. Social influence is the expected perceived importance of implementing solutions from others. Facilitating conditions is the expected potential of implementing the solutions in the current infrastructure. Behavioural intention to use the solutions is the intention to implement the suggested solutions and usage behaviour is the method the couriers are implementing the solutions. The other aspects that influence the results from the interviewee are the gender, age, experience and voluntariness of use (Venkatesh et al., 2003).

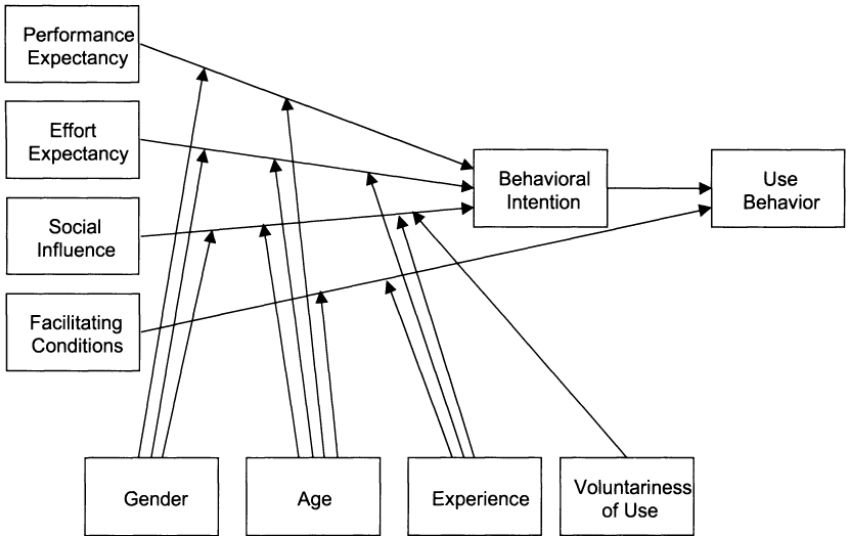

Figure 13. The constructs and different aspects influence the behavioural intention to use the solutions and the user behaviour (Venkatesh et al., 2003).

The statements of these constructs are rated through a five-level Likert scale. The answers the participants could give are: strongly disagree, disagree, neutral, agree, and strongly agree. The strongly disagree had a score of 1 and the strongly agree had a score of 5. Thus, values between 1 and 2 are negative feedback, value 3 means neutral feedback, and 4 to 5 means

positive feedback. The second question asked the couriers their perception of the effectiveness of the suggested solutions. This question also used a five-level Likert scale to collect the average opinions on the suggested solutions.

After the interviews were done, the report, the interviews and the results were revised. This required adjustments in the descriptions of the solutions, as the interview indicated that the solution that was described before as “preparation on expanding The Company”, was a list of solutions and this should be separated into smaller solutions. The results of the interview were adjusted based on the documented comments and feedback that was given on the preferences for the solutions. The interviews in Appendix Q and R have not been adjusted, as these are the interviews that were done. The adjustments that were done to the results have been explained in the next section with the results.

5.2.2 Results Interviews

Through interviewing Appendix Q, the results of the first question are shown in Table 15, creating the most impactful and effective causes to tackle from this research. The results from the second question are shown in Table 16, creating the most impactful and effective causes based on their opinion. These solutions have the highest potential to be implemented as the supervisors and the planner has this power. When creating the implementation plan, it is made sure that the solutions that are implemented are tackling the causes from Table 15.

Ranking	Causes
1	Unreliable route and task agreements
2	SmartRoute bug preventing adjusting or not implementing the processing times
3	Inefficient pickup description
4	Unclear expectations on communication
5	Missing awareness and understanding of logistics processes

Table 15. The top five most impactful and effective causes to tackle from this research are.

Ranking	Solutions
1	Increasing courier equipment and staff
2	Implementing the average/actual departure times
3	Implementing the correct processing times
4	Training for clarified expectations on communication and tasks, and responsibilities
5	Improvements in pickup locations

Table 16. The top five most impactful and effective solutions to implement from this research.

Through interviewing Appendix R, the results of the first question are shown in Table 17 showing the average intention from different perspectives to implement the suggested solutions. The results of the three statements of each of the constructs are combined to show a clear view of each perspective from the couriers.

The results indicate that the couriers have a generally positive outlook towards the solutions proposed to improve their task performances. The score for performance expectancy is on average 4.60, demonstrating that the couriers expect these solutions to have a positive impact. However, some couriers mentioned in their open feedback that they require more detailed information to accurately estimate the potential impact of the proposed solutions.

Courier	PE	EE	SI	FC	BI

1	5.00	4.67	5.00	5.00	5.00
2	5.00	3.33	5.00	3.00	4.67
3	5.00	4.67	4.67	4.33	4.67
4	5.00	4.00	5.00	5.00	4.00
5	5.00	3.33	5.00	3.33	5.00
6	3.67	2.67	4.00	3.33	4.00
7	4.67	4.33	5.00	5.00	5.00
8	4.00	3.00	4.33	3.00	3.33
9	4.00	3.67	4.00	3.67	4.00
Average	4.60	3.74	4.67	3.96	4.40

Table 17. The results of the performance expectancy (PE), effort expectancy (EE) and social influence (SI), facilitating conditions (FC) and behavioural intention to use the solutions (BI) statements.

The score for effort expectancy is on average 3.74, indicating a neutral to positive perception of the expected effort required to implement the solutions. However, in the open feedback, some couriers expressed concerns about the simplicity of implementing the solutions due to past experiences where adjustments are not implemented properly. Unexperienced couriers are also hesitant about the simplicity of implementing the solutions as they still have much to learn and adapt from the other couriers. Some couriers are also uncertain about the ease of implementation as it involves a signification change in behaviour and also several people should implement the adjustments for it to completely work.

The score for social influence is on average 4.67, indicating a positive perception of the perceived importance of implementing solutions for others. The open feedback that is given here is that the couriers also observe the detected causes and/or could understand the negative impact of the detected causes. The open feedback does not report any difficulties in this aspect.

The score for facilitating conditions is on average 3.96, indicating a neutral to positive perception of the expected potential of implementing the solutions in the current infrastructure. However, some couriers mentioned in their open feedback that they require more specific information on implementation to determine the potential of implementing the solutions. How the communication and their tasks require to look is clarified during the training but as this is not presented during the interviews, this made the couriers a bit hesitant. The concerns about past experiences with adjustments that are not properly communicated to everyone involved also impact the perception of the couriers. The solutions that are implemented by the couriers' supervisors make the couriers unsure about the amount of effort, resources and knowledge that is requested from them for those solutions. Some couriers also disagreed with the statement "I have the resources to implement these solutions" because of the current struggles with SmartRoute and the dirty or broken crates. This is a problem that should be solved at The Company and does not fit the scope of this research, but it does impact the resources of the couriers.

The score for behavioural intention to use the solutions is on average 4.40, indicating a positive intention to implement the proposed solutions. The open feedback again showed that some couriers do not rate the statements higher because some of the solutions are implemented by their supervisors and not by the couriers themselves.

Only the second question from the second interview required a small change in the results for this research to use these results of the interview. Solution one from the interview of Appendix R is now separated into solutions one and five, the results from solution one have been also used for solution five. As the current solution four consists of the results of three solutions from the interview of Appendix R, the results of these solutions have been combined as they are tackled through the same training. These adjusted results of the second question are shown in Table 18 showing the average opinion on the suggested solutions.

Employee	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5
Courier 1	4	5	5	4.33	4
Courier 2	5	5	3	5	5
Courier 3	5	5	5	4.67	5
Courier 4	5	5	5	5	5
Courier 5	4	5	5	4.67	4
Courier 6	4	3	3	4	4
Courier 7	4	5	5	4.67	4
Courier 8	5	5	5	5	5
Courier 9	4	4	4	3.67	4
Average	4.44	4.67	4.44	4.56	4.44

Table 18. The opinion on the effectiveness of the solutions in creating more reliable schedules and working hours for the couriers.

Based on the results presented in Table 18, it appears that the couriers have a positive outlook on the effectiveness of the proposed solutions. However, some of the solutions received lower ratings than others, and the open feedback provided by the couriers offers some insights into why this might be the case. The open feedback stayed the same as it was provided on the same solutions, just described differently. Specifically:

1. The visualisation of the standard tasks of the logistics processes that will be used in the training for clarified expectations on communication and tasks, and responsibilities, is viewed as most impactful during the onboarding of the couriers and least impactful for more experienced couriers.
2. Implementing correct processing times can be difficult due to daily and individual variations that impact the effectiveness of implementing the average processing times.
3. Implementing average/actual departure times may cause a bottleneck in the logistics processes at The Company as the couriers start at the same time and they hinder each other.

The solutions of increasing courier equipment and staff and improvements in pickup locations received positive ratings without any further feedback in the open feedback on why they might not be effective. Overall, the results indicate a generally positive outlook towards the proposed solutions. Where more detailed information and communication about implementation are necessary to address the concerns expressed by some couriers.

5.3 Results

Based on the expected effects of the solutions and the feedback from the employees of The Company, the following solutions are assumed to be feasible and impactful for implementation:

1. Increasing courier equipment and staff
2. Implementing the average/actual departure times

3. Implementing the correct processing times
4. Training for clarified expectations on communication and tasks, and responsibilities
5. Improvements in pickup locations

Table 34 reveals that the problem of being unable to adjust the processing time in SmartRoute has already been addressed in this research. The groundwork for the other solutions has been done, but these solutions have not been implemented yet. The implementation plan includes the following steps which are prioritised based on the results of the interviews from Section 5.2.2. The improvements are prioritised from one as most important to five as least important. The prioritisation is explained below for all of the improvements.

1. The couriers' supervisors should implement the departure times of 8:44 in SmartRoute as this is the average detected departure time. The departure times of each courier should however differ at least five minutes after each other.

This improvement is prioritised as the most important improvement as the shift to later and more reliable departure times in the schedules in Smartroute, instantly improves the reliability of the finishing time of the shift of the couriers. The observations and content analysis show that more reliable data on the departure times in SmartRoute create more reliable driving hours.

2. The couriers' supervisors should implement the correct processing times of the clients in SmartRoute that on average take longer and adjustments to the pickup locations are not possible.

The implementation of longer processing times that are required to help clients, improve their schedules as the most feasible and impactful improvement is more accurate data for SmartRoute to create the most reliable schedules and more reliable driving hours.

3. The couriers' supervisors should schedule monthly training sessions for the employees involved in the logistics processes, which should be very detailed and include discussion-based and operations-based exercises. The training should cover the visualisations, tips and tricks, communication expectations, task expectations, responsibilities developed in this research, and priorities in decision-making.

The literature suggests that monthly training sessions should be held to discuss and implement new adjustments to communication, tasks, and responsibilities. They also help to reduce the time required for the morning chats between the couriers, which decreases and improves the reliability of the departure times. Improvements in the prioritisations of the couriers' decision-making and clarifying decision-making through visualisations, tips and tricks, communication expectations, task expectations and responsibilities developed in this research, create more uniform behaviour of the couriers. The interviews and observations show this training improves the work of the couriers, and therefore also improves the schedules.

4. The supervisors should increase courier equipment, increase staffing by utilising existing employees to find new employees and investment in two-speed transmission vehicles when new vehicles are required and there is a budget to invest.

An investment in two-speed transmission vehicles is very expensive and requires a lot of budgeting and planning. These considerations are outside the scope of this research, but interviews show it is required in the short term. Observations show that increasing the other courier equipment increases the feasibility for couriers to do their job, and increasing the

occupation of couriers also solves the shortage of couriers to fill in the shifts. This improvement has its difficulties, but the literature does show the major benefits of this improvement in cases such as The Company.

5. The supervisors should optimise the pickup locations when possible.

The feasibility of the optimisation of the pickup locations is depended on the cooperation of the clients. Observations, interviews and content analysis show that for some clients the optimisation is easily done, but other clients could be more resistant to the adjustments. This improvement also has its difficulties where the literature also shows major benefits for the improvement in cases such as The Company.

6. Conclusion

This chapter provides the conclusion on this research where Section 6.1 provides the short summarised answers to the research questions as the key findings of this research, Section 6.2 recommends adjustments to further improve the logistics processes and implement the solutions, Section 6.3 introduces the required future research for detected but not tackled causes, government-requested solutions, and research aspects from the logistics processes that do not fit the scope of this research, and Section 6.4 provides both the practical and theoretical impact of this research.

6.1 Key Findings

In Section 1.6, the sub-research questions are formulated to answer the main research question *"What improvements in the logistics of collecting the organic waste and delivering the products by The Company could solve the problem of unreliable driving hours?".* The answers to the sub-research question provide research on what problems occur in and around the logistics processes of collecting the organic waste crates and delivering The Company's products, and what improvements should be done.

While the research problem of the unreliable driving hours of the couriers of The Company is by The Company generally known and the problems that cause them are not tackled before by The Company. Through observations, interviews, and content analysis, the logistics processes are evaluated using the Balanced Scorecard framework. This framework assesses key performance indicators (KPIs) from various perspectives, including the customer, internal business, innovation and learning and financial perspectives. The measures of the KPIs reveal several problems that need to be addressed to achieve the desired situation. These problems include the number of clients that are helped outside of the indicated timeslot, the number of clients that pay less than the actual service costs, the number of clients that do not follow the agreements, the number of unclear communication procedures, no visualisation of courier tasks, inadequate preparation for logistics process expansion, and problems with SmartRoute.

The measures of the KPIs derived from the current logistics processes highlight the underlying bottlenecks that are responsible for the unreliable driving hours of the couriers. These bottlenecks are linked to the operational inefficiencies of the logistics processes, such as the regular daytime deliveries that enhance uncertainties. Other various bottlenecks include insufficiency of the transport infrastructure, unanticipated demand requests, inefficiencies in the flow of delivered products and collected organic waste, and unclear expectations regarding communication and task assignments for the stakeholders. Additionally, the absence of accurate processing and departure times enhances these bottlenecks. The absence or inaccuracy of optimisation data on departure times, routes, demand requests, pickup locations, decision-making, awareness of route and task agreements, and prioritisation, as well as the limitations of equipment and staff and the unpredictability of human behaviour, also further enhance the bottlenecks. Moreover, the differences in employee experiences, service inconveniences and the different added value opportunities add to the complexity of the logistical challenges of The Company. The limitations of the logistics processes are client behaviour, the availability of required equipment and staff, and uncertainties.

To address these issues, this research suggests implementing the solutions with the greatest impact and easiest to implement. These solutions involve the training for clarified expectations on communication and tasks, and responsibilities, and implementing the average/actual departure times and the correct processing times in SmartRoute. Other solutions should be

chosen based on the objectives of the couriers' supervisors and the amount of effort they want to make. The couriers' supervisors have decided to implement these solutions and the additional solutions of increasing courier equipment and staff, and improvements in pickup locations. The implementation potential is determined by interviewing the employees of The Company. The couriers have expressed a positive perception to use these solutions and their suggestions on implementation details are also considered to improve the effectiveness and impact of the solutions.

6.2 Recommendations for the Logistics Processes

The implementation plan of Section 5.3 might improve the reliability of the driving hours of the couriers by improving short-term decision-making. However, the adjustments from the supervisors and the employee training are not made yet. This section presents recommendations for improving long-term decision-making solutions.

Firstly, it is recommended to continue collecting data using SmartRoute as most problems observed are underpinned by this data. From the internal business process perspective, this aids in further improving logistics processes. Clearer and more structured data enables easier further research regarding the causes that are not tackled, see Section 6.3. This recommendation creates clearer data and provides more structure to the data.

Secondly, implementing courier meetings is recommended as couriers are the ones who observe inefficiencies and bottlenecks in the logistics processes. These meetings allow for sharing tips and tricks and adapting further adjustments to their tasks. Discussion-based and operations-based exercises can also be implemented to improve the couriers' perspectives. Aspects impacting the behavioural intention to use and the usage behaviour, such as effort expectancy and facilitating conditions attitude, need to be tested and tackled.

Thirdly, communicating client expectations and providing updates is recommended. Clients often fail to resolve issues highlighted by couriers, which creates problems for them. By addressing this, clients' perception of The Company's service can be improved. Expectations of the couriers' tasks should also be further explained and updated.

Fourthly, other solutions created in Chapter 4 should be considered for long-term decision-making. Solutions from similar cases in the literature could prove to be very beneficial for The Company.

Lastly, it is recommended to revise the logistics processes from the financial perspective once the solutions are implemented. The effectiveness of the solutions, whether they solved issues, and whether courier driving hours become more reliable should be evaluated. If no answers are found, research building on this research is required.

6.3 Future Research for the Logistics Processes

Given the scope of this research, not all detected causes of unreliable driving hours are tackled. These causes are discussed to explain the further research that is required to solve these problems. Additionally, some solutions found in the literature are out of the scope of The Company as they are government-requested solutions. Implementing them requires extra research, which is discussed in this section. Furthermore, this research highlighted aspects of the logistics processes that require further research.

6.3.1 Not Tackled Causes

Section 5.1 showed that this research does not tackle some important as they are out of scope. In Table 19, these causes are connected to the KPIs, and they are further explained why more research is required.

KPI	Primary and secondary causes
1. Service at a full-on-time rate	○ Data requires to be stored manually (O)
2. Costs per client	○ Driving to the client takes more time (O/I/C) ○ Increase costs for employees, electricity and maintenance for the equipment (L)
4. Scheduled variance	○ Both The Company and their clients like and dislike the actual number of crates with the current situation (O/I) ○ Data requires to be stored manually (O) ○ The applications to receive the orders from clients and to communicate these orders to the employees are not connected to SmartRoute (O)
7. Internal mobility	○ Delay in ordering electric vehicles (I)
8. CO_2 reduction rate	○ Better waste separation (I)
9. Increase of service clients	○ More parallel suppliers (L)

Table 19. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) are not solved through the primary and secondary research.

The solution for the problem of collecting the data manually of the order receiving applications that are not connected to SmartRoute, or the problem of collecting the data manually from SmartRoute, does not fit the scope of this research. Further research here is required to see the advantages and disadvantages of the disconnected programs and what adjustments should and could be made. Further research on how to collect this data from SmartRoute is also beneficial as it helps with the problem that most of these problems are not detected before this research. Having the data also helps with seeing the exact results of the solutions presented in this research and helps detect future problems.

The problem of taking more time to drive to certain clients is not tackled as the cause of this is the fact that the location of the clients from Rotterdam and Den Haag cannot be changed. The Company is already considering expanding to these cities solve the problem of these extreme costs for these clients. Relocating to either Rotterdam or Den Haag helps to solve these problems as most time is spent driving to these cities. Further research on the preparation for this expansion is required.

The problem of increased costs for employees, electricity, and maintenance for the equipment is a problem that is out of reach for The Company. Improving the schedules decreases the driving hours and therefore also the electricity costs of the vehicles, but these costs are changing out of reach from The Company and, therefore, they cannot be tackled by The Company. The detected problem of not implementing the actual number of crates in the current schedules has both advantages and disadvantages for both The Company and their clients. Having the advantages weigh out the disadvantages, but this cause is not tackled during this research. To improve the schedules further, the information on these crates should be required, but how the contracts are currently made, the current situation does not require a

solution for this problem to create the desired and feasible situation. Further research is required to see the exact advantages and disadvantages are of effects of not knowing the programs and what adjustments should and could be made.

The problem of having a delay in ordering electric vehicles requires further research as researching the cause of this ordering problem is not in the scope of this research. The causes of this problem are probably the shortage of materials which has several causes itself that should be tackled to solve this problem, and The Company cannot tackle the shortage of material causes. The problem of improving the waste separation at the client does not fit the scope of this research. This research looked at the logistics processes from the couriers of The Company and the aspects of the client that impact these logistics processes. The logistics processes of the involved clients are therefore not researched, and further research could find the exact causes of incorrect waste separation to be able to tackle them.

The problem of having some competitors that provide the same service and more parallel suppliers increasing is not tackled during this research. This problem could be solved through market research on the competitors and research on the differences in the added values. This market research is out of the scope of this research, but the number of parallel suppliers in determining the success of the increased number of clients, and therefore the potential for further growth.

6.3.2 Government-Requested Solutions

The literature research also suggested some solutions for the detected causes that are out of the scope of The Company to implement. The most difficult solution is to change policies, measures and traffic restrictions as these are government-requested solutions that could further improve the schedules. Policies and measures like mandatory aged vehicle removal and emission standards (Browne, O'Mahony & Caulfield, 2012; Quak, Nesterova & van Rooijen, 2016), and traffic restrictions, like implementing low-emissions zones in urban areas, could also have a positive effect on electric freight vehicle use, but it also results in less urban traffic making it easier for electric vehicle freight transportation to drive faster and has more reliable driving hours (Morganti & Browne, 2018). When it comes to the costs of electric vehicles, the help of local authorities is until now crucial for the increased use of electric vehicles (Quak, Nesterova & Von Rooijen, 2016). This means that the solutions can only not be created by The Company itself, but improving the attraction to take active participation in governments is a large task (İmre, Celebi, & Koca, 2021).

6.3.3 Future Research Aspects Logistics Processes The Company

As to the limitations of the scope of this research, based on the finding of this research there are several aspects of the logistics processes that require further research. First, data on the current processing times should be collected and integrated into SmartRoute to improve schedules and the reliability of the driving hours of the couriers. Additionally, research is required to understand the client's perspectives on the logistics processes, as well as to validate the assumptions made in secondary research.

Another aspect that requires further research is to investigate the driving adjustments of the scheduled sequence of the couriers in SmartRoute after implementing the solutions. When the courier feels like they are not working efficiently, they feel like they should make their own decisions. When couriers already visit certain clients, they need to help that day, but SmartRoute decided that it is better first to help other clients, and the couriers should be aware there is a reason for this situation. SmartRoute still plans its shift like this because of the

timeslots it considers, the number of crates that fit into the vehicle, and the number of crates collected at each client on average. When the schedules in SmartRoute are improved, further research should show what the reasons are for couriers to still not following the scheduled sequence of the clients. When the data is collected on the couriers' decision-making this could be beneficial for improving the logistics processes. To be able to further improve the schedules of the couriers of The Company, the data that should be implemented in SmartRoute is the number of collectable crates, the action radius based on the weather, estimated traffic, and the estimated weight of the collectable crates, and how much crates fit in the vehicles when the vehicle also has cooling boxes from product deliveries. Currently, these aspects are not further researched on what is beneficial for further improvements of the logistics processes.

Implementation and improvement of human behaviour require The Company to research the behaviour based on the data of SmartRoute, for example, if they do not drive according to the schedules, they take longer to process clients, start later than required or return to The Company more than requested. The courier behaviour improvements to the couriers' behaviour should be communicated and implemented. Another aspect that requires further research is the implementation of a charging strategy. This solution is not implemented yet as it requires more research from The Company before implementation. The Company is required to research creating a charging strategy as they should collect data from their vehicles during cold days. The data should consist of the distances of the vehicles, the battery use, the capacity use and the temperatures during these times. When this data is collected, conclusions on what the best use of the batteries is can be made and a charging strategy could be made and implemented. Another detected aspect during this research that requires further research is the use of organic waste crates for product deliveries instead of the current cooling boxes. The logistics processes benefit from this change as no useful space is utilised by empty cooling boxes after product deliveries, but for the product deliveries, it might have disadvantages that require research.

Another aspect of further research is the potential to create schedules when the courier leaves The Company. As clients often prefer certain timeslots, the client order in the schedule changes based on the departure time. Implementing the expected time is helpful, but it should be researched to create a schedule based on the time the courier leaves. When that becomes possible, the problem of having unreliable driving hours for the couriers is further tackled. Another aspect of further research is the fact that the product orders are currently not shown in SmartRoute. When a courier has several orders, they require to check if service clients also have product orders extra. If they forget, they need to return to this client later which takes up extra time.

The last aspect that requires further research is the current struggles with the equipment of the couriers. Currently, stickers are released or not readable for the “zebra” to scan, which requires the courier to put new stickers on the crates which takes way more time. During this research, new improved stickers have been ordered but the effect of this should be checked. It also occurs that the crates are broken or not completely clean when the courier is delivering them to the clients. Removing these rejected crates from the clean crates takes a lot of time for the couriers and this problem should be tackled at The Company.

6.4 Contributions to Theory and Practice

The contribution to practice is the flowcharts for the visualisations of the logistics processes of the couriers, the clarifications on the responsibilities, communication, tasks, and decision-making, that should be implemented are made. The research also provides the current situation of the logistics processes, the causes of the unreliable driving hours of the couriers and the solutions for these causes to help the employees of the logistics processes of The Company in their decision-making process regarding improvements of the logistics processes. Although the solutions can currently not be entirely validated, the potential benefits and the opinions and perspectives on the solutions are promising. The presented solutions are completely practical and modifiable in terms of input when several changes are made and the data on the logistics processes should be updated, they are easily implemented. The Company can use the literature research from this research as a source of information on the different perspectives to keep in mind when measuring other logistics processes at the company. The literature research is also a source of information on the potential for future solutions, as some solutions are not easily implemented in the current situation at The Company in Utrecht, but there could be more potential for the use of certain solutions with the expansion to different cities and starting new locations.

The results of the interview of the stakeholder assessment provide an overall positive response to the solutions. The employees of The Company are most positive about the expected impact of the solutions to improve the couriers' performance of tasks, the expected perceived importance of implementing solutions from others, and the intention to implement the suggested solutions. They were somewhat positive about the simplicity of using the solutions and the expected potential of implementing the solutions in the current infrastructure. This provides the internal motivation and feasibility of the assessment of the stakeholders to adopt the improvements. The solutions are easily modifiable and can be used as a source of information for future research and improvements. The investment in two-speed transmission vehicles requires a direct financial investment, whereas the other solutions require an indirect financial investment through time and work for the employees to make the changes.

The five recommended improvements are solutions for the short term as they fit into the current infrastructure of The Company. The solutions created in the primary and secondary research that are not recommended, are not interesting in the current infrastructure of The Company. These solutions are created for the long-term, but as The Company changes constantly, these solutions are not recommended yet as the benefits are not known in the case of The Company changes and are not similar to the researched situation anymore.

The contribution to theory is the supplementary insight into the different aspects that need to be tackled when improving the logistics processes. The detected causes at the logistics processes of The Company through observations, interviews and/or content analysis that aligned with the causes from the literature research, contribute to the literature as underpinned research. The detected causes through observations, interviews and/or content analysis that do not align with the causes from the literature research, contribute to the literature as new research. In the current literature, there are no case studies done with companies such as The Company. No research on similar city logistics problems is found as Dutch cities are different from other countries. Dutch cities have several bikers and only allow bikers in some parts of the city centre. This research contributes to the literature with a new case study on the improvements in city logistics of waste collection in the Netherlands.

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Appendices

Appendix A The Average Weight of the Organic Waste Crates

Week&Year of date	Total number of crates	Total kg/week	Kg/crate
W03 2022	133	1016,55	7,64
W04 2022	169	1379,45	8,16
W05 2022	273	2274,9	8,33
W06 2022	281	2434,2	8,66
W07 2022	270	2174,8	8,05
W08 2022	567	4309,95	7,60
W09 2022	406	3268	8,05
W10 2022	155	1324,2	8,54
W11 2022	618	5019,8	8,12
W12 2022	365	3170,4	8,69
W13 2022	605	5412,1	8,95
W14 2022	666	6003,2	9,01
W15 2022	760	6563,1	8,64
W16 2022	553	4629,85	8,37
W17 2022	675	5805,2	8,60
W18 2022	666	5797,55	8,71
W19 2022	676	5822,05	8,61
W20 2022	764	6723,45	8,80
W21 2022	781	6770,35	8,67
W22 2022	748	6539,15	8,74
W23 2022	685	5755	8,40
W24 2022	944	8182,5	8,67
W25 2022	728	6102,65	8,38
W26 2022	895	7980,45	8,92
W27 2022	922	7641,85	8,29
W28 2022	852	7116,55	8,35
W29 2022	762	6416,95	8,42
W30 2022	713	5855,65	8,21
W31 2022	644	5368,55	8,34
W32 2022	802	6706,65	8,36
W33 2022	734	6091,5	8,30
W34 2022	954	7881,6	8,26
W35 2022	978	8215,1	8,40
W36 2022	981	8231,85	8,39
W37 2022	1061	9195,7	8,67
W38 2022	1264	10426,95	8,25
W39 2022	1384	12117,45	8,76
W40 2022	1341	10966,2	8,18
W41 2022	1386	11817,1	8,53
W42 2022	1394	12150,45	8,72
W43 2022	1388	11856,35	8,54
W44 2022	344	3097,6	9,00
		The average amount of kilogram per crate:	8,42

*Table 20. The weight of the collected crates is based on the data from week 3 until week 44 of 2022***.**

Appendix B The Delayed Times of Service by The Company

Date	Client	Timeslot	Time too late	Time too early
19-11-2022	**Confidential information**	09:00-10:00	00:50	
19-11-2022	**Confidential information**	09:15-11:00	00:09	
21-11-2022	**Confidential information**	08:00-12:30	01:57	
21-11-2022	**Confidential information**	09:00-14:00	00:43	
21-11-2022	**Confidential information**	11:00-?		0:08
22-11-2022	**Confidential information**	? -14:00	00:07	
22-11-2022	**Confidential information**	08:00-14:00	00:15	
23-11-2022	**Confidential information**	08:00-16:00	00:40	
23-11-2022	**Confidential information**	09:00-10:00	00:36	
24-11-2022	**Confidential information**	08:00-11:00	02:26	
24-11-2022	**Confidential information**	08:00-09:00	00:46	
24-11-2022	**Confidential information**	08:00-11:00	00:15	
24-11-2022	**Confidential information**	09:00-11:00	00:16	
24-11-2022	**Confidential information**	08:00-12:00	02:22	
24-11-2022	**Confidential information**	10:30-12:00	02:51	
24-11-2022	**Confidential information**	09:00-12:00	03:08	
24-11-2022	**Confidential information**	09:00-13:00	01:25	
24-11-2022	**Confidential information**	10:00-14:00	00:31	
24-11-2022	**Confidential information**	01:00-14:00	00:43	
25-11-2022	**Confidential information**	09:15-11:00	00:57	
25-11-2022	**Confidential information**	9:30-15:30		0:37
28-11-2022	**Confidential information**	08:00-10:00	01:40	
28-11-2022	**Confidential information**	09:15-11:00	01:04	
28-11-2022	**Confidential information**	09:00-11:00	01:23	
29-11-2022	**Confidential information**	16:00-?		1:24
29-11-2022	**Confidential information**	16:00-?		1:14
29-11-2022	**Confidential information**	08:30-12:00	03:16	
29-11-2022	**Confidential information**	08:00-14:00	02:17	
30-11-2022	**Confidential information**	08:00-15:00	00:28	
30-11-2022	**Confidential information**	08:00-16:00	00:12	
30-11-2022	**Confidential information**	09:00-10:00	00:27	
1-12-2022	**Confidential information**	01:00-12:00	00:32	
1-12-2022	**Confidential information**	07:00-12:00	00:36	
1-12-2022	**Confidential information**	10:30-12:00	01:16	
1-12-2022	**Confidential information**	08:30-14:00	01:10	
1-12-2022	**Confidential information**	08:00-09:00	01:07	
1-12-2022	**Confidential information**	08:00-09:00	01:29	
1-12-2022	**Confidential information**	09:00-13:00	02:57	
1-12-2022	**Confidential information**	10:00-14:00	02:05	
1-12-2022	**Confidential information**	01:00-14:00	02:05	
1-12-2022	**Confidential information**	11:00-14:00	01:28	
2-12-2022	**Confidential information**	09:00-14:00	00:06	
2-12-2022	**Confidential information**	09:15-11:00	00:35	

2-12-2022	**Confidential information**	9:30-15:30		0:30
3-12-2022	**Confidential information**	09:00-10:00	00:46	
5-12-2022	**Confidential information**	09:00-11:00	00:15	
5-12-2022	**Confidential information**	08:00-12:30	01:54	
5-12-2022	**Confidential information**	09:00-14:00	00:41	
6-12-2022	**Confidential information**	08:00-14:00	01:35	
7-12-2022	**Confidential information**	08:00-12:00	01:25	
7-12-2022	**Confidential information**	09:00-10:00	00:48	
7-12-2022	**Confidential information**	09:00-12:00	01:28	
8-12-2022	**Confidential information**	09:00-14:00	00:09	
8-12-2022	**Confidential information**	08:30-14:00	01:01	
8-12-2022	**Confidential information**	11:00-14:00	00:08	
9-12-2022	**Confidential information**	08:30-12:00	01:09	
9-12-2022	**Confidential information**	9:30-15:30		0:14
10-12-2022	**Confidential information**	09:00-10:00	01:47	
10-12-2022	**Confidential information**	09:15-11:00	00:46	
12-12-2022	**Confidential information**	11:00-17:00		0:26
13-12-2022	**Confidential information**	16:00-?		2:18
13-12-2022	**Confidential information**	16:00-?		2:09
13-12-2022	**Confidential information**	16:00-?		1:49
13-12-2022	**Confidential information**	08:30-12:00	03:32	
13-12-2022	**Confidential information**	08:00-16:00	00:15	
14-12-2022	**Confidential information**	08:00-12:00	03:00	
14-12-2022	**Confidential information**	08:30-11:00	01:11	
14-12-2022	**Confidential information**	08:00-12:00	02:27	
14-12-2022	**Confidential information**	09:00-10:00	00:52	
14-12-2022	**Confidential information**	08:00-14:00	01:33	
16-12-2022	**Confidential information**	09:00-14:00	00:16	
16-12-2022	**Confidential information**	08:30-12:00	02:46	
16-12-2022	**Confidential information**	07:00-15:15	01:24	
16-12-2022	**Confidential information**	14:00-17:00		4:28
16-12-2022	**Confidential information**	09:30-15:30		0:18
17-12-2022	**Confidential information**	09:00-10:00	02:01	
17-12-2022	**Confidential information**	09:15-11:00	01:01	
19-12-2022	**Confidential information**	08:00-11:00	00:14	
19-12-2022	**Confidential information**	09:00-11:00	00:14	
19-12-2022	**Confidential information**	09:15-11:00	00:34	
19-12-2022	**Confidential information**	10:00-13:00	00:35	
19-12-2022	**Confidential information**	08:00-12:30	01:29	
19-12-2022	**Confidential information**	09:00-14:00	00:13	
19-12-2022	**Confidential information**	11:00-?		0:18
20-12-2022	**Confidential information**	09:00-12:00	00:09	
20-12-2022	**Confidential information**	08:30-12:00	02:33	
21-12-2022	**Confidential information**	08:00-12:00	02:06	
21-12-2022	**Confidential information**	08:00-15:00	00:06	
21-12-2022	**Confidential information**	08:00-16:00	00:20	

21-12-2022	**Confidential information**	09:00-10:00	00:38	
22-12-2022	**Confidential information**	08:00-11:00	01:11	
22-12-2022	**Confidential information**	09:00-11:00	01:12	
22-12-2022	**Confidential information**	09:00-12:00	00:20	
23-12-2022	**Confidential information**	09:00-17:00		0:25
23-12-2022	**Confidential information**	09:15-11:00	01:34	
23-12-2022	**Confidential information**	14:00-17:00		4:33
24-12-2022	**Confidential information**	09:00-09:30	01:37	
24-12-2022	**Confidential information**	09:15-11:00	00:20	
26-12-2022	**Confidential information**	08:30-09:00	00:12	
26-12-2022	**Confidential information**	09:00-11:00	01:11	
27-12-2022	**Confidential information**	16:00-?		3:03
27-12-2022	**Confidential information**	16:00-?		2:53
27-12-2022	**Confidential information**	08:30-12:00	03:29	
28-12-2022	**Confidential information**	09:00-10:00	01:16	
28-12-2022	**Confidential information**	09:15-11:00	00:36	
28-12-2022	**Confidential information**	09:00-12:00	03:41	
29-12-2022	**Confidential information**	08:30-14:00	00:22	
29-12-2022	**Confidential information**	08:30-11:00	01:21	
29-12-2022	**Confidential information**	08:30-11:00	01:30	
30-12-2022	**Confidential information**	08:30-12:00	00:07	
30-12-2022	**Confidential information**	09:15-11:00	01:32	
30-12-2022	**Confidential information**	08:00-14:00	01:09	
31-12-2022	**Confidential information**	09:00-10:00	00:10	
2-1-2023	**Confidential information**	11:00-17:00		0:08
2-1-2023	**Confidential information**	09:00-11:00	00:10	
2-1-2023	**Confidential information**	08:00-12:30	01:18	
2-1-2023	**Confidential information**	11:00-?		1:00
3-1-2023	**Confidential information**	16:00-?		0:07
3-1-2023	**Confidential information**	08:30-12:00	02:13	
4-1-2023	**Confidential information**	09:15-11:00	00:44	
5-1-2023	**Confidential information**	08:00-11:00	03:47	
5-1-2023	**Confidential information**	09:00-11:00	03:47	
5-1-2023	**Confidential information**	10:30-12:00		0:50
5-1-2023	**Confidential information**	08:30-14:00	01:40	
5-1-2023	**Confidential information**	10:00-?		0:35
5-1-2023	**Confidential information**	11:00-14:00	00:59	
6-1-2023	**Confidential information**	8:30-12:00	00:16	
6-1-2023	**Confidential information**	14:00-17:00		4:22
7-1-2023	**Confidential information**	09:00-10:00	02:26	
7-1-2023	**Confidential information**	09:15-11:00	01:26	
9-1-2023	**Confidential information**	09:00-11:00	00:34	
9-1-2023	**Confidential information**	09:00-11:00	00:42	
9-1-2023	**Confidential information**	10:00-13:00	01:25	
9-1-2023	**Confidential information**	11:00-?		0:45
10-1-2023	**Confidential information**	16:00-?		3:48

10-1-2023	**Confidential information**	16:00-?		3:39
10-1-2023	**Confidential information**	08:00-09:00	00:52	
10-1-2023	**Confidential information**	08:30-12:00	00:28	
11-1-2023	**Confidential information**	09:15-11:00	01:14	
11-1-2023	**Confidential information**	09:00-12:00	02:03	
12-1-2023	**Confidential information**	08:00-12:00	00:53	
12-1-2023	**Confidential information**	10:30-12:00	00:28	
13-1-2023	**Confidential information**	09:00-14:00	00:17	
13-1-2023	**Confidential information**	14:00-17:00		4:04
14-1-2023	**Confidential information**	09:00-10:00	01:22	
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16-1-2023	**Confidential information**	09:00-12:00		0:10
16-1-2023	**Confidential information**	10:30-23:59		0:08
16-1-2023	**Confidential information**	11:00-17:00		0:18
16-1-2023	**Confidential information**	10:00-13:00	01:39	
16-1-2023	**Confidential information**	08:30-14:00	01:01	
17-1-2023	**Confidential information**	16:00-?		0:13
17-1-2023	**Confidential information**	08:30-12:00	03:12	
17-1-2023	**Confidential information**	08:00-14:00	01:53	
17-1-2023	**Confidential information**	08:00-16:00	00:12	
18-1-2023	**Confidential information**	08:00-12:00	01:48	
18-1-2023	**Confidential information**	08:00-11:00	03:26	
18-1-2023	**Confidential information**	? -11:00	03:33	
18-1-2023	**Confidential information**	09:00-15:00	00:57	
18-1-2023	**Confidential information**	09:00-10:00	02:03	
18-1-2023	**Confidential information**	09:15-11:00	01:03	
18-1-2023	**Confidential information**	08:00-14:00	00:08	
18-1-2023	**Confidential information**	11:00-12:00	01:08	
19-1-2023	**Confidential information**	08:00-11:00	02:37	
19-1-2023	**Confidential information**	08:00-11:00	01:30	
19-1-2023	**Confidential information**	09:00-11:00	01:30	
19-1-2023	**Confidential information**	01:00-12:00	00:39	
19-1-2023	**Confidential information**	07:00-12:00	00:46	
19-1-2023	**Confidential information**	10:30-12:00	00:54	
19-1-2023	**Confidential information**	11:00-14:00	00:08	
20-1-2023	**Confidential information**	09:00-14:00	00:39	
20-1-2023	**Confidential information**	09:15-11:00	02:56	
20-1-2023	**Confidential information**	08:00-14:00	00:58	
20-1-2023	**Confidential information**	14:00-17:00		0:42
21-1-2023	**Confidential information**	09:00-10:00	01:14	
21-1-2023	**Confidential information**	09:15-11:00	02:05	
23-1-2023	**Confidential information**	12:00-17:00		0:37
23-1-2023	**Confidential information**	09:15-11:00	00:09	
23-1-2023	**Confidential information**	09:00-11:00	00:26	
23-1-2023	**Confidential information**	10:00-13:00	00:47	
23-1-2023	**Confidential information**	01:00-12:00	01:53	

23-1-2023	**Confidential information**	08:00-12:30	01:40	
23-1-2023	**Confidential information**	09:00-14:00	00:26	
23-1-2023	**Confidential information**	11:00-?		0:23
24-1-2023	**Confidential information**	08:30-12:00	01:02	
25-1-2023	**Confidential information**	09:15-11:00	01:32	
25-1-2023	**Confidential information**	08:00-14:00	01:24	
25-1-2023	**Confidential information**	11:00-12:00	01:20	
26-1-2023	**Confidential information**	08:30-11:00	00:09	
26-1-2023	**Confidential information**	08:30-11:00	00:49	
26-1-2023	**Confidential information**	08:00-11:00	00:11	
26-1-2023	**Confidential information**	10:30-12:00		0:13
26-1-2023	**Confidential information**	09:00-13:00	00:13	
26-1-2023	**Confidential information**	11:00-23:59		0:13
26-1-2023	**Confidential information**	11:00-14:00	01:55	
27-1-2023	**Confidential information**	09:15-11:00	00:14	
27-1-2023	**Confidential information**	08:00-14:00	00:17	
27-1-2023	**Confidential information**	11:00-17:00		0:44
28-1-2023	**Confidential information**	09:00-10:00	01:04	
30-1-2023	**Confidential information**	11:00-17:00		0:39
30-1-2023	**Confidential information**	01:00-12:00	00:41	
30-1-2023	**Confidential information**	08:00-12:30	00:24	
30-1-2023	**Confidential information**	08:00-14:00	00:21	
30-1-2023	**Confidential information**	10:00-13:00	01:24	
30-1-2023	**Confidential information**	09:00-14:00	00:45	
30-1-2023	**Confidential information**	11:00-?		0:24
30-1-2023	**Confidential information**	12:00-?		1:23
31-1-2023	**Confidential information**	08:00-16:00	00:35	
31-1-2023	**Confidential information**	08:30-12:00	03:48	
31-1-2023	**Confidential information**	08:00-14:00	02:22	
31-1-2023	**Confidential information**	12:00-17:00	00:12	
1-2-2023	**Confidential information**	08:00-12:00	02:42	
1-2-2023	**Confidential information**	08:00-15:00	00:20	
1-2-2023	**Confidential information**	08:00-16:00	00:36	
2-2-2023	**Confidential information**	08:30-11:00	00:14	
2-2-2023	**Confidential information**	01:00-14:00	00:46	
2-2-2023	**Confidential information**	01:00-14:00	01:49	
2-2-2023	**Confidential information**	01:00-14:00	01:49	
2-2-2023	**Confidential information**	08:00-14:00	01:49	
2-2-2023	**Confidential information**	09:00-13:00	03:47	
2-2-2023	**Confidential information**	10:00-14:00	02:50	
2-2-2023	**Confidential information**	01:00-14:00	02:57	
2-2-2023	**Confidential information**	11:00-14:00	01:50	
3-2-2023	**Confidential information**	14:00-17:00		2:36
6-2-2023	**Confidential information**	09:15-11:00	00:52	
6-2-2023	**Confidential information**	10:00-13:00	00:46	
6-2-2023	**Confidential information**	01:00-14:00	02:10	

7-2-2023	**Confidential information**	08:00-15:00	02:17	
7-2-2023	**Confidential information**	08:00-16:00	01:18	
7-2-2023	**Confidential information**	07:30-16:00	01:18	
7-2-2023	**Confidential information**	09:00-17:00	00:18	
7-2-2023	**Confidential information**	08:30-12:00	05:38	
7-2-2023	**Confidential information**	08:00-14:00	02:06	
8-2-2023	**Confidential information**	08:00-11:00	04:15	
8-2-2023	**Confidential information**	? -11:00	04:15	
8-2-2023	**Confidential information**	08:30-11:00	04:15	
8-2-2023	**Confidential information**	08:00-12:00	03:15	
8-2-2023	**Confidential information**	08:00-12:00	03:16	
8-2-2023	**Confidential information**	08:00-16:30	00:12	
8-2-2023	**Confidential information**	08:30-16:00	01:14	
8-2-2023	**Confidential information**	09:00-10:00	00:31	
8-2-2023	**Confidential information**	09:15-11:00	01:09	
8-2-2023	**Confidential information**	08:00-14:00	01:10	
9-2-2023	**Confidential information**	08:00-11:00	02:38	
9-2-2023	**Confidential information**	01:00-12:00	01:23	
9-2-2023	**Confidential information**	07:00-12:00	01:23	
9-2-2023	**Confidential information**	09:00-12:00	00:23	
9-2-2023	**Confidential information**	10:30-12:00	01:55	
9-2-2023	**Confidential information**	11:00-14:00	01:50	
10-2-2023	**Confidential information**	09:00-14:00	00:29	
10-2-2023	**Confidential information**	11:00-17:00		0:48
10-2-2023	**Confidential information**	14:00-17:00		1:30
10-2-2023	**Confidential information**	09:15-11:00	00:11	
10-2-2023	**Confidential information**	10:00-11:00	00:37	
11-2-2023	**Confidential information**	09:00-10:00	02:19	
11-2-2023	**Confidential information**	09:15-11:00	01:19	
13-2-2023	**Confidential information**	09:00-11:00	00:14	
13-2-2023	**Confidential information**	09:15-11:00	00:59	
13-2-2023	**Confidential information**	08:00-11:00	00:14	
13-2-2023	**Confidential information**	10:00-13:00	00:50	
13-2-2023	**Confidential information**	01:00-14:00	00:19	
14-2-2023	**Confidential information**	16:00-?		3:41
14-2-2023	**Confidential information**	16:00-?		3:02
14-2-2023	**Confidential information**	16:00-?		2:36
14-2-2023	**Confidential information**	08:30-12:00	03:50	
14-2-2023	**Confidential information**	08:00-14:00	02:42	
14-2-2023	**Confidential information**	08:00-16:00	00:18	
15-2-2023	**Confidential information**	08:00-12:00	01:52	
15-2-2023	**Confidential information**	08:00-16:00	00:43	
15-2-2023	**Confidential information**	09:00-10:00	04:07	
15-2-2023	**Confidential information**	09:00-11:00	03:07	
15-2-2023	**Confidential information**	08:00-14:00	02:08	
15-2-2023	**Confidential information**	11:00-12:00	00:35	

16-2-2023	**Confidential information**	08:00-11:00	03:14	
16-2-2023	**Confidential information**	08:30-11:00	00:12	
16-2-2023	**Confidential information**	09:00-12:00	00:07	
16-2-2023	**Confidential information**	10:30-12:00		0:27
17-2-2023	**Confidential information**	14:00-17:00		1:35
17-2-2023	**Confidential information**	09:15-11:00	02:36	
18-2-2023	**Confidential information**	09:00-10:00	01:03	
18-2-2023	**Confidential information**	09:15-11:00	00:20	

Table 23. The clients helped outside of their indicated timeslots in the period from November 19th 2022 until February 19th 2023.

Appendix C The Material Flow and Profit and Cost Streams of the Logistics Processes at The Company.

This flowchart represents the material flow of the organic waste through the logistics processes of The Company and its third parties. The process of creating new products out of the organic waste at the partnership companies could require multiple companies to create the final product that is sold from The Company to its clients. These partnership companies are in the Netherlands creating locally sourced and produced products.

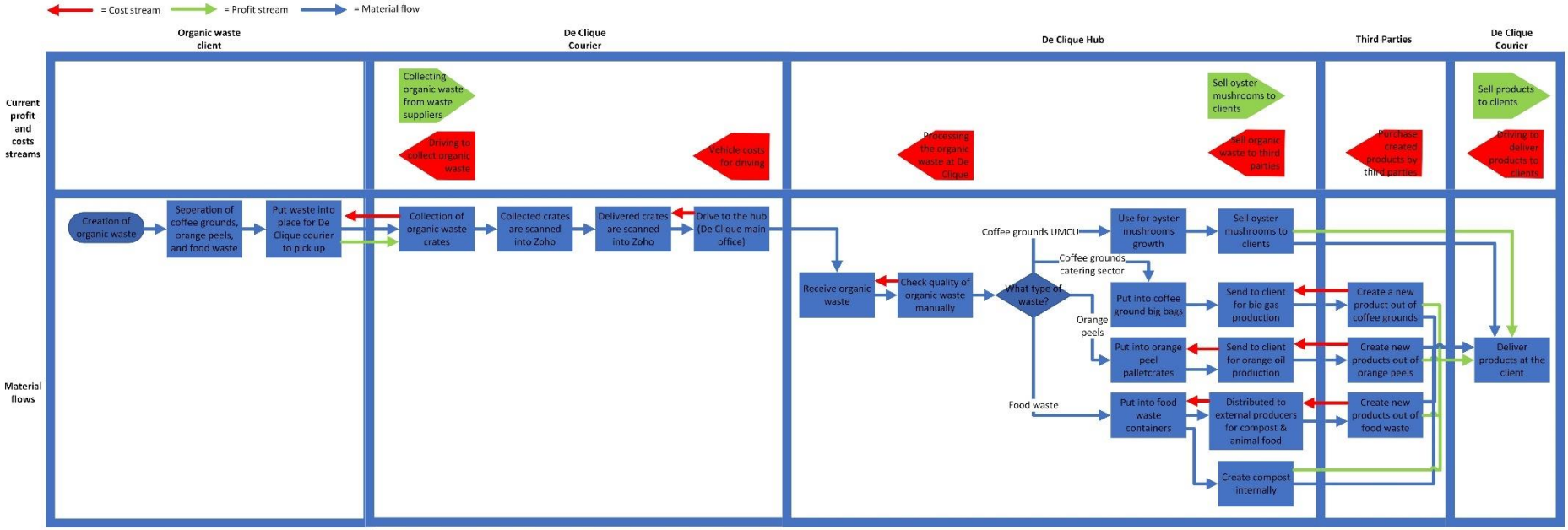

Figure 14. The costs, profit, and material flow of The Company of this research.

Appendix D The Processing Times of the Clients Distributed by Each Client Type.

Date	Planned working hours in SmartRoute	Scanned working hours in SmartRoute	Total working hours	Number of clients	Average time per client
2-11-2022	07:32	04:50	08:18	12	00:41
3-11-2022	06:47	06:09	08:30	11	00:46
8-11-2022	08:35	08:15	09:15	14	00:39
10-11-2022	04:36	04:52	06:29	10	00:38
15-11-2022	08:20	07:14	08:02	13	00:37
16-11-2022	07:31	05:17	06:58	13	00:32
17-11-2022	04:19	04:47	06:27	9	00:43
22-11-2022	08:47	08:42	09:31	15	00:38
23-11-2022	08:06	07:35	09:14	14	00:39
24-11-2022	04:30	04:44	06:00	10	00:36
29-11-2022	06:25	05:36	06:55	11	00:37
30-11-2022	07:56	06:38	08:29	13	00:39
1-12-2022	07:03	06:51	08:26	11	00:46
6-12-2022	08:02	07:33	09:26	12	00:47
7-12-2022	08:01	05:52	08:23	14	00:35
8-12-2022	06:46	05:35	07:32	10	00:45
13-12-2022	09:23	04:39	06:27	11	00:35
14-12-2022	07:19	06:33	08:07	12	00:40
20-12-2022	09:38	08:31	10:34	14	00:45
21-12-2022	08:55	07:05	09:25	16	00:35
22-12-2022	08:44	06:31	08:24	10	00:50
27-12-2022	06:41	04:19	06:10	11	00:33
28-12-2022	08:38	02:26	04:55	15	00:19
29-12-2022	06:15	01:27	03:57	8	00:29
3-1-2023	09:41	07:21	08:56	15	00:35
4-1-2023	08:19	05:28	07:39	15	00:30
5-1-2023	06:42	01:58	04:28	10	00:26
10-1-2023	06:26	02:50	04:40	10	00:28
11-1-2023	07:12	05:43	08:16	11	00:45
12-1-2023	06:48	04:08	06:39	10	00:39
17-1-2023	08:01	07:09	09:00	12	00:45
18-1-2023	09:02	06:07	08:31	16	00:31
24-1-2023	06:28	06:48	08:39	10	00:51
25-1-2023	08:59	05:17	08:03	11	00:43
26-1-2023	05:28	03:00	05:28	9	00:36
31-1-2023	10:00	08:15	09:57	15	00:39
1-2-2023	09:27	07:07	09:46	14	00:41
2-2-2023	05:42	05:31	07:58	10	00:47
7-2-2023	07:31	02:32	04:13	14	00:18
8-2-2023	09:20	02:15	04:01	12	00:20
9-2-2023	08:05	05:29	08:00	11	00:43

14-2-2023	05:51	03:57	06:16	9	00:41
14-2-2023	07:27	03:35	06:23	6	01:03
15-2-2023	09:40	06:17	08:52	14	00:38
16-2-2023	08:05	05:26	07:55	10	00:47

Table 22. The processing times of the clients from the central government between November 2nd 2022 and February 19th 2023.

Table 23 shows that some courier shifts from the Klepierre clients are not scanned in SmartRoute.

Date	Planned working hours in SmartRoute	Scanned working hours in SmartRoute	Total working hours	Number of clients	Average time per client
4-11-2022	01:24	00:47	01:01	6	00:10
11-11-2022	01:24	01:07	01:32	6	00:15
18-11-2022	01:24	01:04	01:34	6	00:15
25-11-2022	01:24	00:42	01:17	6	00:12
2-12-2022	01:24	00:49	01:29	6	00:14
9-12-2022	01:24	00:45	01:19	6	00:13
16-12-2022	01:24	00:38	01:13	6	00:12
23-12-2022	01:24	01:02	01:31	6	00:15
28-12-2022	00:24	04:36	04:56	5	00:59
30-12-2022	01:24	00:21	00:43	6	00:07
3-1-2023	01:14	02:16	02:46	5	00:33
3-2-2023	01:24	00:18	00:47	6	00:07
7-2-2023	01:14	01:20	01:50	5	00:22
14-2-2023	01:14	04:29	04:59	5	00:59
17-2-2023	01:24	02:37	03:06	6	00:31

Table 23. The processing times of the clients from Klepierre between November 2nd 2022 and February 19th 2023.

Date	Planned working hours in SmartRoute	Scanned working hours in SmartRoute	Total working hours	Number of clients	Average time per client
2-11-2022	02:25	02:22	03:05	11	00:16
4-11-2022	01:04	00:52	01:23	3	00:27
7-11-2022	00:49	00:53	01:01	2	00:30
11-11-2022	00:49	00:26	00:58	2	00:29
14-11-2022	00:49	00:49	01:04	2	00:32
16-11-2022	02:22	01:52	02:24	10	00:14
18-11-2022	00:49	00:14	00:46	2	00:23
21-11-2022	01:24	03:58	04:29	5	00:53
25-11-2022	00:49	00:21	00:53	2	00:26
28-11-2022	01:24	00:25	00:56	5	00:11
30-11-2022	02:27	02:02	02:31	9	00:16
2-12-2022	00:49	00:28	01:04	2	00:32
5-12-2022	01:24	00:46	01:19	5	00:15
9-12-2022	00:49	00:28	00:59	2	00:29

12-12-2022	01:52	00:50	01:12	5	00:14
14-12-2022	02:27	02:23	03:02	9	00:20
16-12-2022	00:49	00:31	01:09	2	00:34
19-12-2022	01:52	00:41	01:16	5	00:15
21-12-2022	02:22	02:01	02:35	9	00:17
23-12-2022	00:49	00:28	01:05	2	00:32
28-12-2022	02:04	00:56	01:28	8	00:11
2-1-2023	01:52	00:30	01:05	5	00:13
4-1-2023	03:29	04:25	05:21	10	00:32
9-1-2023	01:52	00:41	01:16	5	00:15
11-1-2023	02:04	03:17	03:49	10	00:22
16-1-2023	01:24	01:26	01:57	5	00:23
18-1-2023	02:08	03:09	03:39	10	00:21
23-1-2023	01:34	00:57	01:49	5	00:21
25-1-2023	02:18	04:30	05:10	10	00:31
30-1-2023	01:34	00:46	01:27	5	00:17
1-2-2023	02:18	01:31	02:11	10	00:13
3-2-2023	00:59	00:19	00:36	2	00:18
6-2-2023	01:34	00:52	01:35	5	00:19
7-2-2023	03:21	02:51	03:30	10	00:21
8-2-2023	02:18	04:38	05:18	10	00:31
13-2-2023	01:34	01:05	01:48	5	00:21
15-2-2023	02:18	06:58	07:38	10	00:45

Table 24. The processing times of the clients from the Uithof between November 2nd 2022 and February 19th 2023.

Date	Planned working hours in SmartRoute	Scanned working hours in SmartRoute	Total working hours	Number of clients	Average time per client
2-11-2022	02:51	04:26	04:56	12	00:24
3-11-2022	05:27	06:48	07:16	23	00:18
3-11-2022	04:16	04:48	05:07	19	00:16
4-11-2022	03:49	07:08	07:48	16	00:29
5-11-2022	02:48	03:48	04:11	11	00:22
7-11-2022	04:44	06:19	06:40	21	00:19
7-11-2022	02:26	02:39	03:14	9	00:21
8-11-2022	05:35	06:22	06:46	22	00:18
10-11-2022	05:57	05:59	06:22	26	00:14
11-11-2022	03:32	04:00	04:34	15	00:18
12-11-2022	02:41	03:44	04:07	11	00:22
14-11-2022	04:30	07:19	07:53	19	00:24
14-11-2022	02:56	02:13	02:32	11	00:13
15-11-2022	03:29	04:28	04:49	13	00:22
15-11-2022	01:50	03:13	04:05	7	00:35
16-11-2022	03:11	04:20	04:45	13	00:21
17-11-2022	05:50	06:47	07:11	28	00:15
17-11-2022	04:02	04:26	04:55	18	00:16

18-11-2022	04:05	04:57	05:33	17	00:19
19-11-2022	02:50	03:13	03:37	11	00:19
21-11-2022	05:11	07:13	07:40	23	00:20
23-11-2022	02:59	04:16	04:48	12	00:24
24-11-2022	07:03	07:15	07:35	29	00:15
24-11-2022	03:55	05:49	06:01	17	00:21
25-11-2022	03:34	05:52	06:32	15	00:26
26-11-2022	03:26	03:27	03:51	12	00:19
28-11-2022	04:49	06:39	07:08	21	00:20
28-11-2022	01:55	01:33	01:52	8	00:14
29-11-2022	01:46	01:26	01:52	6	00:18
30-11-2022	02:31	03:51	04:20	10	00:26
1-12-2022	06:18	06:57	07:18	27	00:16
2-12-2022	03:51	07:19	08:00	18	00:26
3-12-2022	03:18	03:30	04:02	12	00:20
5-12-2022	05:03	07:05	07:29	23	00:19
5-12-2022	01:55	01:08	01:38	7	00:14
6-12-2022	03:54	02:46	03:13	14	00:13
7-12-2022	03:08	03:40	04:40	13	00:21
8-12-2022	05:37	05:56	06:25	24	00:16
9-12-2022	06:02	05:12	05:45	15	00:23
10-12-2022	03:16	02:29	02:56	11	00:16
12-12-2022	04:44	03:31	03:58	20	00:11
12-12-2022	02:53	02:13	02:21	9	00:15
13-12-2022	03:38	04:20	04:47	14	00:20
14-12-2022	02:43	03:38	04:04	11	00:22
16-12-2022	06:01	04:39	05:15	16	00:19
17-12-2022	03:16	02:52	03:19	12	00:16
19-12-2022	04:49	06:05	06:31	21	00:18
20-12-2022	03:36	04:28	04:54	15	00:19
21-12-2022	03:11	04:37	05:05	13	00:23
22-12-2022	05:53	05:22	05:45	27	00:12
23-12-2022	04:18	05:14	05:43	15	00:22
24-12-2022	03:21	02:59	03:23	12	00:16
26-12-2022	05:08	04:22	04:53	21	00:13
27-12-2022	03:31	03:24	03:46	14	00:16
28-12-2022	03:26	01:45	02:09	14	00:09
29-12-2022	05:53	05:01	05:26	29	00:11
31-12-2022	03:43	02:26	02:50	11	00:15
2-1-2023	04:17	05:38	06:00	20	00:18
4-1-2023	02:50	04:27	04:54	11	00:26
5-1-2023	05:39	05:41	06:04	27	00:13
6-1-2023	05:42	05:04	05:38	15	00:22
7-1-2023	02:58	01:51	02:19	11	00:12
9-1-2023	04:36	06:05	06:29	21	00:18
10-1-2023	03:00	02:54	03:19	13	00:15

11-1-2023	03:14	04:13	04:40	13	00:21
12-1-2023	05:20	05:07	05:33	24	00:13
13-1-2023	03:32	07:02	07:33	17	00:26
16-1-2023	04:59	06:25	06:51	22	00:18
18-1-2023	02:33	02:40	03:10	10	00:19
20-1-2023	03:29	06:00	06:31	15	00:26
21-1-2023	03:12	02:40	03:04	12	00:15
23-1-2023	04:50	06:28	06:54	20	00:20
24-1-2023	02:52	03:55	04:21	12	00:21
25-1-2023	03:07	03:19	03:51	12	00:19
26-1-2023	04:40	04:36	05:00	20	00:15
27-1-2023	02:18	04:29	04:58	11	00:27
28-1-2023	03:01	01:55	02:23	11	00:13
30-1-2023	03:44	04:12	04:44	13	00:21
30-1-2023	04:56	06:57	07:22	21	00:21
31-1-2023	02:54	03:30	03:56	12	00:19
1-2-2023	02:50	02:50	03:21	10	00:20
2-2-2023	04:51	05:34	05:56	22	00:16
3-2-2023	02:38	02:06	02:34	9	00:17
4-2-2023	03:01	02:08	02:36	11	00:14
6-2-2023	05:28	07:15	07:40	22	00:20
7-2-2023	03:16	02:59	03:25	13	00:15
8-2-2023	03:10	03:30	04:02	12	00:20
9-2-2023	03:12	04:45	05:12	13	00:24
10-2-2023	02:52	02:34	02:59	10	00:17
11-2-2023	03:03	01:07	01:34	12	00:07
13-2-2023	05:54	06:11	06:34	24	00:16
14-2-2023	03:12	04:06	04:32	13	00:20
15-2-2023	03:07	04:21	04:53	14	00:20
16-2-2023	04:18	05:26	05:37	20	00:16
17-2-2023	02:16	05:00	05:28	9	00:36
18-2-2023	02:38	01:17	01:45	11	00:09

Table 25. The processing times of the clients from the city centre between November 2nd 2022 and February 19th 2023.

Date	Planned working hours in SmartRoute	Scanned working hours in SmartRoute	Total working hours	Number of clients	Average time per client
2-11-2022	01:47	03:08	03:11	7	00:27
4-11-2022	05:33	05:55	06:25	16	00:24
8-11-2022	00:44	00:55	01:39	5	00:19
11-11-2022	06:14	06:28	06:59	17	00:24
16-11-2022	01:42	01:08	01:36	6	00:16
18-11-2022	04:48	05:39	06:12	14	00:26
22-11-2022	01:34	00:58	01:52	5	00:22
23-11-2022	01:47	01:09	01:34	7	00:13
25-11-2022	05:43	05:35	06:02	18	00:20

2-12-2022	05:58	05:12	06:01	18	00:20
6-12-2022	01:59	01:14	01:53	6	00:18
7-12-2022	01:53	01:23	01:55	7	00:16
9-12-2022	05:54	06:07	06:44	18	00:22
13-12-2022	04:26	01:18	02:01	6	00:20
14-12-2022	02:26	02:39	03:10	9	00:21
16-12-2022	05:54	06:55	07:32	18	00:25
19-12-2022	03:25	01:49	02:23	9	00:15
20-12-2022	04:26	01:32	02:15	7	00:19
21-12-2022	01:53	01:24	01:56	7	00:16
23-12-2022	05:56	06:47	07:29	18	00:24
28-12-2022	01:40	00:51	01:23	6	00:13
30-12-2022	04:56	03:31	04:06	15	00:16
2-1-2023	03:24	02:08	02:39	9	00:17
3-1-2023	04:26	01:15	01:58	6	00:19
4-1-2023	01:45	01:01	01:33	7	00:13
6-1-2023	05:54	05:20	06:23	18	00:21
9-1-2023	03:21	01:42	02:13	9	00:14
10-1-2023	04:26	03:34	04:17	10	00:25
11-1-2023	01:53	01:04	01:36	7	00:13
12-1-2023	04:35	04:55	05:05	20	00:15
13-1-2023	06:05	06:45	07:23	19	00:23
16-1-2023	02:23	02:08	02:17	9	00:15
17-1-2023	03:05	04:09	04:35	13	00:21
17-1-2023	03:17	04:40	05:17	11	00:28
18-1-2023	02:36	02:17	02:49	10	00:16
20-1-2023	06:11	07:10	07:34	20	00:22
23-1-2023	03:58	03:32	04:00	12	00:20
23-1-2023	02:23	01:43	02:13	9	00:14
24-1-2023	03:21	02:30	03:09	10	00:18
25-1-2023	02:16	01:15	01:47	8	00:13
26-1-2023	01:38	00:56	01:29	4	00:22
26-1-2023	04:11	03:52	04:11	19	00:13
27-1-2023	04:48	04:38	05:26	14	00:23
30-1-2023	02:56	01:31	01:40	10	00:10
31-1-2023	03:40	02:28	03:10	11	00:17
1-2-2023	02:26	00:58	01:29	9	00:09
2-2-2023	01:49	01:17	01:51	5	00:22
2-2-2023	03:44	04:12	04:28	16	00:16
3-2-2023	05:46	05:37	06:17	17	00:22
3-2-2023	02:20	02:47	03:27	8	00:25
6-2-2023	03:28	03:20	03:49	12	00:19
6-2-2023	01:56	01:10	01:39	7	00:14
8-2-2023	02:30	01:00	01:32	10	00:09
9-2-2023	04:30	06:25	06:50	20	00:20
10-2-2023	05:48	05:57	06:29	17	00:22

10-2-2023	01:47	02:37	03:10	7	00:27
13-2-2023	03:03	02:51	03:28	10	00:20
13-2-2023	01:55	01:17	01:26	7	00:12
14-2-2023	03:32	02:49	03:29	11	00:19
15-2-2023	01:25	00:22	01:34	2	00:47
15-2-2023	02:28	01:16	01:35	10	00:09
16-2-2023	02:56	02:35	03:08	9	00:20
16-2-2023	03:13	02:51	03:28	14	00:14
17-2-2023	04:46	04:14	04:50	15	00:19
17-2-2023	03:19	03:51	04:28	10	00:26

Table 26. The processing times of the clients from outside the city centre between November 2nd 2022 and February 19th 2023.

Appendix E The Number of Times the Average Times Spend for Each Type of Client

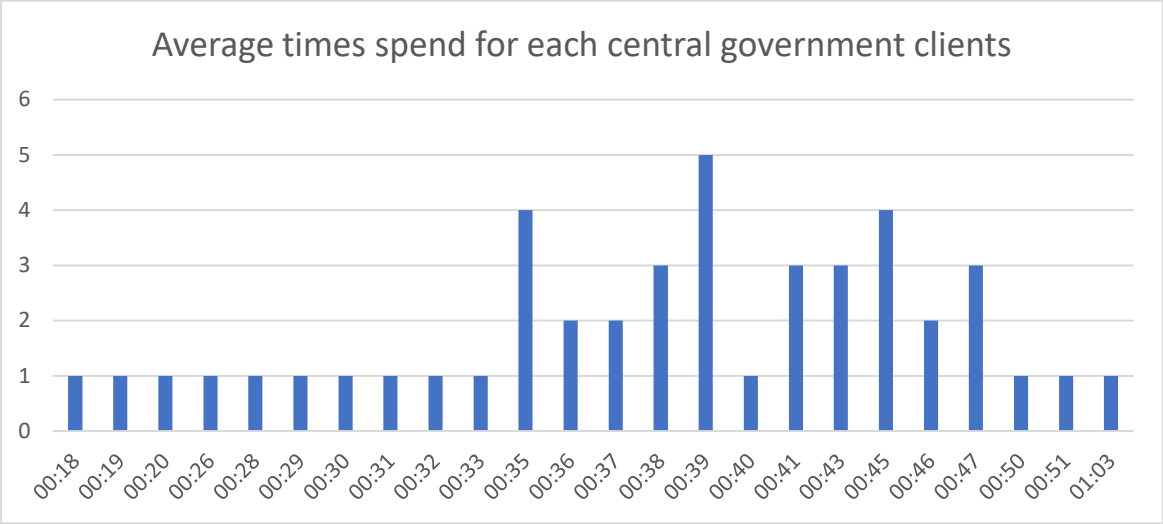

Figure 15. Average times spend for each central government client.

Figure 16. Average times spend for each klepierre client.

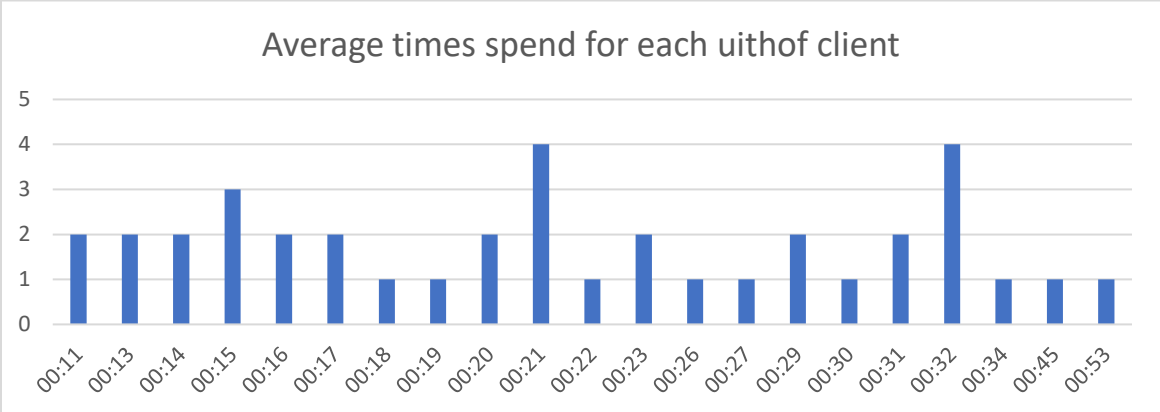

Figure 17. Average times spend for each uithof client.

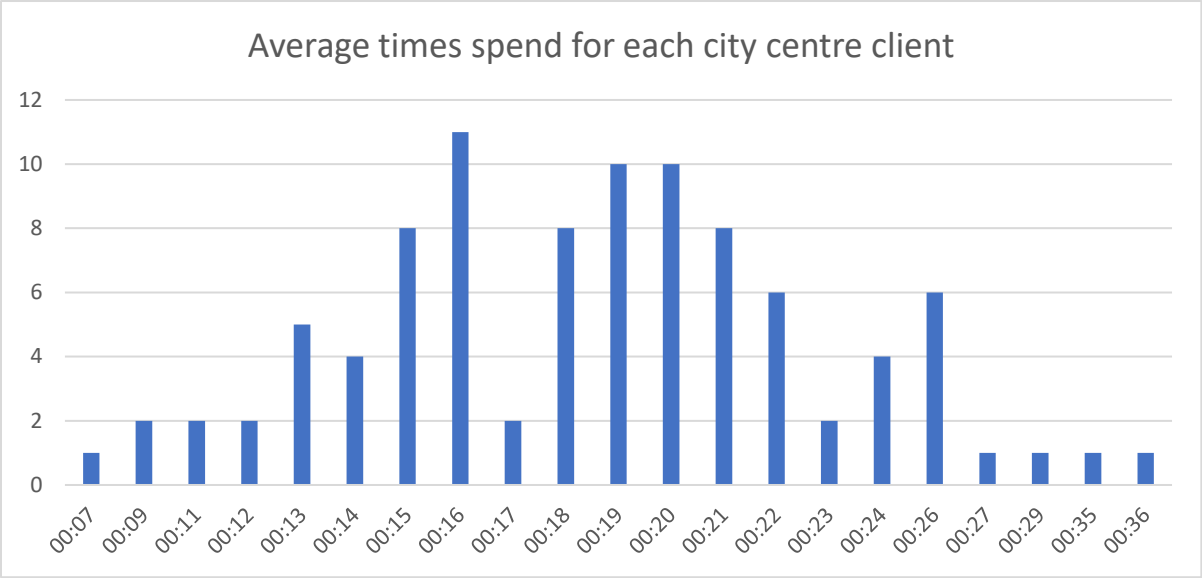

Figure 18. Average times spend for each client in the city centre.

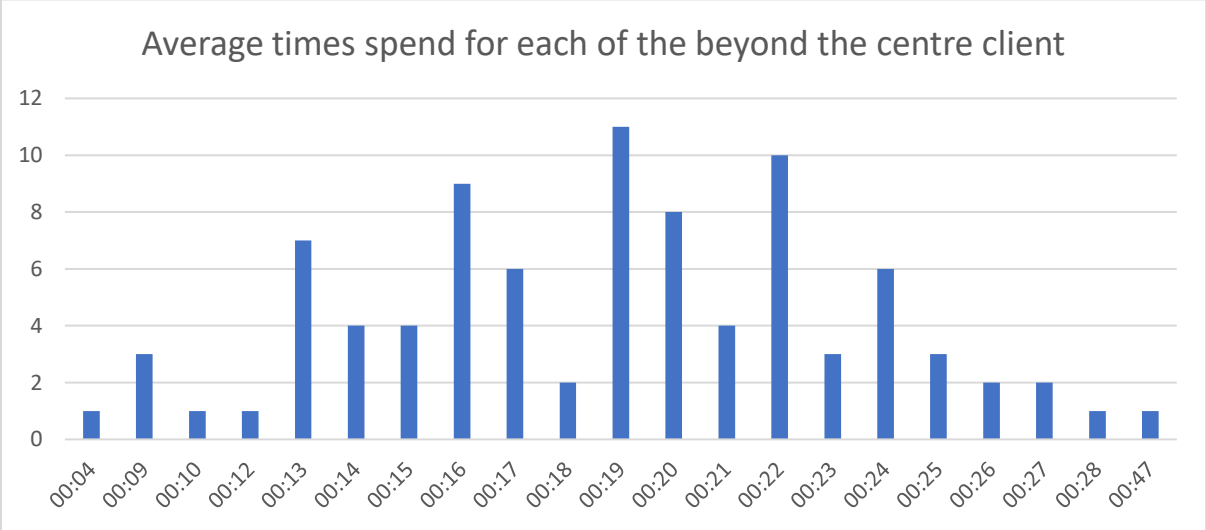

Figure 19. Average times spend for each client outside the city centre.

Appendix F The Differences Between Planned and Actual Clients and Crates

Date	Planned clients	Planned number of crates	Clients with crates	Number of crates collected
19-11-2022	11	55	8	41
21-11-2022	49	245	44	246
22-11-2022	40	200	37	323
23-11-2022	56	280	32	302
24-11-2022	56	280	47	368
25-11-2022	41	205	39	459
26-11-2022	12	60	8	40
28-11-2022	47	235	40	220
29-11-2022	37	185	32	279
30-11-2022	41	205	30	226
1-12-2022	55	275	46	381
2-12-2022	44	220	35	415
3-12-2022	12	60	10	47
5-12-2022	50	250	42	230
6-12-2022	37	185	37	329
7-12-2022	44	220	33	263
8-12-2022	54	270	46	336
9-12-2022	41	205	34	363
10-12-2022	11	55	9	40
12-12-2022	46	230	40	241
13-12-2022	36	180	33	280
14-12-2022	41	205	31	264
16-12-2022	42	210	37	373
17-12-2022	12	60	10	43
19-12-2022	48	240	44	228
20-12-2022	41	205	37	300
21-12-2022	45	225	37	298
22-12-2022	54	270	45	346
23-12-2022	41	205	34	296
24-12-2022	12	60	10	35
26-12-2022	23	115	11	73
27-12-2022	30	150	25	164
28-12-2022	48	240	30	223
29-12-2022	55	275	41	279
30-12-2022	42	210	29	217
31-12-2022	11	55	9	42
2-1-2023	46	230	33	171
3-1-2023	40	200	29	184
4-1-2023	43	215	31	164
5-1-2023	55	275	40	227
6-1-2023	33	165	31	217
7-1-2023	11	55	9	41
9-1-2023	46	230	36	218

10-1-2023	38	190	29	274
11-1-2023	41	205	31	203
12-1-2023	54	270	42	322
13-1-2023	36	180	37	369
14-1-2023	12	60	11	47
16-1-2023	48	240	42	204
17-1-2023	41	205	38	374
18-1-2023	46	230	32	265
19-1-2023	55	275	50	429
20-1-2023	35	175	34	360
21-1-2023	12	60	11	47
23-1-2023	46	230	40	236
24-1-2023	37	185	34	341
25-1-2023	41	205	34	318
26-1-2023	52	260	46	436
27-1-2023	36	180	31	402
28-1-2023	11	55	11	64
30-1-2023	49	245	41	229
31-1-2023	43	215	33	359
1-2-2023	43	215	31	306
2-2-2023	53	265	45	400
3-2-2023	42	210	32	343
4-2-2023	11	55	10	46
6-2-2023	46	230	40	209
7-2-2023	42	210	34	364
8-2-2023	44	220	32	286
9-2-2023	52	260	47	443
10-2-2023	34	170	36	372
11-2-2023	12	60	9	31
13-2-2023	46	230	41	201
14-2-2023	44	220	38	362
15-2-2023	50	250	23	335
16-2-2023	53	265	45	345
17-2-2023	42	210	42	474
18-2-2023	11	55	8	35
Total	**2,985**	**14,985**	**2,507**	**20,029**

Table 27. The planned and actual clients helped, and crates are collected from November 19th 2022 until February 19th 2023.

Appendix G The Differences Between the Expected Schedules and the Actual Schedules

The difference between the scanned working hours and the total working hours is the time of driving to the first client and returning from the last client, which is not scanned in SmartRoute but estimated based on the google maps driving times, plus the scanned working hours from SmartRoute. The actual total working hours of the couriers are only compared to the planned working hours in SmartRoute as these times are more reliable/adjusted to each specific situation.

Date	The type of vehicle	Planned working hours in Shift-base	Planned working hours in Smart-Route	Scanned working hours in Smart-Route	Total working hours of the couriers	Extra driven than planned in Smart-Route	Less driven than planned in Smart-Route	Time left
18-10-2022	Van	08:15	08:03	08:14	09:17	01:14	0	08:52
18-10-2022	New goupil	07:00	04:54	05:22	05:43	00:49	0	08:42
19-10-2022	Van	07:15	07:22	05:41	08:50	01:28	0	07:42
19-10-2022	New goupil	07:15	04:18	05:11	05:46	01:28	0	08:40
20-10-2022	Van	07:15	06:22	01:30	05:02	0	01:20	08:01
20-10-2022	New goupil	07:15	05:57	08:19	08:46	02:49	0	08:47
20-10-2022	Old goupil	08:15	03:57	06:59	07:32	03:35	0	08:56
21-10-2022	Van	07:15	05:19	05:53	06:22	01:03	0	08:36
21-10-2022	New goupil	05:15	03:08	04:13	04:47	01:39	0	08:09
21-10-2022	Old goupil	04:15	02:13	03:54	04:26	02:13	0	08:39
22-10-2022	New goupil	04:00	02:47	02:25	02:49	00:02	0	09:55
24-10-2022	Van	05:15	03:33	04:00	04:29	00:56	0	08:47
24-10-2022	New goupil	06:15	04:27	05:35	05:59	01:32	0	08:46
24-10-2022	Old goupil	07:15	03:29	02:53	03:15	0	00:14	08:47
25-10-2022	Van	08:15	08:03	06:43	07:51	0	00:12	08:25
25-10-2022	New goupil	07:00	04:54	06:43	07:07	02:13	0	08:25
26-10-2022	Van	07:15	07:59	05:57	09:22	01:23	0	07:42
26-10-2022	New goupil	07:15	04:13	05:22	05:46	01:33	0	08:44
26-10-2022	Old goupil	04:30	02:37	04:35	05:08	02:31	0	10:25
27-10-2022	Van	07:15	07:59	05:15	07:31	0	00:28	07:57
27-10-2022	New goupil	07:15	05:00	07:11	07:36	02:36	0	08:50
27-10-2022	Old goupil	08:15	05:24	07:27	07:55	02:31	0	08:58
28-10-2022	Van	07:15	05:37	05:46	06:26	00:49	0	08:29
28-10-2022	New goupil	05:15	03:04	04:04	04:33	01:29	0	08:37
28-10-2022	Old goupil	04:15	02:26	03:26	03:55	01:29	0	08:07
29-10-2022	New goupil	04:00	02:45	02:38	03:01	00:16	0	10:12
31-10-2022	Van	05:15	03:32	02:42	03:08	0	00:24	09:06
31-10-2022	New goupil	06:15	04:18	06:41	07:04	02:46	0	08:31
31-10-2022	Old goupil	05:14	02:12	01:36	01:50	0	00:22	09:22
31-10-2022	Old goupil	02:00	00:49	00:32	00:50	00:01	0	11:12
1-11-2022	Van	08:15	07:58	05:14	06:23	0	01:35	08:23
1-11-2022	New goupil	06:00	05:17	07:17	07:29	02:12	0	09:56
2-11-2022	Van	07:15	07:32	04:50	08:18	00:46	0	07:41

2-11-2022	New goupil	07:15	02:51	04:26	04:56	02:05	0	08:51
2-11-2022	Old goupil	00:00	01:47	03:08	03:11	01:24	0	10:07
2-11-2022	Old goupil	02:30	02:25	02:22	03:05	00:40	0	13:00
3-11-2022	Van	07:15	06:47	06:09	08:30	01:43	0	08:13
3-11-2022	New goupil	07:15	05:27	06:48	07:16	01:49	0	09:04
3-11-2022	Old goupil	09:15	04:16	04:48	05:07	00:51	0	09:51
4-11-2022	Van	07:15	05:33	05:55	06:25	00:52	0	08:46
4-11-2022	New goupil	05:15	03:49	07:08	07:48	03:59	0	09:12
4-11-2022	Old goupil	02:00	01:24	00:47	01:01	0	00:23	11:09
4-11-2022	Old goupil	02:15	01:04	00:52	01:23	00:19	0	08:39
5-11-2022	New goupil	04:00	02:48	03:48	04:11	01:23	0	09:59
7-11-2022	Van	05:15	04:07	03:56	04:22	00:15	0	08:33
7-11-2022	New goupil	06:15	04:44	06:19	06:40	01:56	0	08:35
7-11-2022	Old goupil	05:15	02:26	02:39	03:14	00:48	0	08:32
7-11-2022	Old goupil	02:00	00:49	00:53	01:01	00:12	0	10:04
8-11-2022	Van	08:15	08:35	08:15	09:15	00:40	0	09:06
8-11-2022	New goupil	07:00	05:35	06:22	06:46	01:11	0	08:45
8-11-2022	Old goupil	05:15	00:44	00:55	01:39	00:55	0	14:15
10-11-2022	Van	07:15	04:36	04:52	06:29	01:53	0	08:54
10-11-2022	New goupil	07:15	05:57	05:59	06:22	00:25	0	08:33
10-11-2022	Old goupil	08:15	04:08	05:13	05:25	01:17	0	09:01
11-11-2022	Van	07:15	06:14	06:28	06:59	00:45	0	08:28
11-11-2022	New goupil	05:15	03:32	04:00	04:34	01:02	0	08:50
11-11-2022	Old goupil	02:15	00:49	00:26	00:58	00:09	0	08:13
11-11-2022	Old goupil	02:00	01:24	01:07	01:32	00:08	0	10:09
12-11-2022	New goupil	04:00	02:41	03:44	04:07	01:26	0	09:56
14-11-2022	Van	05:15	04:26	04:30	04:48	00:22	0	08:39
14-11-2022	New goupil	06:15	04:30	07:19	07:53	03:23	0	08:26
14-11-2022	Old goupil	02:00	00:49	00:49	01:04	00:15	0	10:40
14-11-2022	Old goupil	05:15	02:56	02:13	02:32	0	00:24	08:36
15-11-2022	Van	08:15	08:20	07:14	08:02	0	00:18	09:30
15-11-2022	New goupil	07:00	03:29	04:28	04:49	01:20	0	08:32
15-11-2022	Old goupil	05:15	01:50	03:13	04:05	02:15	0	12:26
16-11-2022	Van	07:15	07:31	05:17	06:58	0	00:33	08:29
16-11-2022	New goupil	07:15	03:11	04:20	04:45	01:34	0	11:27
16-11-2022	Old goupil	02:30	02:22	01:52	02:24	00:02	0	09:01
16-11-2022	Old goupil	00:00	01:42	01:08	01:36	0	00:06	09:19
17-11-2022	Van	07:15	04:19	04:47	06:27	02:08	0	08:18
17-11-2022	New goupil	07:15	05:50	06:47	07:11	01:21	0	09:13
17-11-2022	Old goupil	08:15	04:02	04:26	04:55	00:53	0	08:44
18-11-2022	Van	07:15	04:48	05:39	06:12	01:24	0	08:45
18-11-2022	New goupil	05:15	04:05	04:57	05:33	01:28	0	09:13
18-11-2022	Old goupil	02:00	01:24	01:04	01:34	00:10	0	10:08
18-11-2022	Old goupil	02:15	00:49	00:14	00:46	0	00:03	08:38
19-11-2022	New goupil	04:00	02:50	03:13	03:37	00:47	0	10:06
21-11-2022	Van	05:15	03:33	03:09	03:30	0	00:03	08:54
21-11-2022	New goupil	06:15	05:11	07:13	07:40	02:29	0	08:20

21-11-2022	Old goupil	05:15	02:10	01:45	02:13	00:03	0	08:53
21-11-2022	Old goupil	02:00	01:24	03:58	04:29	03:05	0	10:52
22-11-2022	Van	08:15	08:47	08:42	09:31	00:44	0	08:36
22-11-2022	New goupil	06:00	03:57	05:12	05:43	01:46	0	08:40
22-11-2022	Old goupil	02:00	01:34	00:58	01:52	00:18	0	13:26
23-11-2022	Van	07:15	08:06	07:35	09:14	01:08	0	08:13
23-11-2022	New goupil	07:15	02:59	04:16	04:48	01:49	0	09:05
23-11-2022	Old goupil	02:00	01:47	01:09	01:34	0	00:13	13:32
24-11-2022	Van	07:15	04:30	04:44	06:00	01:30	0	08:32
24-11-2022	New goupil	07:15	07:03	07:15	07:35	00:32	0	09:12
24-11-2022	Old goupil	08:15	03:55	05:49	06:01	02:06	0	09:40
25-11-2022	Van	07:15	05:43	05:35	06:02	00:19	0	08:22
25-11-2022	New goupil	05:15	03:34	05:52	06:32	02:58	0	09:09
25-11-2022	Old goupil	02:00	01:24	00:42	01:17	0	00:07	10:15
25-11-2022	Old goupil	02:15	00:49	00:21	00:53	00:04	0	08:17
26-11-2022	New goupil	04:00	03:26	03:27	03:51	00:25	0	10:14
28-11-2022	Van	05:15	03:31	03:07	03:20	0	00:11	08:29
28-11-2022	New goupil	06:15	04:49	06:39	07:08	02:19	0	08:39
28-11-2022	Old goupil	05:15	01:55	01:33	01:52	0	00:03	08:37
28-11-2022	Old goupil	02:00	01:24	00:25	00:56	0	00:28	10:44
29-11-2022	Van	08:15	06:25	05:36	06:55	00:30	0	08:41
29-11-2022	New goupil	06:00	03:41	04:25	04:46	01:05	0	08:59
29-11-2022	Old goupil	02:00	01:46	01:26	01:52	00:06	0	14:28
30-11-2022	Van	07:15	07:56	06:38	08:29	00:33	0	08:26
30-11-2022	New goupil	07:15	02:31	03:51	04:20	01:49	0	09:06
30-11-2022	Old goupil	00:00	02:16	01:34	01:58	0	00:18	13:14
30-11-2022	Old goupil	02:30	02:27	02:02	02:31	00:04	0	10:33
1-12-2022	Van	07:15	07:03	06:51	08:26	01:23	0	08:48
1-12-2022	New goupil	07:15	06:18	06:57	07:18	01:00	0	09:13
1-12-2022	Old goupil	08:15	03:57	06:18	07:04	03:07	0	09:44
2-12-2022	Van	07:15	05:58	05:12	06:01	00:03	0	08:41
2-12-2022	New goupil	07:15	03:51	07:19	08:00	04:09	0	09:06
2-12-2022	Old goupil	02:00	01:24	00:49	01:29	00:05	0	10:30
2-12-2022	Old goupil	02:15	00:49	00:28	01:04	00:15	0	08:18
3-12-2022	New goupil	04:00	03:18	03:30	04:02	00:44	0	10:15
5-12-2022	Van	05:15	03:53	03:53	04:27	00:34	0	08:48
5-12-2022	New goupil	06:15	05:03	07:05	07:29	02:26	0	08:16
5-12-2022	Old goupil	05:15	01:55	01:08	01:38	0	00:17	08:56
5-12-2022	Old goupil	02:00	01:24	00:46	01:19	0	00:05	10:27
6-12-2022	Van	08:15	08:02	07:33	09:26	01:24	0	08:24
6-12-2022	New goupil	06:15	03:54	02:46	03:13	0	00:41	08:56
6-12-2022	Old goupil	02:00	01:59	01:14	01:53	0	00:06	14:16
7-12-2022	Van	07:15	08:01	05:52	08:23	00:22	0	07:48
7-12-2022	New goupil	07:15	03:08	03:40	04:40	01:32	0	09:29
7-12-2022	Old goupil	02:00	01:53	01:23	01:55	00:02	0	13:37
8-12-2022	Van	07:15	06:46	05:35	07:32	00:46	0	08:16
8-12-2022	New goupil	07:15	05:37	05:56	06:25	00:48	0	08:54

8-12-2022	Old goupil	08:15	04:31	05:01	05:22	00:51	0	08:57
9-12-2022	Van	07:15	05:54	06:07	06:44	00:50	0	08:18
9-12-2022	New goupil	07:15	06:02	05:12	05:45	0	00:17	08:33
9-12-2022	Old goupil	02:00	01:24	00:45	01:19	0	00:05	10:49
9-12-2022	Old goupil	02:15	00:49	00:28	00:59	00:10	0	08:34
10-12-2022	New goupil	04:00	03:16	02:29	02:56	0	00:20	10:55
12-12-2022	Van	05:15	04:26	03:42	04:22	0	00:04	09:02
12-12-2022	New goupil	06:15	04:44	03:31	03:58	0	00:46	08:16
12-12-2022	Old goupil	05:15	02:53	02:13	02:21	0	00:32	08:48
12-12-2022	Old goupil	02:00	01:52	00:50	01:12	0	00:40	11:09
13-12-2022	Van	08:15	09:23	04:39	06:27	0	02:56	08:27
13-12-2022	New goupil	06:00	03:38	04:20	04:47	01:09	0	09:16
13-12-2022	Old goupil	02:00	04:26	01:18	02:01	0	02:25	14:51
14-12-2022	Van	09:00	07:19	06:33	08:07	00:48	0	08:03
14-12-2022	New goupil	07:15	02:43	03:38	04:04	01:21	0	09:11
14-12-2022	Old goupil	00:00	02:26	02:39	03:10	00:44	0	12:41
14-12-2022	Old goupil	02:30	02:27	02:23	03:02	00:35	0	10:10
16-12-2022	Van	07:15	05:54	06:55	07:32	01:38	0	09:28
16-12-2022	New goupil	07:15	06:01	04:39	05:15	0	00:46	08:53
16-12-2022	Old goupil	02:00	01:24	00:38	01:13	0	00:11	10:32
16-12-2022	Old goupil	02:15	00:49	00:31	01:09	00:20	0	08:27
17-12-2022	New goupil	04:00	03:16	02:52	03:19	00:03	0	11:14
19-12-2022	Van	05:15	04:39	03:28	04:09	0	00:30	08:32
19-12-2022	New goupil	06:15	04:49	06:05	06:31	01:42	0	08:31
19-12-2022	Old goupil	05:15	03:25	01:49	02:23	0	01:02	08:40
19-12-2022	Old goupil	02:00	01:52	00:41	01:16	0	00:36	10:43
20-12-2022	Van	08:15	09:38	08:31	10:34	00:56	0	08:30
20-12-2022	New goupil	06:00	03:36	04:28	04:54	01:18	0	09:06
20-12-2022	Old goupil	02:00	04:26	01:32	02:15	0	02:11	13:53
21-12-2022	Van	07:15	08:55	07:05	09:25	00:30	0	08:06
21-12-2022	New goupil	07:15	03:11	04:37	05:05	01:54	0	09:08
21-12-2022	Old goupil	02:00	01:53	01:24	01:56	00:03	0	14:13
21-12-2022	Old goupil	02:30	02:22	02:01	02:35	00:13	0	12:28
22-12-2022	Van	07:15	08:44	06:31	08:24	0	00:20	08:17
22-12-2022	New goupil	07:15	05:53	05:22	05:45	0	00:08	08:16
22-12-2022	Old goupil	08:15	05:14	04:27	04:49	0	00:25	08:40
23-12-2022	Van	07:15	05:56	06:47	07:29	01:33	0	08:45
23-12-2022	New goupil	07:15	04:18	05:14	05:43	01:25	0	08:38
23-12-2022	Old goupil	02:00	01:24	01:02	01:31	00:07	0	10:31
23-12-2022	Old goupil	02:15	00:49	00:28	01:05	00:16	0	08:53
24-12-2022	New goupil	04:00	03:21	02:59	03:23	00:02	0	10:01
26-12-2022	New goupil	08:15	05:08	04:22	04:53	0	00:15	08:57
27-12-2022	Van	08:15	06:41	04:19	06:10	0	00:31	08:11
27-12-2022	New goupil	08:00	03:31	03:24	03:46	00:15	0	08:35
27-12-2022	Old goupil	06:00	04:26	01:07	01:50	0	02:36	14:45
28-12-2022	Van	07:15	08:38	02:26	04:55	0	03:43	08:04
28-12-2022	New goupil	07:15	03:26	01:45	02:09	0	01:17	08:55

28-12-2022	Old goupil	00:00	01:40	00:51	01:23	0	00:17	14:09
28-12-2022	Old goupil	02:00	02:04	00:56	01:28	0	00:36	14:32
28-12-2022	Old goupil	05:15	00:24	04:36	04:56	04:32	0	08:19
29-12-2022	Van	07:15	06:15	01:27	03:57	0	02:18	07:39
29-12-2022	New goupil	07:15	05:53	05:01	05:26	0	00:27	09:14
29-12-2022	Old goupil	08:15	03:59	03:48	04:06	00:07	0	11:14
30-12-2022	Van	07:15	04:56	03:31	04:06	0	00:50	08:48
30-12-2022	New goupil	07:15	05:54	07:03	07:44	01:50	0	09:02
30-12-2022	Old goupil	02:00	01:24	00:21	00:43	0	00:41	10:43
31-12-2022	New goupil	04:00	03:43	02:26	02:50	0	00:53	09:54
2-1-2023	Van	05:15	04:26	03:44	04:25	0	00:01	08:32
2-1-2023	New goupil	06:15	04:17	05:38	06:00	01:43	0	08:36
2-1-2023	Old goupil	05:15	03:24	02:08	02:39	0	00:45	08:40
2-1-2023	Old goupil	02:00	01:52	00:30	01:05	0	00:47	09:59
3-1-2023	Van	08:15	09:41	07:21	08:56	0	00:45	08:18
3-1-2023	New goupil	06:00	03:30	04:07	04:33	01:03	0	08:39
3-1-2023	Old goupil	02:00	04:26	01:15	01:58	0	02:28	13:33
3-1-2023	Old goupil	05:15	01:14	02:16	02:46	01:32	0	11:07
4-1-2023	Van	07:15	08:19	05:28	07:39	0	00:40	07:58
4-1-2023	New goupil	07:15	02:50	04:27	04:54	02:04	0	09:17
4-1-2023	Old goupil	02:00	01:45	01:01	01:33	0	00:12	14:03
4-1-2023	Old goupil	02:30	03:29	04:25	05:21	01:52	0	09:06
5-1-2023	Van	07:15	06:42	01:58	04:28	0	02:14	07:50
5-1-2023	New goupil	07:15	05:39	05:41	06:04	00:25	0	09:00
5-1-2023	Old goupil	08:15	05:33	05:57	06:14	00:41	0	08:55
6-1-2023	Van	07:15	05:54	05:20	06:23	00:29	0	08:00
6-1-2023	New goupil	07:15	05:42	05:04	05:38	0	00:04	09:08
7-1-2023	New goupil	04:00	02:58	01:51	02:19	0	00:39	11:26
9-1-2023	Van	05:15	04:26	03:51	04:32	00:06	0	08:44
9-1-2023	New goupil	06:15	04:36	06:05	06:29	01:53	0	08:25
9-1-2023	Old goupil	05:15	03:21	01:42	02:13	0	01:08	08:23
9-1-2023	Old goupil	02:00	01:52	00:41	01:16	0	00:36	11:18
10-1-2023	Van	08:15	06:26	02:50	04:40	0	01:46	08:26
10-1-2023	New goupil	06:00	03:00	02:54	03:19	00:19	0	09:10
10-1-2023	Old goupil	02:00	04:26	03:34	04:17	0	00:09	09:35
11-1-2023	Van	07:15	07:12	05:43	08:16	01:04	0	08:10
11-1-2023	New goupil	07:15	03:14	04:13	04:40	01:26	0	09:22
11-1-2023	Old goupil	00:00	01:53	01:04	01:36	0	00:17	13:42
11-1-2023	Old goupil	02:30	02:04	03:17	03:49	01:45	0	11:41
12-1-2023	Van	07:15	06:48	04:08	06:39	0	00:09	08:05
12-1-2023	New goupil	07:15	05:20	05:07	05:33	00:13	0	08:51
12-1-2023	Old goupil	08:15	04:35	04:55	05:05	00:30	0	08:46
13-1-2023	Van	07:15	06:05	06:45	07:23	01:18	0	08:27
13-1-2023	New goupil	04:15	03:32	07:02	07:33	04:01	0	08:47
14-1-2023	New goupil	04:00	03:12	04:19	04:43	01:31	0	10:33
16-1-2023	Van	05:15	03:22	03:25	03:51	00:29	0	08:31
16-1-2023	New goupil	06:15	04:59	06:25	06:51	01:52	0	08:48

16-1-2023	Old goupil	05:15	02:23	02:08	02:17	0	00:06	08:44
16-1-2023	Old goupil	02:00	01:24	01:26	01:57	00:33	0	11:29
17-1-2023	Van	08:15	08:01	07:09	09:00	00:59	0	08:00
17-1-2023	New goupil	06:00	03:05	04:09	04:35	01:30	0	08:47
17-1-2023	Old goupil	02:00	03:17	04:40	05:17	02:00	0	11:32

Table 28. The data on the courier routes from the 18th of October until the 17th of January 2022 is collected through SmartRoute.

Appendix H The Visualisation of the Logistics Processes and Extra Required Information

When couriers finish their tasks, they help at The Company when this is useful, and for that reason, some processes of The Company employees are also added to this appendix.

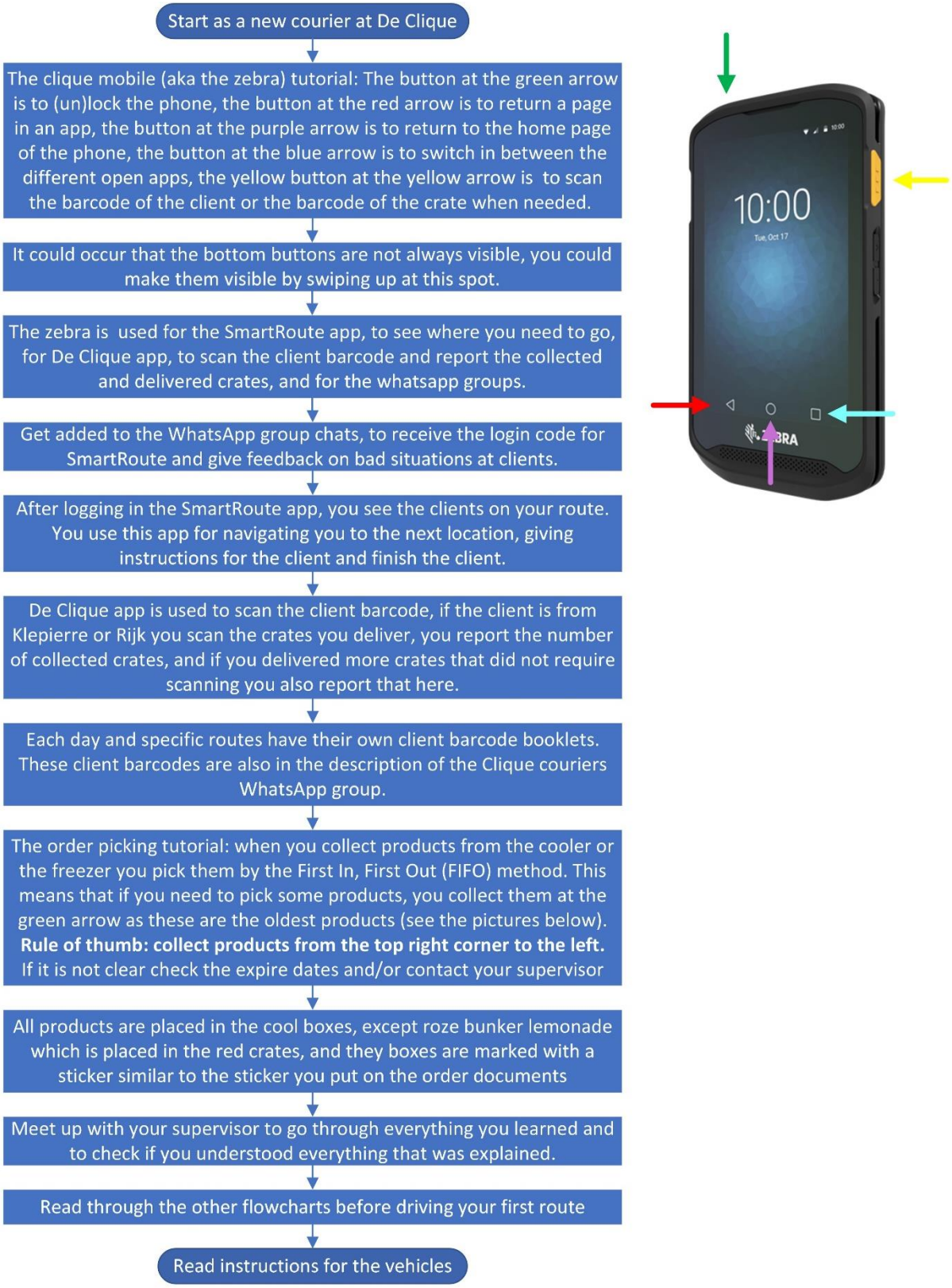

Figure 20. The visualisation of the introduction for the tasks of a new courier.

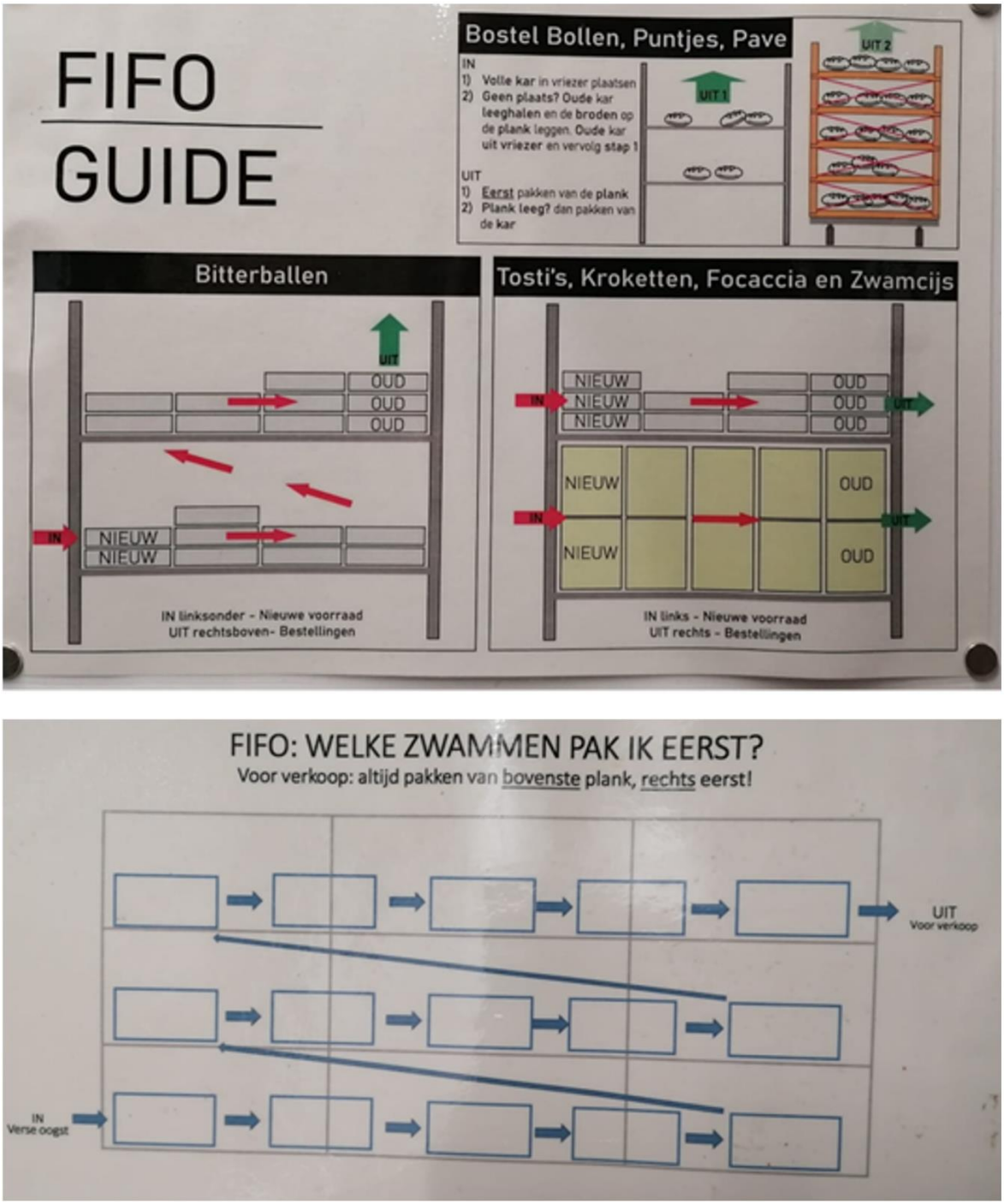

Figure 21. The visualisations in both the freezer and the cooling container for correct order picking of the couriers.

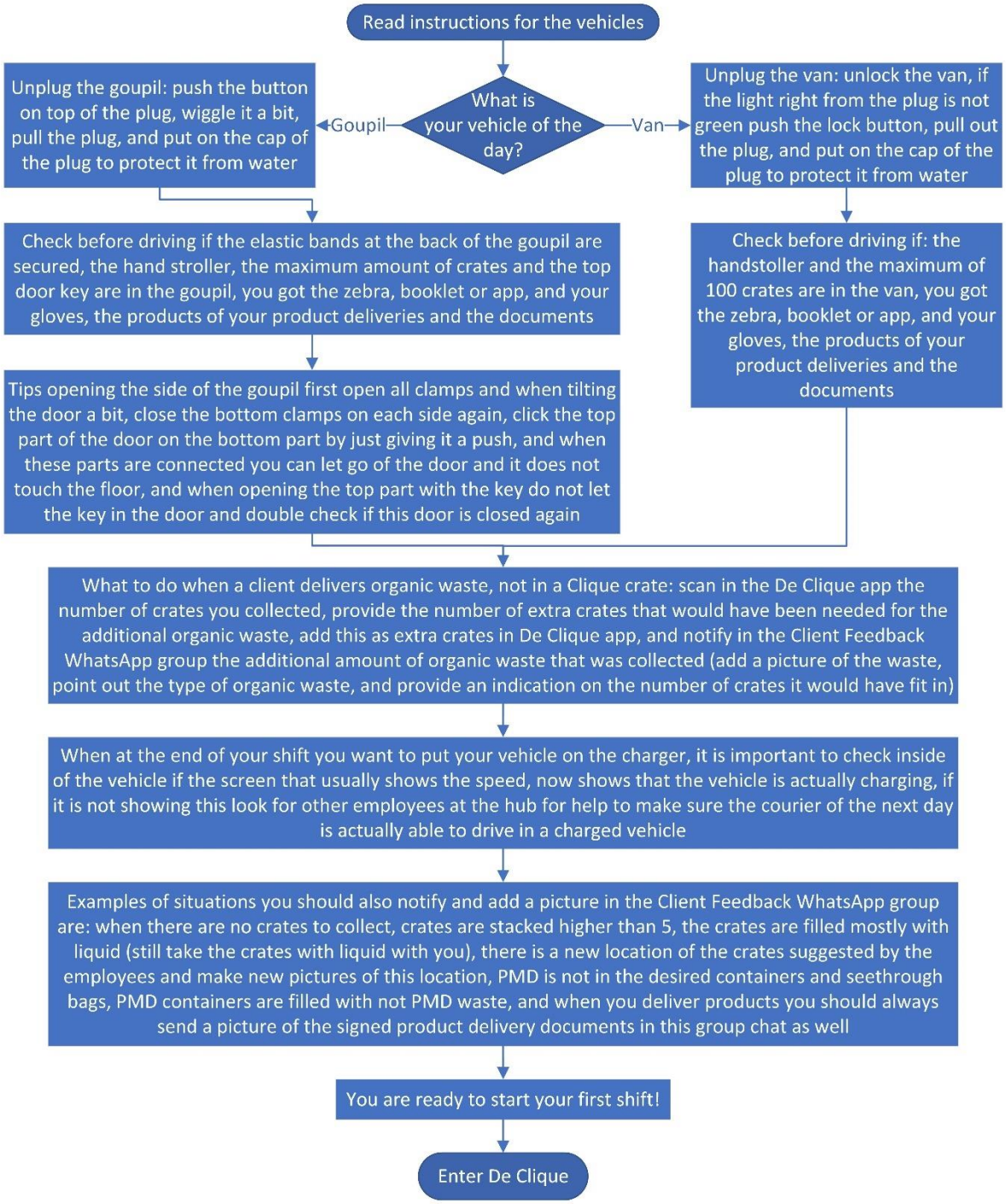

Figure 22. The visualisation of the introduction of the vehicle's instructions for new couriers.

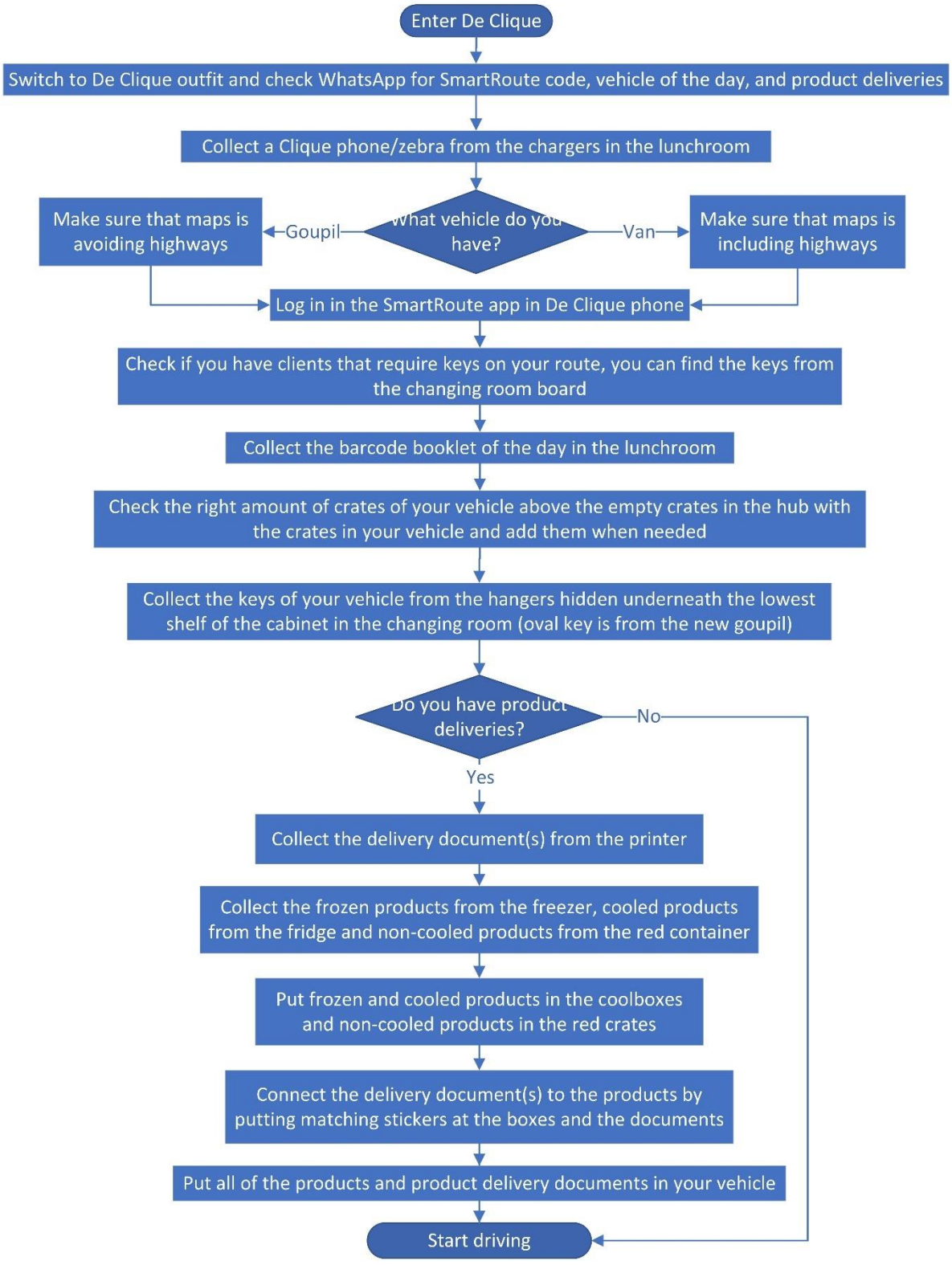

Figure 23. The standard morning tasks at The Company of a courier before they start driving.

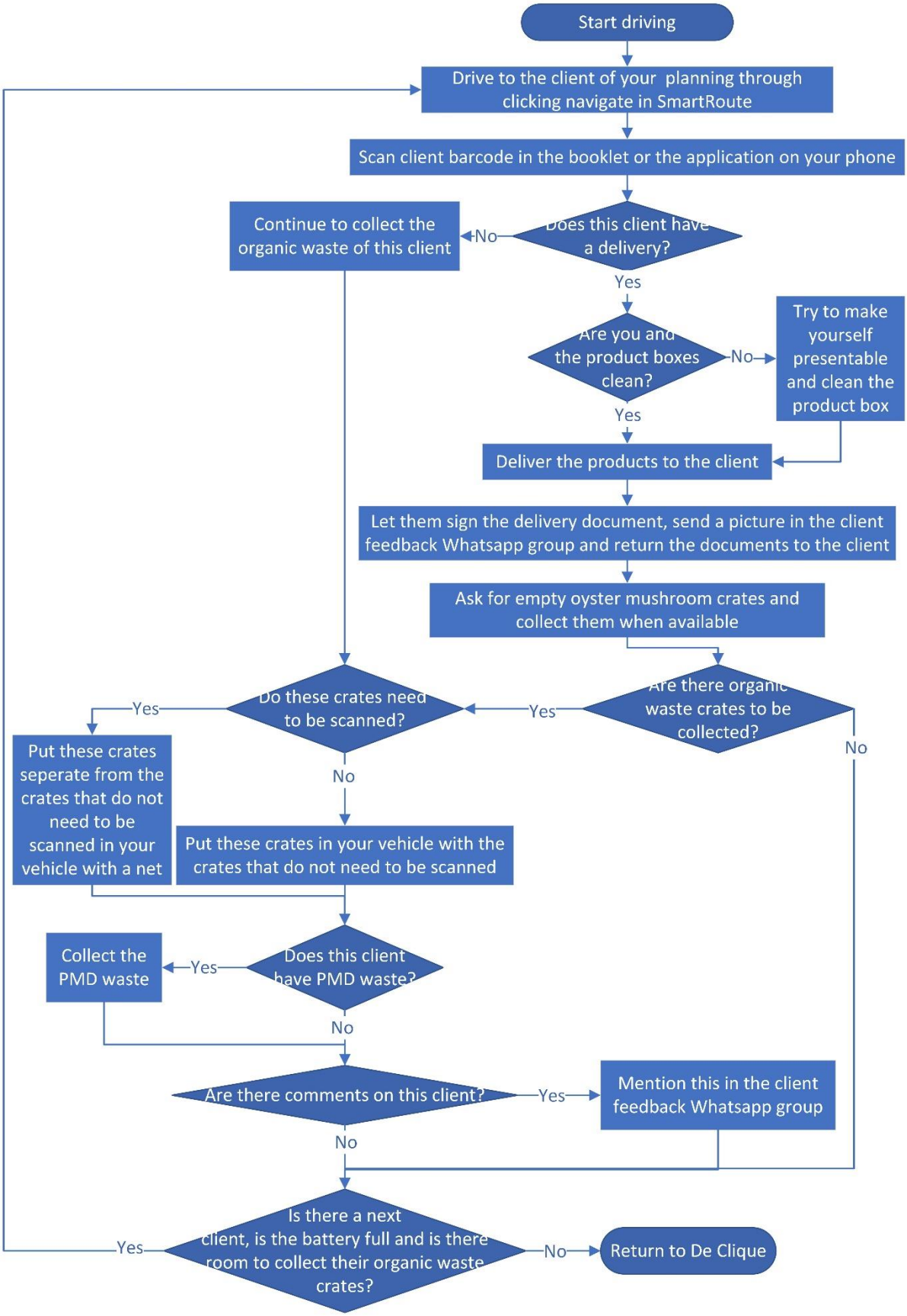

Figure 24. The visualisation of the tasks and decisions of a courier when arriving at a client.

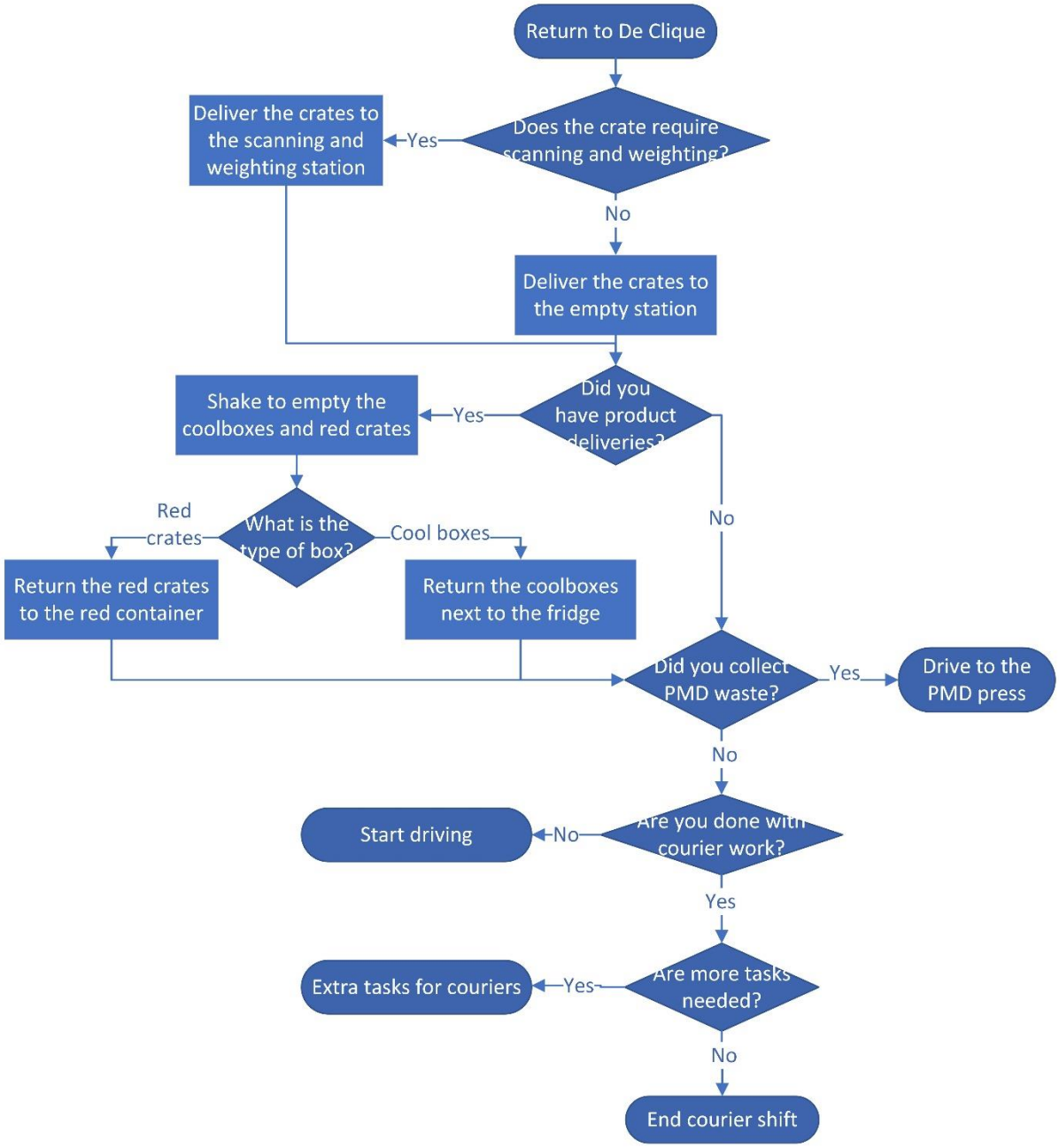

Figure 25. The visualisation of the tasks of emptying the vehicle when returning to The Company and the required next tasks based on the situation.

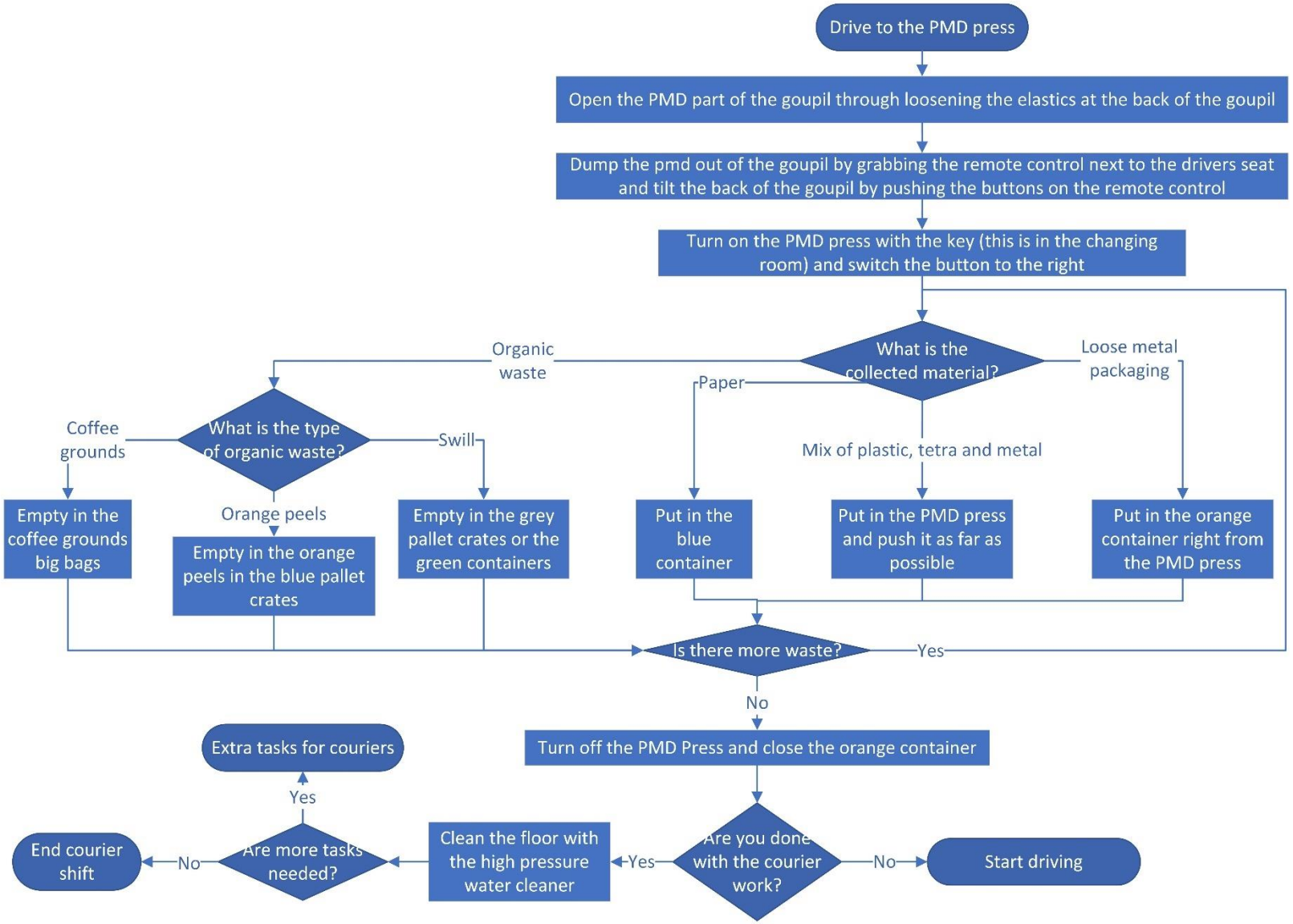

Figure 26. The visualisation of the tasks when a courier collected either PMD or other waste from clients' containers.

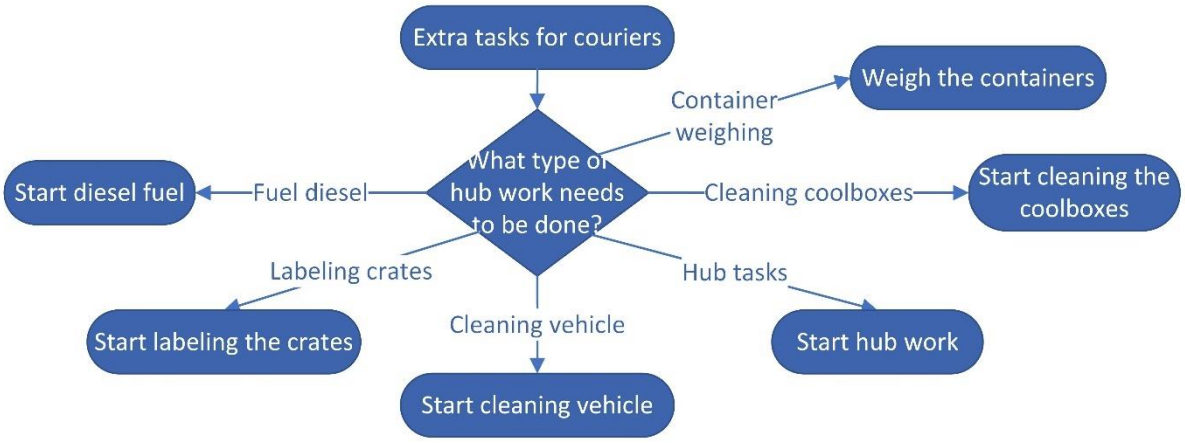

Figure 27. The visualisation of the (potential) extra tasks of the couriers.

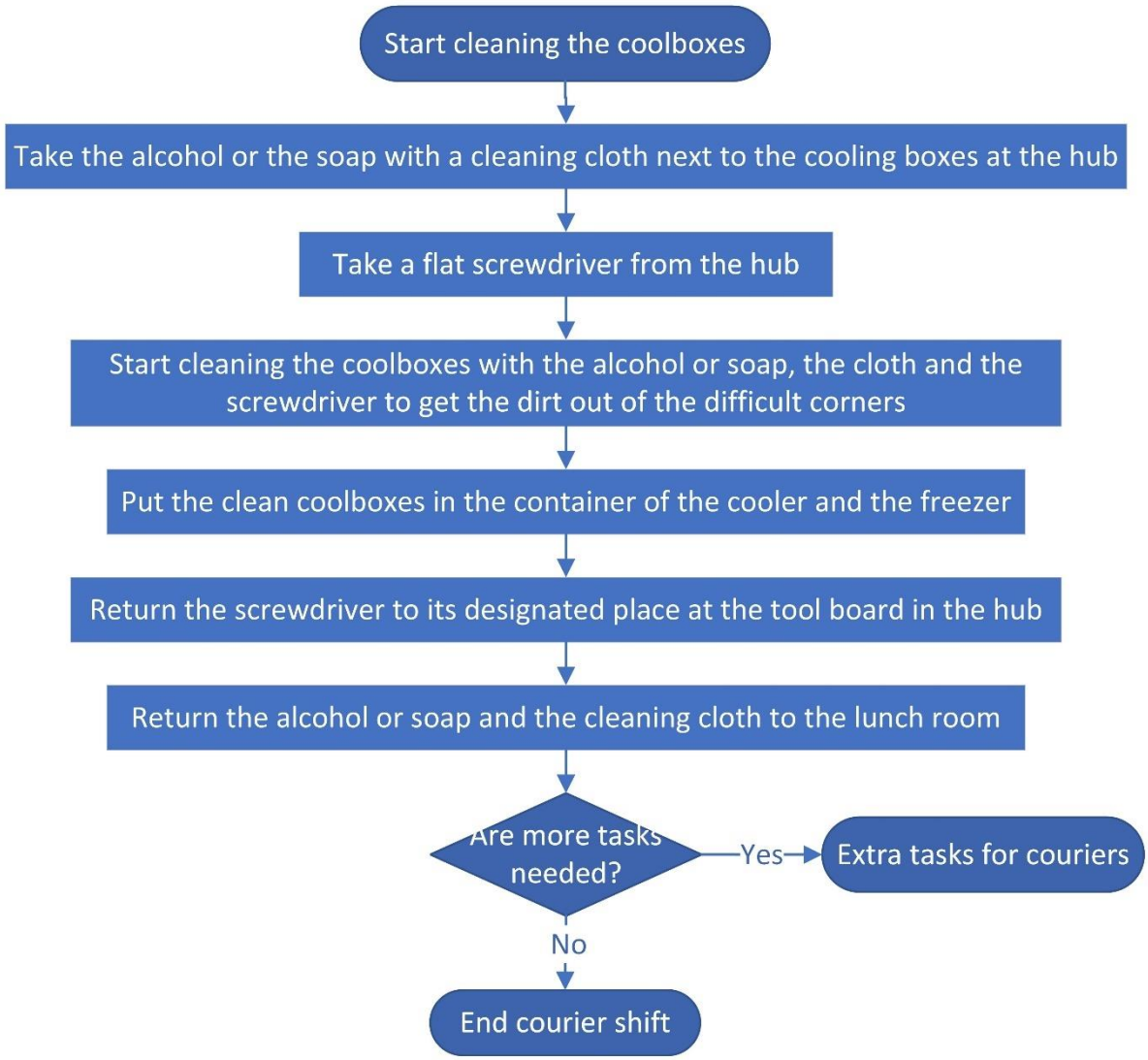

Figure 28. The visualisation of the steps to correctly clean the cooling boxes for product deliveries.

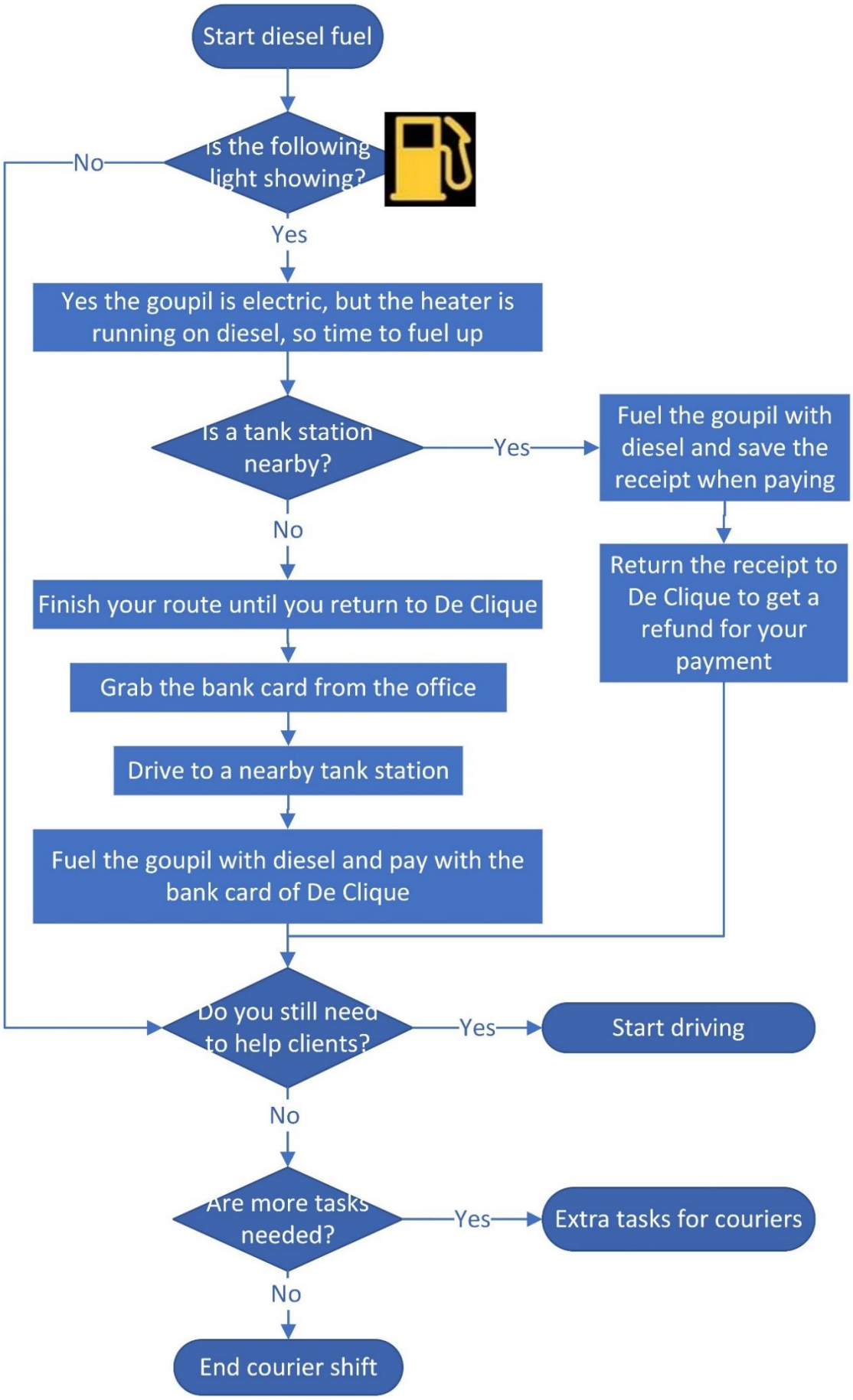

Figure 29. The tasks when the vehicle models goupil G4 and G4L shows an empty tank.

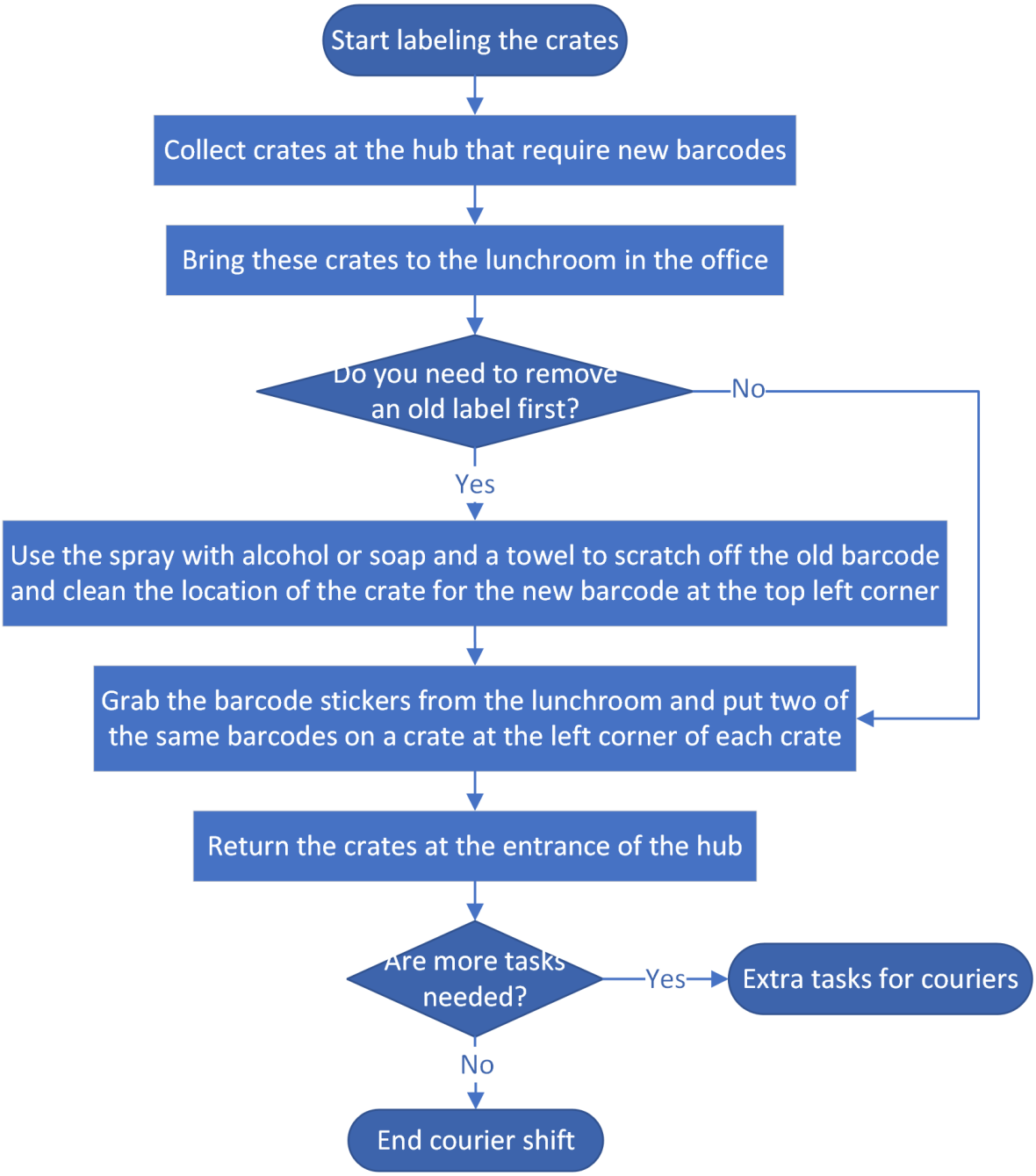

Figure 30. The visualisation of each of the steps when (re)labelling the organic waste crates.

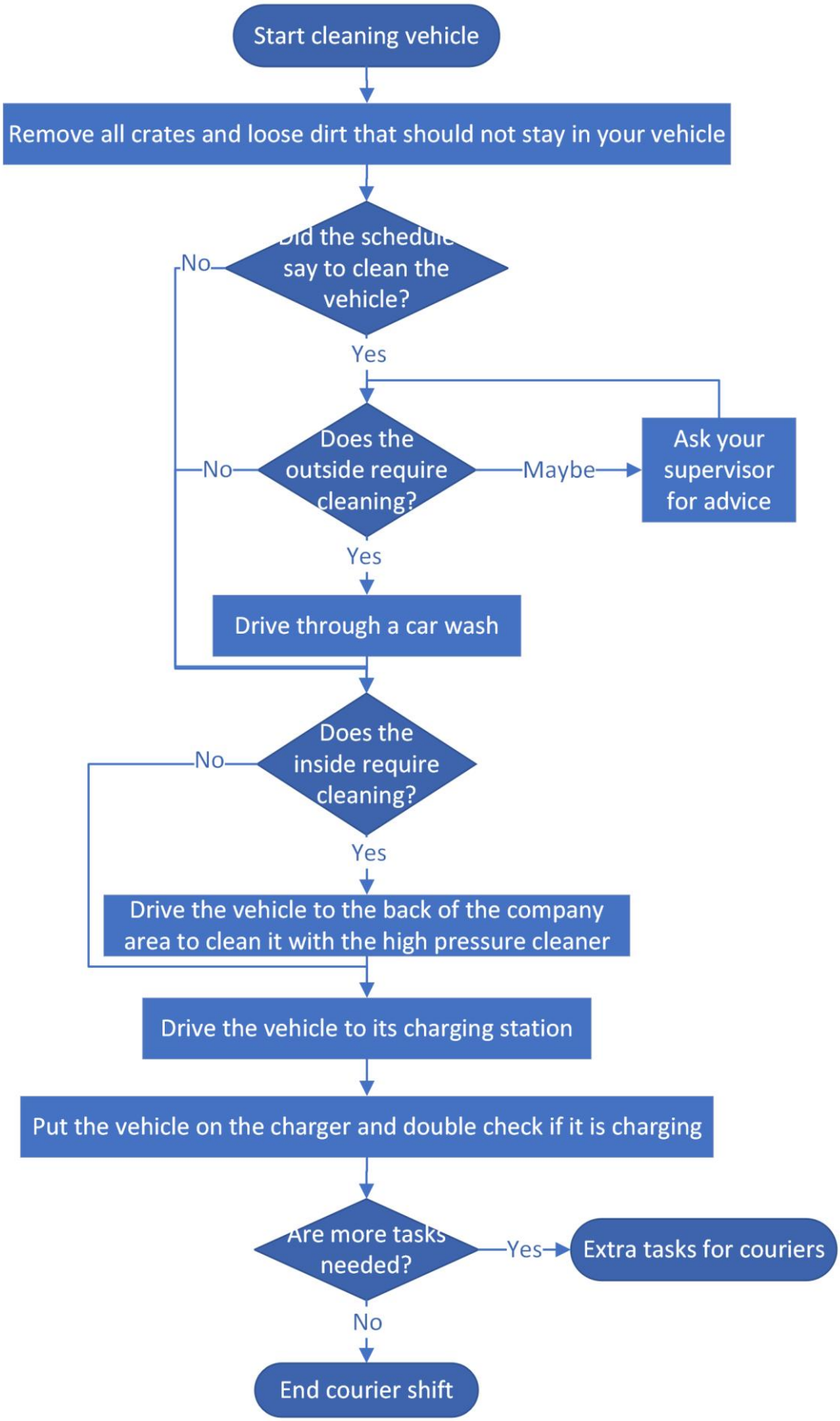

Figure 31. The visualisations of the different decisions when it comes to cleaning the vehicle.

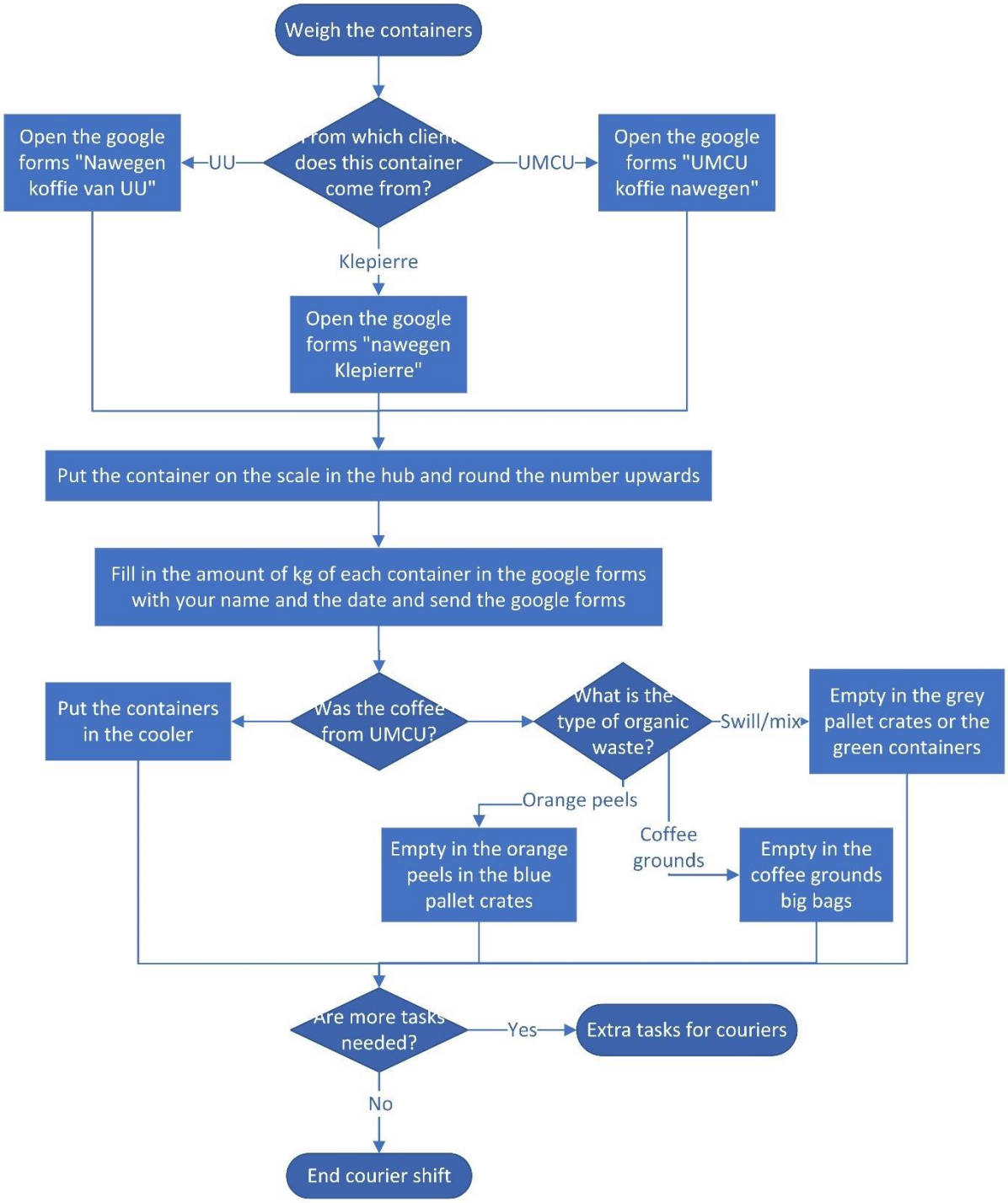

Figure 32. The weighting of the clients' containers and correct processing of the contents.

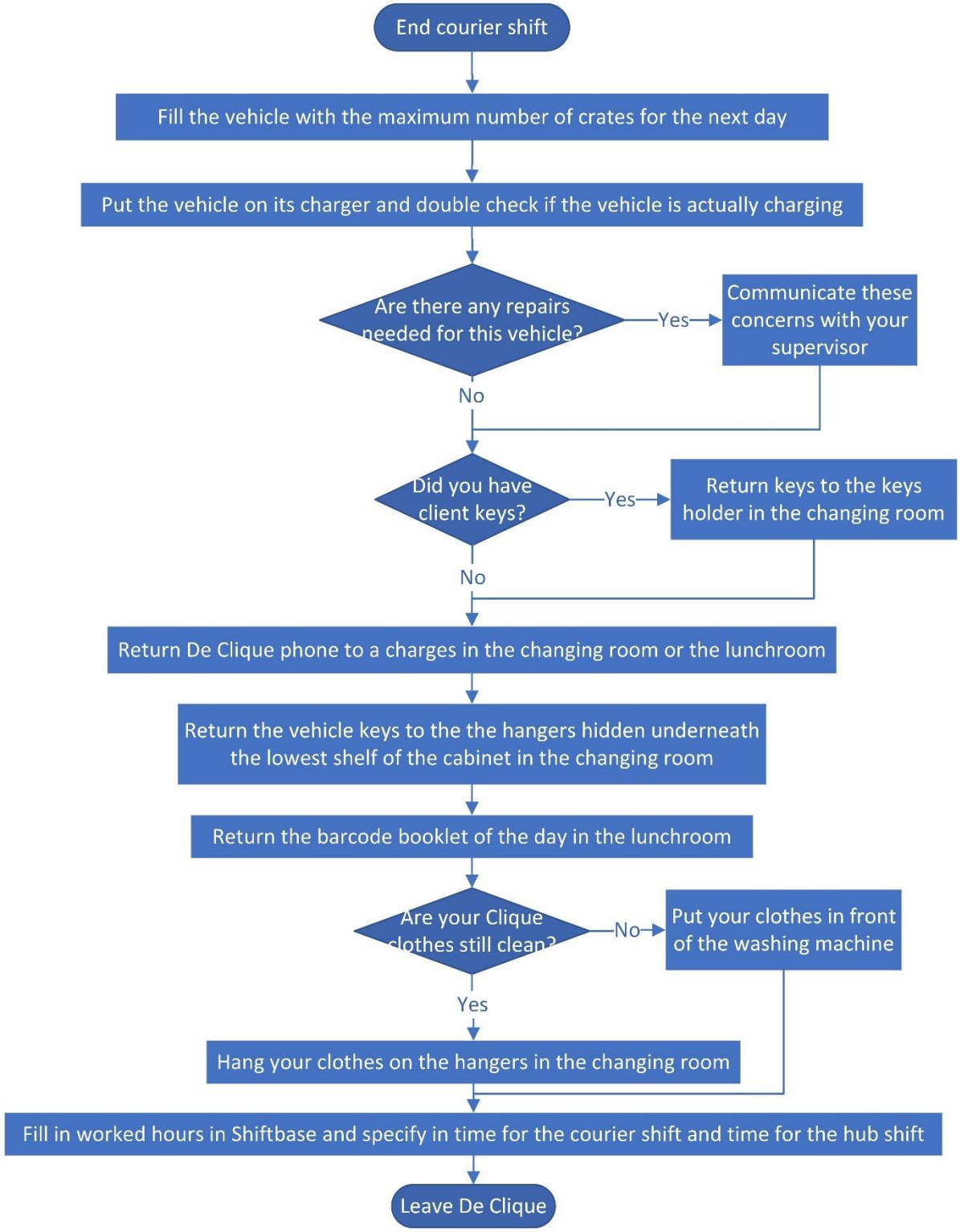

Figure 33. The standard tasks when ending a courier shift at The Company.

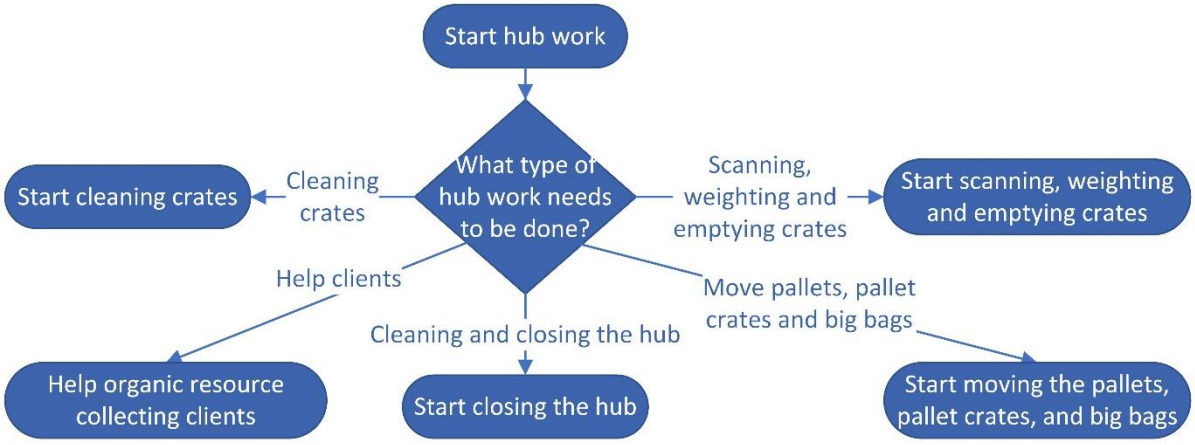

Figure 34. The couriers' standard tasks when they help at The Company.

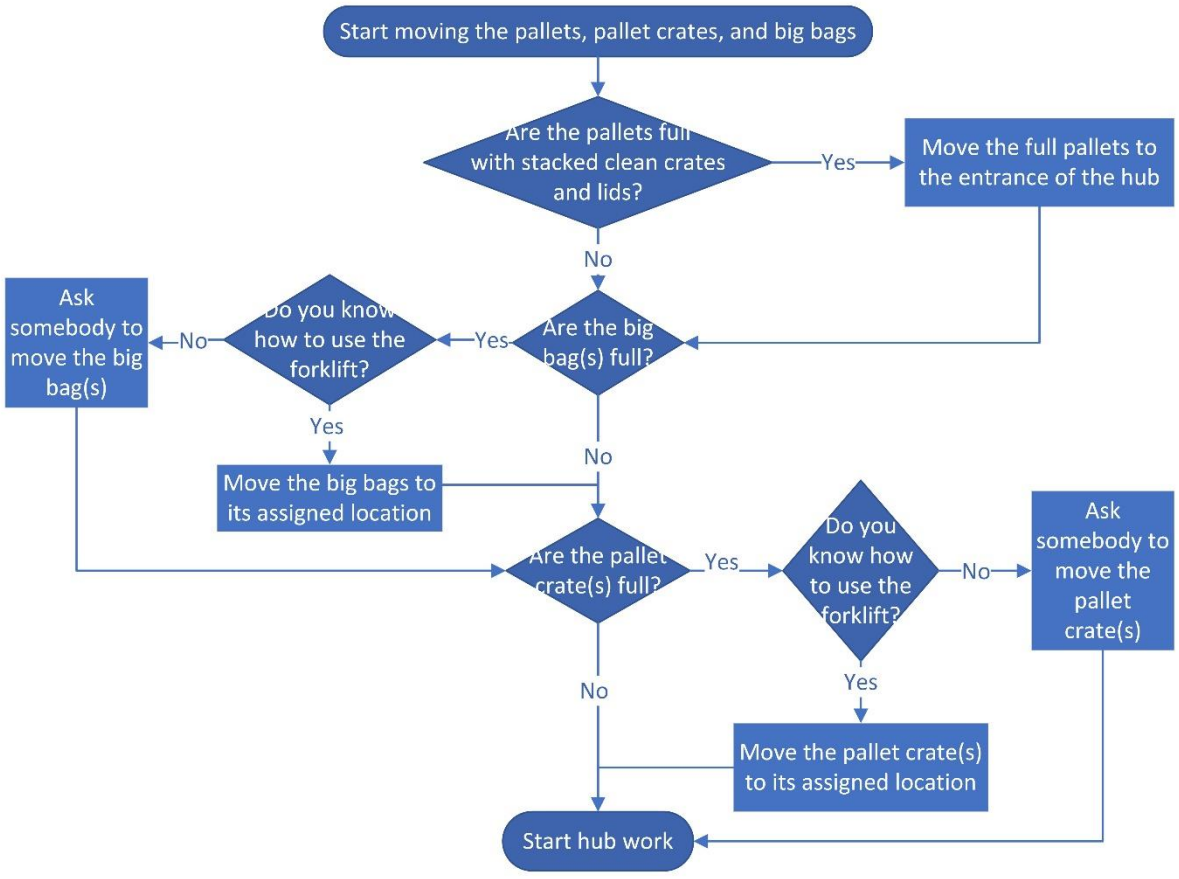

Figure 35. The visualisation of the decisions on what to do when the pallets, pallet crates and big bags require to be moved at The Company.

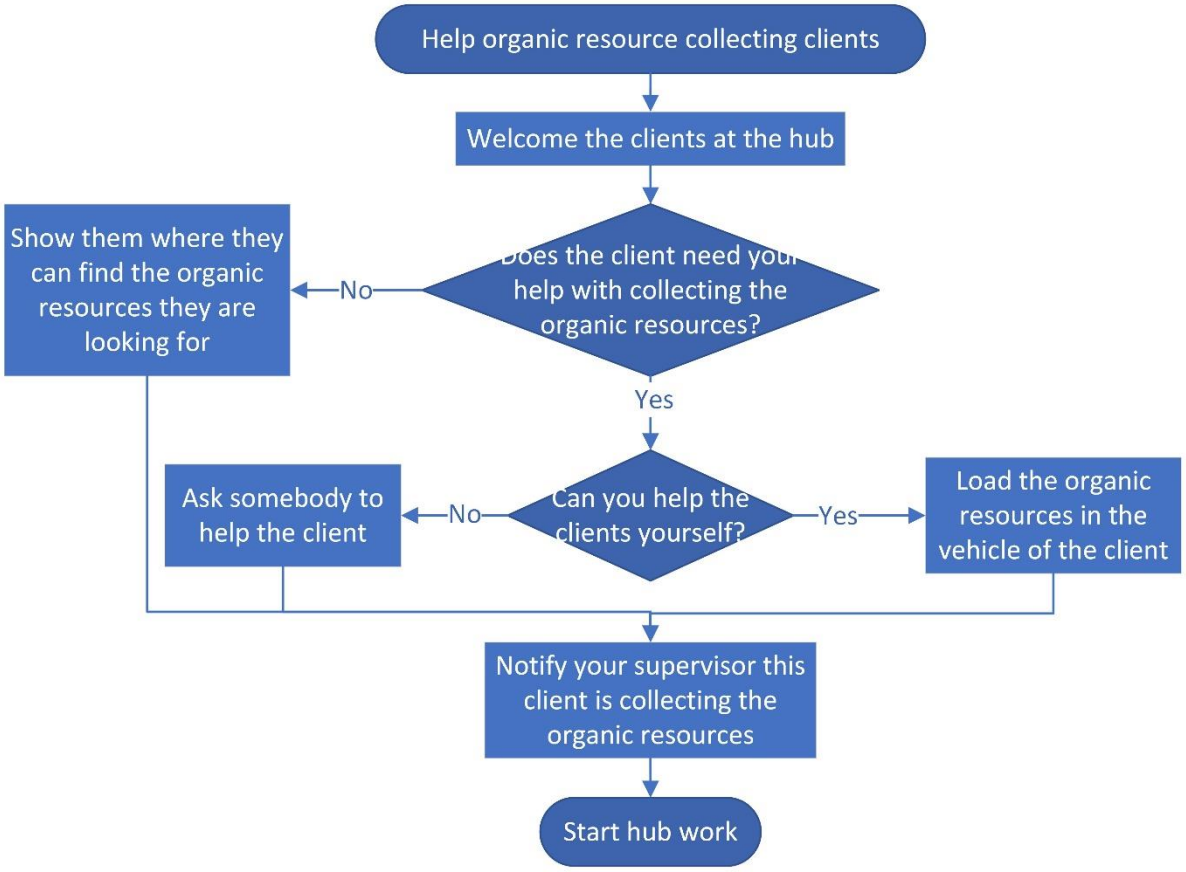

Figure 36. The visualisation of the steps when helping organic resource-collecting clients.

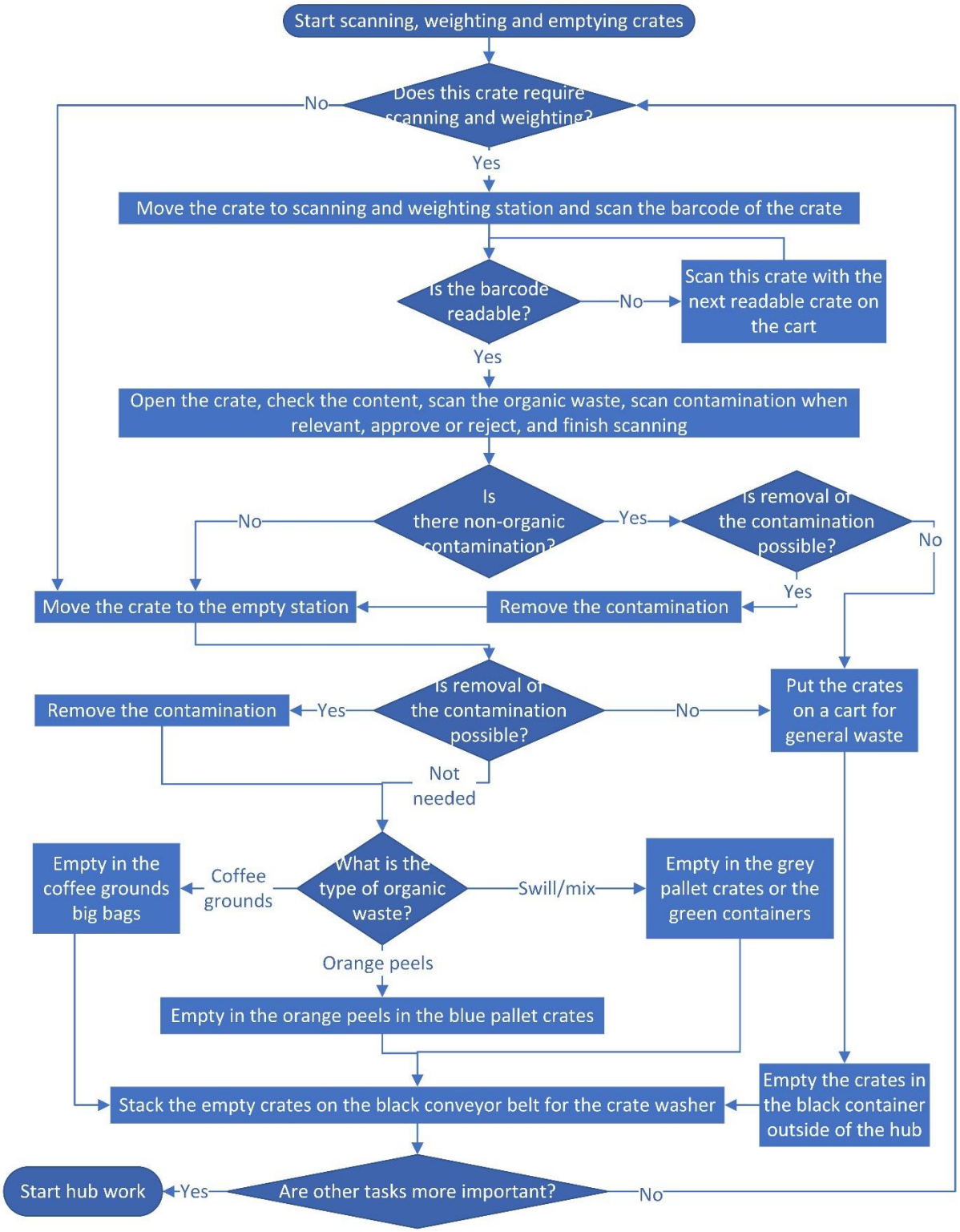

Figure 37. The visualisation of the tasks when scanning, weighting and emptying the organic waste crates.

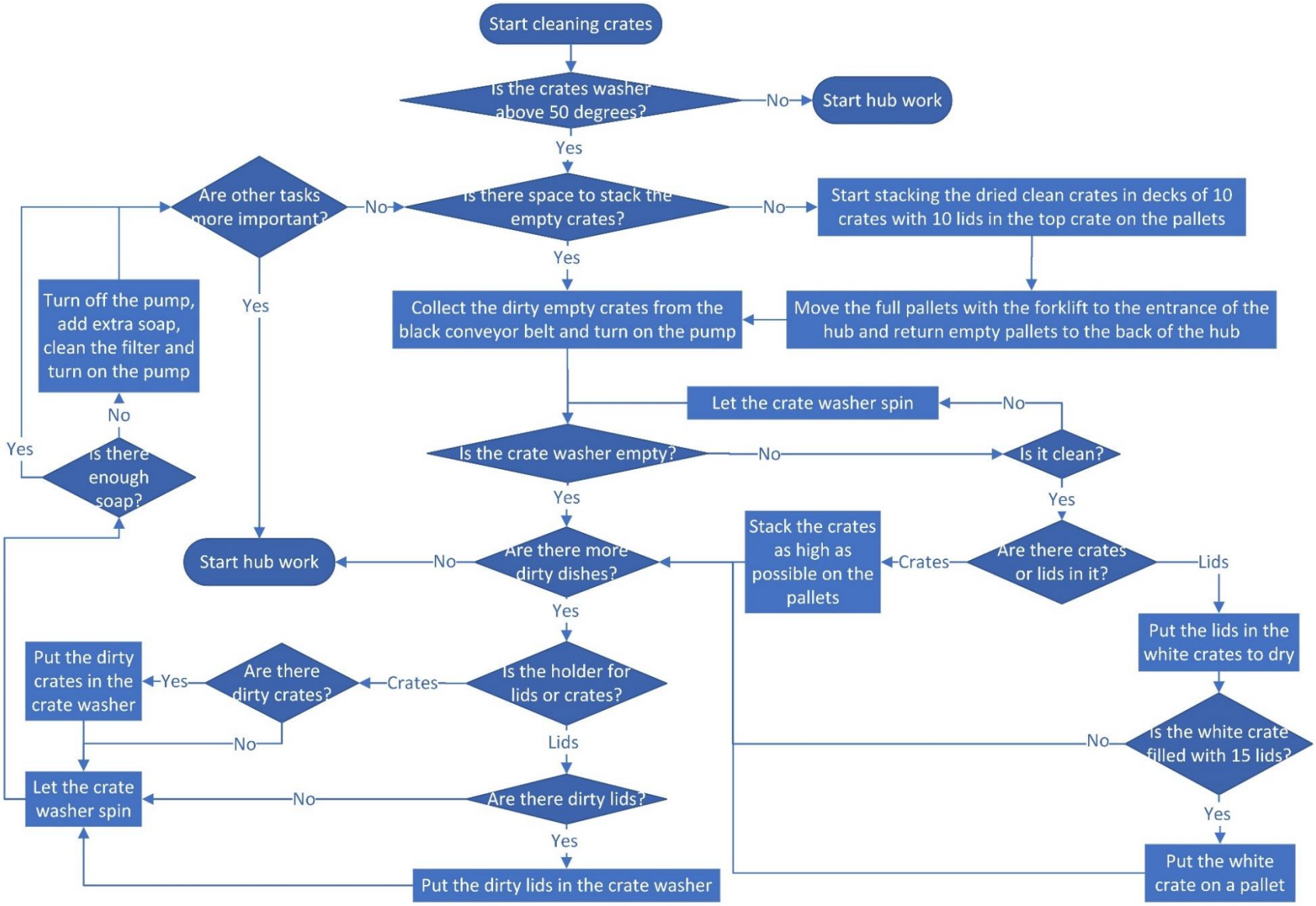

Figure 38. The visualisation of the tasks in the different standard situations when cleaning the organic waste crates.

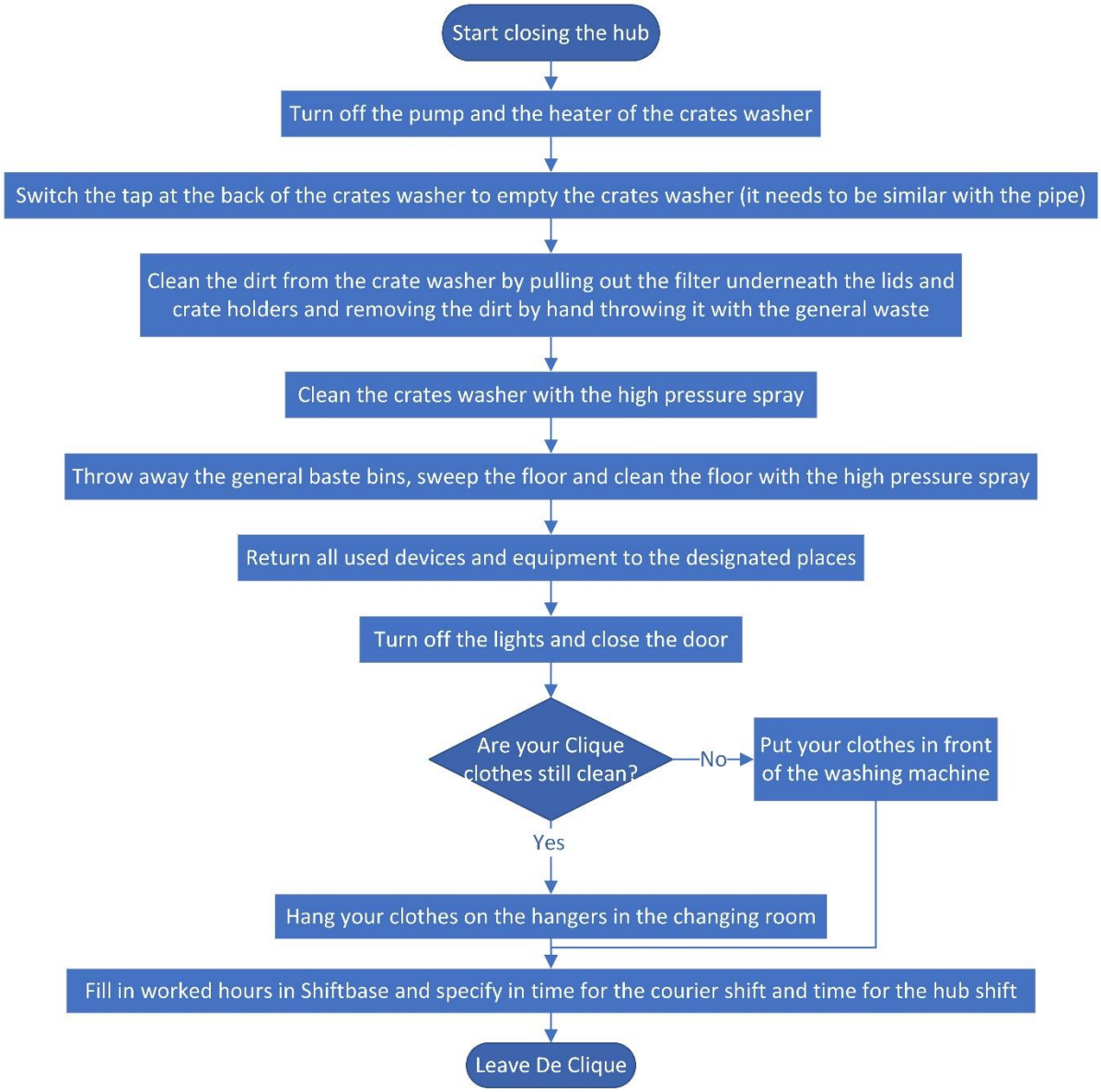

Figure 39. The visualisation of the tasks that are required when closing The Company.

Appendix I The Total Amount and Increased Kilogram of Collected Organic Waste per Month

Kg per month collected	February	March	April	May	June	July	August	September	Oktober	November
Kg per month of central government clients	14,65	39,65	55,2	74,05	49,15	91,25	1195,05	5517,05	9714,3	12452,1
Kg per month of klepierre clients	4407	4927	5762	7472	7529	7615	6275	8186	8370	6529
Kg per month of uithof clients	4611,50	5015,94	4762,93	6055,64	6276,26	12693,28	7478,72	7316,75	8187,10	9017,37
Kg per month of in and beyond the city centre clients	8978,05	15422,25	18965,6	22716,2	24818,4	23077,65	24700,05	32262,5	34418,4	39895,1
Total kg per month	18011,35	25404,89	29545,28	36318,24	38673,26	43476,83	39648,97	53281,85	60689,8	67893,98
The total increase of kg per month	unknown	41,05%	16,30%	22,92%	6,48%	12,42%	-8,80%	34,38%	13,90%	11,87%

Table 29. The collected amount of organic waste for each type of client from February 2022 to November 2022.

Appendix J The Overview of Both the Primary and Secondary Causes

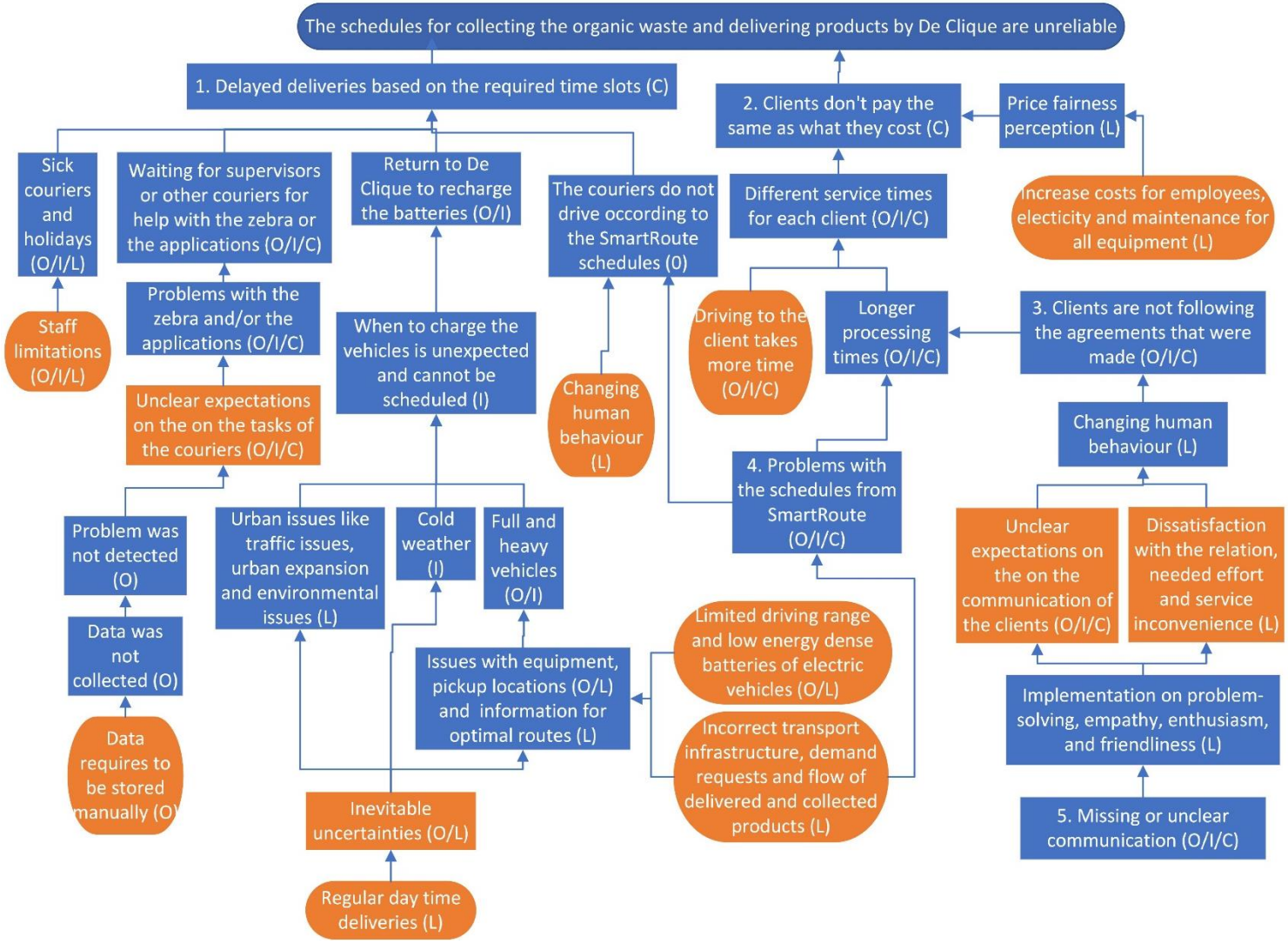

Figure 40. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the customers' perspective.

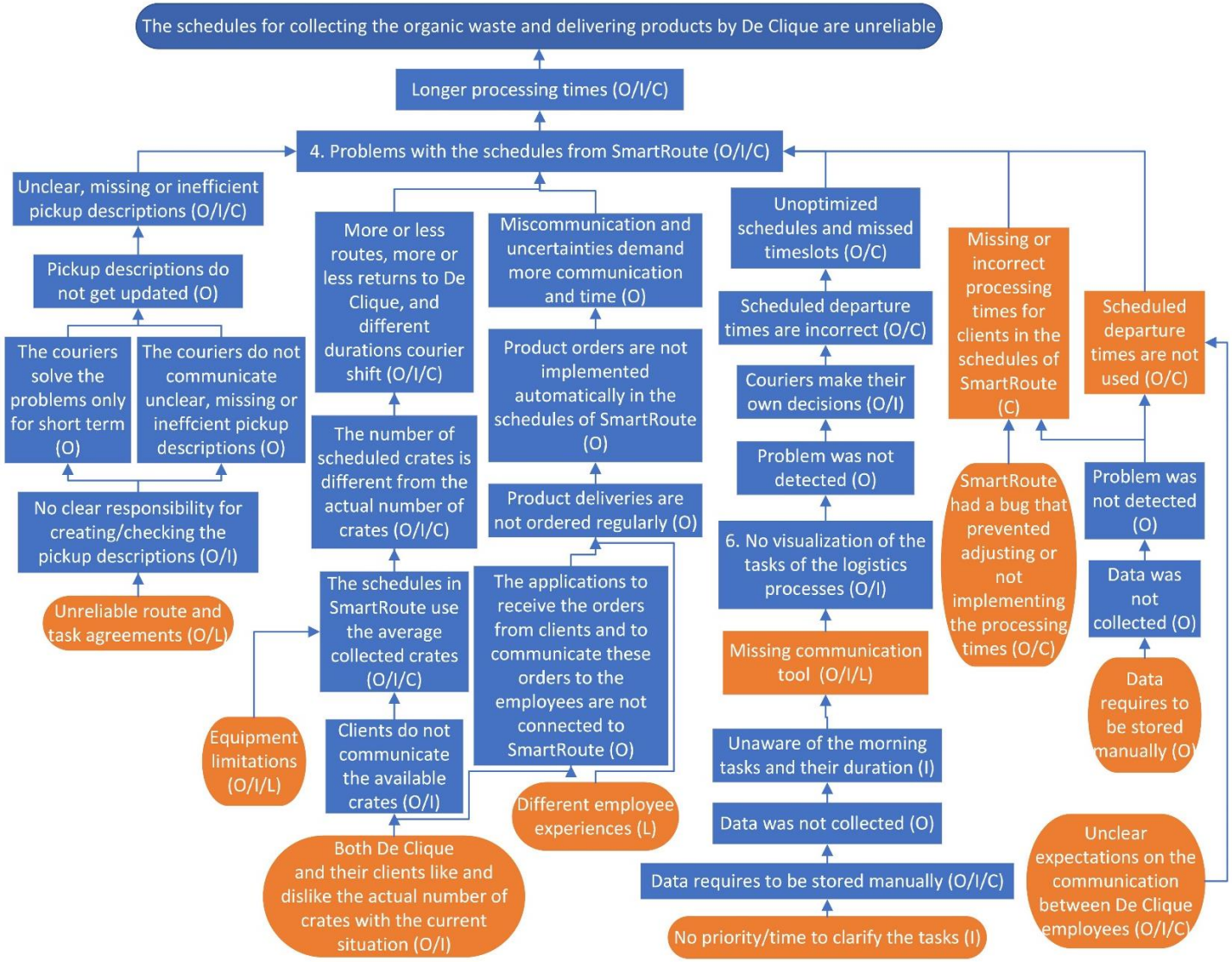

Figure 41. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the internal business process perspective.

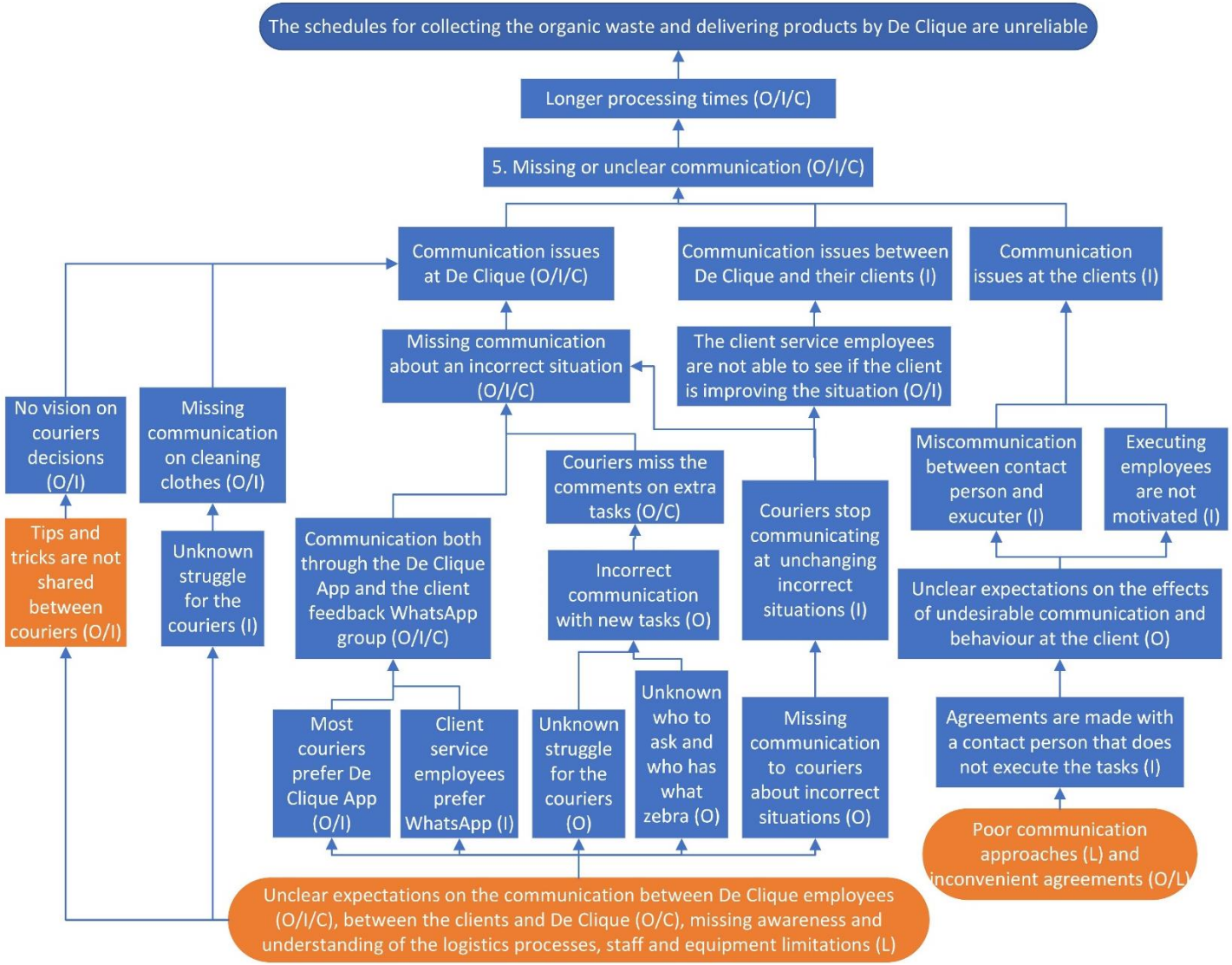

Figure 42. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the internal business process perspective.

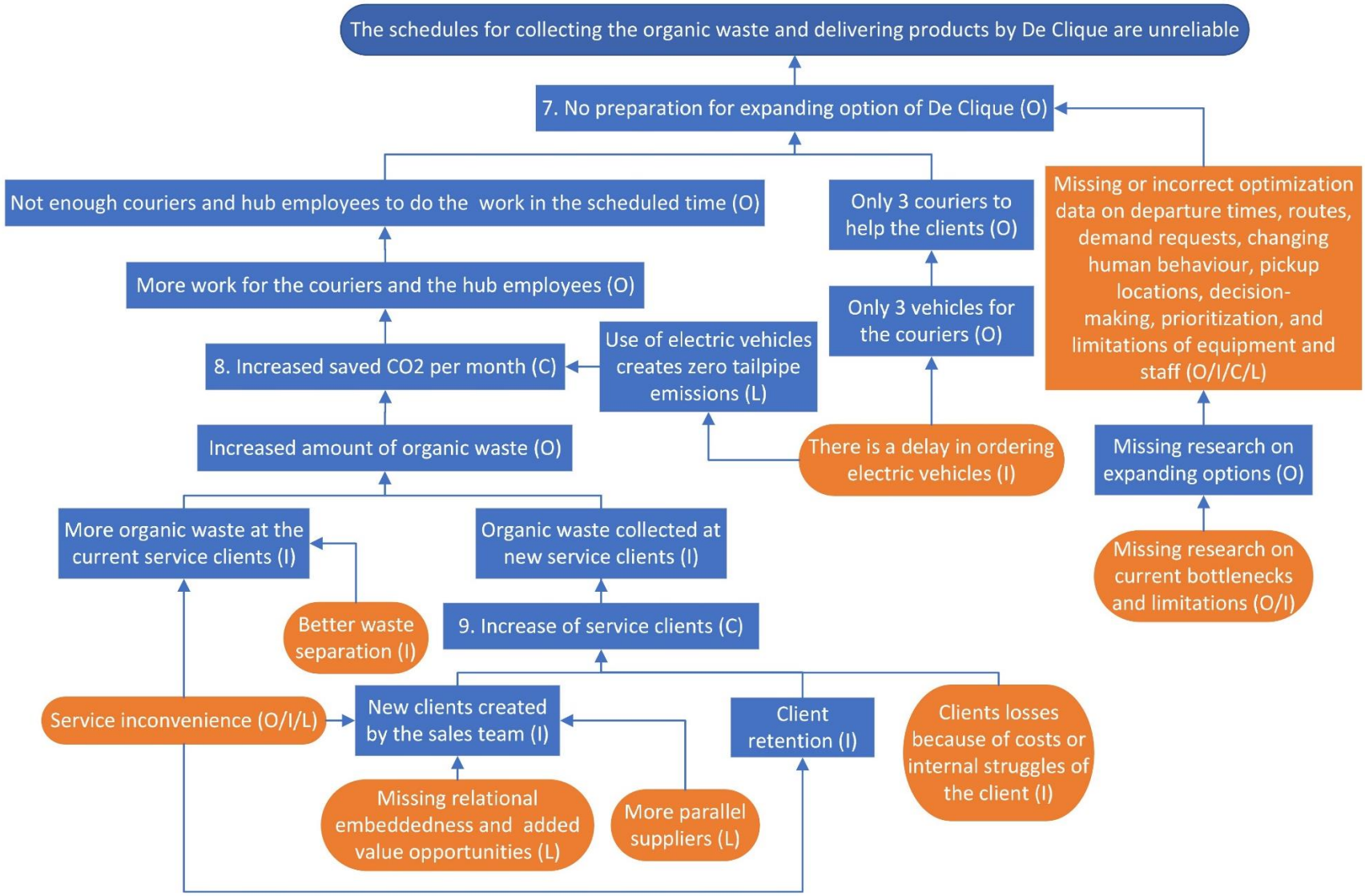

Figure 43. The causes of the different research methods (observations (O), interviews (I), content analysis (C) and literature research (L)) from the innovation and learning perspective and the financial perspective.

Appendix K The Observed Tips and Tricks Required for Each Courier

Tips and tricks for couriers:

- When the return button is not visible in the The Company app, but the courier does want to make a change, they can swipe from the bottom of the “zebra” to make the task management, the home and the return button visible again.
- When you make a mistake in the The Company app and there is no way to undo the mistake, the adjustment that needs to be made needs to be sent to the client photo feedback group chat.
- If the “zebra” is not scanning the barcode and the barcode seems destroyed, you can grab another crate with a barcode that does scan when leaving it at a client that requires scanning or put new barcodes on the crates that do scan (**rule of thumb**: always add the sticker on the left top corner of the crate). If it looks like the problem is the “zebra” as none of the barcodes is scanning, it could be the case that there is no internet, and the courier should just wait a bit before being able to scan again. If the courier does have internet and it is the The Company app, the courier should download the The Company app again.
- When you are finished with driving for the day but are still able to do the extra tasks, the priority is to start cleaning your vehicle when it is very dirty as there is no other time to do this task. The second priority is to start cleaning the cool boxes for product deliveries as this is an important task for the image of The Company during product deliveries and there is no better time to clean them.
- The SmartRoute app cannot be working when the site that is implemented is the regular SmartRoute site and not **confidential information.**
- When you deliver a product delivery at a client, but forgot the delivery documents at The Company, you should send a picture of the delivery to the client in the client photo feedback group chat.
- When the battery of your vehicle is detected to be 20% or less, you should always stop driving to clients at that point and return to The Company to recharge the vehicle to make sure they do not get stuck somewhere. Because in the case of you getting stuck, this takes even more time and creates further problems along the line.
- When you return to The Company or you leave at The Company and there are vehicles or other road blockades, there is always an option to pass garden centre Steck on the other side than usual.

Appendix L Clarification of the Expectations on the Communication and Tasks from the Couriers

The observed aspects that require more clarification for the couriers to improve the overall tasks of the couriers are:

- Always make sure there is a clean jacket in your vehicle. This should make sure that during product deliveries you can present yourself clean to the client for a better image of The Company. Can you not find a clean jacket to add to your vehicle? Comment this to your supervisor and they get you one.
- When you know a shortcut or other tips or tricks that have not between added to the courier handbook, this should be mentioned in the courier group chat to make sure other couriers that could have that shift could also benefit from this. The tips and tricks observed during this research are added to Appendix K and are implemented in the courier handbook. This also includes additional information on routes where some vehicles are not able to take certain routes, e.g. when the vehicles are not able to drive under certain bridges, which is the case at the Uithof.
- When the courier is picking up orders at The Company but is confused the rule of thumb is ALWAYS: pick the products from the highest shelf of these products from the top right to the top left, next the products from the 2nd shelf can be picked also from right to left. When the couriers are still not clear about what products to grab first, they could check the dates and grab the earliest one or they could find help from another courier, somebody at The Company or their supervisors to get a better explanation and pick the correct products for their order.
- The couriers should always use the client photo feedback group chat to mention feedback and other comments on the clients and the delivery documents when delivering a product delivery at a client. The couriers should ignore the option in the The Company app.
- When a pickup description is missing, the courier should send a picture of the situation and the location of the crates in the client photo feedback group chat and write a short description of what helps any other courier to collect the crates of this client.
- When a pickup description is unclear, the courier should make a comment about this in the client photo feedback group chat, send additional pictures of the situation and the crate location and write a short description to clarify the situation.
- When the crates are at a different location than written in the pickup description, this should be sent to the client photo feedback group chat in combination with a picture of the situation.
- When a client requests new pickup agreements with a courier, the courier should request them to make this comment to their contact person at The Company but still, comment on this request in the client photo feedback group chat.
- When the courier notices without opening the crate that a client delivers a crate filled with liquid/soup, garden waste or any other incorrect waste in the crates of The Company, the courier should send a picture to the client photo feedback group chat and still bring them to The Company, and they are rejected here. Usually, the couriers do not look in the crates at all, but when you feel/see the incorrect content this should be mentioned.
- When a client has a product order, but they are not available to receive it, the courier should check the timeslot in SmartRoute. When they are too early, they should notify this in the courier group chat so the planners know and continue their route and return

later. When they are there at the correct time or too late, they should call their supervisor for communication.

- When a client barcode is missing in the client barcode booklet and the online link for the client barcodes, the courier should take a picture and comment on the collected and delivered crates at this client and comment on the fact that this barcode is missing in the client photo feedback group chat.
- Always rely on SmartRoute for the best schedules as there are probably reasons why SmartRoute is suggesting you skip a client the first time you visit them (e.g., timeslots that need to be obtained or the capacity of the vehicle determined to help this client later). When you feel like you have found a problem with SmartRoute, take a screenshot of the situation and send it to the courier group chat and the planner investigates the problem. During this research, there are some problems observed with SmartRoute, but they are now solved, making the schedules more reliable. The tips and tricks that are also added to the handbook help you drive more efficiently from one client to another one. These are the situations where SmartRoute is not the most effective and the tips and tricks should be implemented by the couriers. That's why it should become part of their job to notify these shortcuts for other couriers. Tips on how to handle road work should also be shared with the couriers.
- When a client is added to SmartRoute for just a product delivery and not the service, there is no pickup description, as there are no crates to collect. It should therefore also become clear to the couriers when this is the case and it is not a mistake in SmartRoute.
- Couriers should always continue communicating an incorrect situation in the client photo feedback group chat. The moment you do not feel heard when the situation is not changing, you should contact the client service employees directly to check up on the situation from their point of view.
- When a courier resolves a situation when it is incorrect, it is still requested to communicate this incorrection situation in the client photo feedback group chat.

Appendix M Clarification of the Expectations on the Communication and Tasks from the Couriers' Supervisors

The observed aspects that require more clarification for the supervisors to improve the overall tasks of the couriers are:

- The supervisors are responsible for making sure there are enough clean jackets for the couriers to take one extra in their vehicle for product deliveries.
- The tips and tricks that are shared in the courier group chat need to be checked and if they are beneficial for the couriers the supervisors are responsible implement them in the courier handbook and share them once in the weekly courier mail to notify the current couriers of the tip or trick. If the comment that is made by a courier is not beneficial, the supervisor can now make comments on it and monitor it in the future.
- When the supervisor notices that a courier is struggling with picking the correct products for their order, the extra explanation should be shared in the weekly courier mail to also explain it better to the other couriers.
- When a courier is at the correct time or too late for a client for product delivery and they are not available, the supervisor should contact the client. When the courier is there at the correct time, the supervisor should contact the client services employees about the situation, so it does not happen again.
- The supervisors should call the couriers when they need to handle a new and time-relevant task or adjust their schedules to make sure they receive the message in time and decide on what the best decision is, for that situation.
- When the supervisors want to make adjustments to the communication and tasks, this needs to be shared with everybody that is involved with this to also receive feedback and increase the adaptability of these adjustments.
- The supervisors should also change a lot of the standard and important information to English so everybody understands it and as the amount of internationals increases, this saves them a lot of time.
- The supervisors should make sure that the couriers do their onboarding on the days they are going to working on. Every route is different and as the pickup descriptions are different and unique for each client, the couriers should get their onboarding for their scheduled routes.

Appendix N Clarification of the Expectations on the Communication and Tasks from the Planners of the Couriers' Schedules

The observed aspects that require more clarification for the planners to improve the overall tasks of the couriers are:

- When pictures and comments of pickup descriptions or the pickup agreements are made by the couriers in the group, the planner is responsible to add these pictures and comments to both SmartRoute and the courier handbook.
- When a courier is too early at a client for product delivery, the planner is responsible to look at the situation and see what adjustments need to be made for this not to happen again.
- When a courier comments on a missing client barcode, this barcode needs to be created and added to both the client barcode booklets and the online link for the client barcodes.
- The couriers should always be able to rely on SmartRoute and the planner should check in SmartRoute if the courier is following the created schedule if that is not the case and it does create some problems, the couriers should receive comments about this and are managed to follow SmartRoute again.
- The planners should call the couriers when they need to handle a new and time-relevant task or adjust their schedules to make sure they receive the message in time and decide on what the best decision is, for that situation.
- The planner should always combine the delivery of products with the service providing day to reduce both the costs of The Company and the client.

Appendix O Clarification of the Expectations on the Communication from the Client Service Employees

The observed aspects that require more clarification for the client service employees to improve the overall tasks of the couriers are:

- To prevent the couriers from stopping communication on the reoccurring incorrect situations at clients, it is important to always reply to the comments of incorrect situations made. When getting a reply is the standard for the couriers, it becomes noticeable when a message does not come through and the employees get a view of how the situation is handled.
- When pictures and comments of pickup descriptions or the pickup agreements are made by the couriers in the group, the client service employees are responsible to check if these pictures and comments are the most efficient or they should provide feedback on these descriptions and agreements to the clients, to the couriers, and to the planners to adjust in SmartRoute and the courier handbook.
- When a client requests new pickup agreements with a courier, the client service employees are responsible to check if these agreements are also checked with their contact person and if these agreements are the most efficient. The results of the chat with the contact person should be reflected by the couriers, and to the planners when adjustments should be made in SmartRoute and the courier handbook.
- When a courier is at the correct time for product delivery and the client is not available, the client services employees should contact their contact person to prevent this situation from happening again.
- The client services employees should call the couriers when they need to handle a new and time-relevant task or adjust their schedules to make sure they receive the message in time and decide on what the best decision is, for that situation. The client services employees can find out who to call through two options: first, they could see in the courier group chat who is driving what vehicle and SmartRoute shows them what vehicle is driving what route or second, they could either contact the couriers' supervisors or the planner of the schedules who should be called.
- The client services employees should always combine the delivery of products with the service providing day to reduce both the costs of The Company and the client.

Appendix P Clarification of the Expectations on the Communication and Tasks from the Clients

The observed aspects that require more clarification for the clients to improve the overall tasks of the couriers are:

- When clients do not deliver the crates at the agreed pickup location, it is not the fault of the courier that the crates are not collected and replaced. When a client requests new pickup locations or wants to make any other adjustments to the pickup agreements, the request should be made to the contact person at The Company and not the courier.
- When clients deliver full crates with soup, garden cuttings, tea bags or non-organic waste, these crates are still picked up by the couriers of The Company to be able to provide new and clean boxes for the clients, but these incorrect crates are charged more as the content cannot be processed the correct way at The Company.
- When a client delivers the crates inappropriately, for example, the crates are stacked higher than five crates, the crates do not have lids, or it is an overall mess, or they do not follow the other agreements made, the courier is not obliged to take the crates until the situation is how it is supposed to be.

Appendix Q The Interview to Select the Most Important Solutions and Causes to Tackle from the Supervisors and Planner

This research is shown that several causes create the difference between the desired and the current situation of the logistics processes. Several solutions for these causes are found and, in this interview, I am interested in your opinion on the causes and the solutions.

The first question relates to the following 16 causes that should be tackled.

1. Regular daytime deliveries – driving between 6 AM and 7 PM
2. Inevitable uncertainties – weather or traffic impact
3. Limited driving range and low energy dense batteries of electric vehicles – uncertainties and lacking technology impacting the use of the batteries
4. Missing or incorrect optimisation data on departure times, routes, demand requests, human behaviour, pickup locations, decision-making, prioritisation, and limitations of equipment and staff or other data to expand – incorrect transport infrastructure, transport characteristics and all in between.
5. Changing human behaviour – inefficient decision-making
6. Unclear expectations on the communication between The Company employees – inconsistent decision-making and unexpected
7. SmartRoute had a bug that prevented adjusting or not implementing the processing times – schedules do not implement the time it takes to help some clients
8. Unreliable route and task agreements - missing motivation and/or communication
9. Different employee experiences – missing decision-support method
10. Missing awareness and understanding of logistics processes – difficult to manage and control questions.
11. Staff limitations – the physical and mental effort of the couriers
12. Equipment limitations – missing required resources to obtain job objectives.
13. Poor communication approaches and inconvenient agreements – less job satisfaction
14. No priority/time to clarify the tasks – unawareness of the courier tasks and difficulty to manage through missing a communication tool and no visualisation of the courier tasks
15. Service inconvenience – price fairness perception of the clients
16. Relational embeddedness and different added value opportunities - differentiation from competitors

Question 1. Create the top five most important causes to tackle by ranking the causes from most to least important to tackle, with 1 being the most impactful and effective cause and 5 being the least impactful and effective cause.

Nr.	Causes	Importance:
1	Regular daytime deliveries	
2	Inevitable uncertainties	
3	Limited driving range and low energy dense batteries of electric vehicles	
4	Missing or incorrect optimisation data on departure times, routes, demand requests, human behaviour, pickup locations, decision-making, and prioritisation	
5	Changing human behaviour	
6	Unclear expectations on the communication and tasks of the involved parties	

7	SmartRoute had a bug that prevented adjusting or not implementing the processing times	
8	Unreliable route and task agreements	
9	Different employee experiences	
10	Missing awareness and understanding of logistics processes	
11	Limitations of staff	
12	Limitations of equipment	
13	Poor communication approaches and inconvenient agreements	
14	No priority/time to clarify the tasks	
15	Service inconvenience	
16	Relational embeddedness and different added value opportunities	

Table 30. The classification of the detected causes is based on the impactful and effective perception of the couriers' supervisors and planners.

Question 2. Could you explain the choices made to select the above top five causes?

In the second part of this survey, two questions are asked about the suggested solutions, to improve the logistics processes of The Company. Some solutions tackle one of the above causes and other solutions tackle multiple of the above causes. The questions relate to the following 14 solutions with a small explanation of how these solutions look like:

1. Implementing the correct processing times – processing times are scheduled in SmartRoute and adjusted when pickup locations create longer processing times

Longer processing times are required to be scheduled, for example when pickup descriptions require to call the client before entering, require walking into the building to collect the crates, when 20+ crates are collected on average or when the timeslots are during hours with a lot of traffic or other accumulations.

2. Implementing the average/actual departure times – departure times are adjusted to 8:44 instead of 8:00

Currently, the average departure time is 8:44, and tracking the departure times every month to see if these change and require to be adjusted. Departure times are calculated from SmartRoute by collecting the first scan minus the travel time according to SmartRoute to these clients.

3. Adjust client timeslots to off-peak hours – timeslots are increased and adjusted to off-peak hours where possible

When timeslots are expended (timeslots from one hour increase to timeslots of at least two or three hours) and/or adjusted to off-peak hours of these clients (not during lunchtime as these are the busiest for cafés), this increases the chances of the fulfilling the timeslots and increases improvements of the schedules.

4. Minimise internal struggle at the client and create added value to improve willingness to pay – couriers take the filled crates at the client, improve relational commitment from clients and increase cross-servicing potential (clients making use of both services and products)

The required adjustments are also discussed in the expectation appendices. Appendix L describes that couriers should take the filled crates to the client (also the crates with incorrect

waste) and how the couriers fulfil the objectives of the clients, Appendix N describes how planners increase the cross-servicing potential and Appendix O also describes how client services employees should increase the cross-servicing potential.

5. Clarified responsibilities – Couriers always notify pickup descriptions when missing in SmartRoute and/or the courier handbook, and the planner implements the (new) pickup descriptions in both SmartRoute and the courier handbook

See the clarification of tasks in Appendix L and O below for couriers and planners to adjust.

6. Clarified expectations on communication and tasks – Uniform decision-making process of the couriers, the client service employees, and the clients. Decrease the amount of required effort for the current staff, increase courier equipment, improve information flows through clustering logistics entities, and use information flows for communication of data and analytical systems for optimisation. Prioritise the stakeholder objectives of minimising costs or maximising service quality.

See Appendix K, L, M, N, O, and P below for clarification that requires to be communicated to each type of employee and each client

7. Visualisation of the standard tasks in the logistics processes and guaranteed correct interpretation of tasks – Create awareness and improve management of the couriers' tasks

See Appendix H below for the visualisations done based on the current logistics processes.

8. Preparation on expanding The Company – tackle bottlenecks and limitations, implement/prepare for economic, human, infrastructure, natural environment and business environment uncertainties, increase flexibility in resources and processes, increase consolidations, improve pickup locations, utilise existing employees to find new employees, focus on training and improving both knowledge and skills, implement multiple recharging stations, and invest in two-speed transmission vehicles.

The solution of preparing on expanding The Company is implemented when:
- optimisation on changing pickup locations is done
- optimisation through scheduling training for the couriers to implement the adjustments that they should be made according to this research and further research
- optimisation through increasing courier equipment to increase the flexibility of the couriers
- optimisation through increasing staff by utilising existing employees to find new employees
- optimisation through implementing recharging stations in case of cold weather
- vehicle optimisation through investments in two-speed transmission vehicles
- optimisation through improved clarified prioritisation for the employees

9. Implementation and improving human behaviour – predict courier decisions and adjust schedules based on these decisions and improve the decision-making process

Implementation and improving human behaviour require The Company to do research on the behaviour based on the data of SmartRoute, for example, if they do not drive according to the schedules, they take longer to process clients, start later than required or return to The Company more than requested. The courier behaviour improvements to the couriers' behaviour should be communicated and implemented.

10. Implementing a charging strategy – track energy use data to determine required en-route charging

The Company is required to research creating a charging strategy as they should collect data from their vehicles during cold days. The data should consist of the distances of the vehicles, the battery use, the capacity use and the temperatures during these times. When this data is collected, conclusions on what the best use of the batteries is can be made and a charging strategy could be made and implemented.

11. Working during off hours – provide courier service from 7 PM to 6 AM to avoid restrictions and traffic, and implement larger vehicles

The solution of working during off hours has not been implemented yet and when this solution is implemented, changes should be made. To do this the timeslots of the clients should also be in the off hours and the clients should be able to also receive the products during off hours. This means that implementing these solutions also requires adjustments from the clients. When problems occur with clients the supervisors should also be available to help them which also requires them to change their shifts. When these adjustments are made, the uncertainties are decreased, and more reliable schedules can be created.

Question 3. Create the top five most important causes to tackle by ranking the solutions from most to least important to tackle, with 1 being the most impactful and effective solution and 5 being the least impactful and effective solution.

Nr	Solution	Importance:
1	Implementing the correct processing times	
2	Implementing the average/actual departure times	
3	Adjust client timeslots to off-peak hours	
4	Minimise internal struggle at the client, create added value and improve willingness to pay	
5	Clarified responsibilities	
6	Clarified expectations on communication and tasks	
7	Visualisation of the standard tasks in the logistics processes and guaranteed correct interpretation of tasks	
8	Preparation on expanding The Company	
9	Implementing and improving human behaviour	
10	Implementing a charging strategy	
11	Working during off hours	

Table 31. The classification of the created solutions based on the impactful and effective perception of the couriers' supervisors and planner

Question 4. Could you explain the choices made to select the above top five solutions?

Appendix R The Interview to Collect the Opinion of the Couriers on the Logistics Processes

This research started with research on the current situation of the logistics processes of The Company. Several causes are found for the unreliable driving hours for the couriers. Through a selection of the most important problems that require to be tackled, the most impactful solutions are chosen. Let's start with an introduction to the causes that require to be tackled:

The summary of the logistics processes bottlenecks is the regular daytime deliveries that increase the inevitable uncertainties. The missing or incorrect optimisation data on departure times, demand requests, pickup locations, decision-making, awareness of route and task agreements, prioritisation, and different human behaviour and experiences. Limitations of equipment and staff. The limitation of the logistics processes is the client behaviour and the assumptions that are required due to the bottleneck of the uncertainties. The six solutions that help to solve these problems are as followed:

1. Preparation for expanding The Company – The solution of preparing for expanding The Company is implemented when:
   - optimisation on changing pickup locations is done
   - optimisation through scheduling training for the couriers to implement the adjustments that they should be made according to this research and further research
   - optimisation through increasing courier equipment to increase the flexibility of the couriers
   - optimisation through increasing staff by utilising existing employees to find new employees
   - optimisation through implementing recharging stations in case of cold weather
   - vehicle optimisation through investments in two-speed transmission vehicles
   - optimisation through improved clarified prioritisation for the employees
2. Implementing the correct processing times – processing times are scheduled in SmartRoute and adjusted when pickup locations create longer processing times. Longer processing times are required to be scheduled, for example when pickup descriptions require to call the client before entering, require walking into the building to collect the crates, when 20+ crates are collected on average or when the timeslots are during hours with a lot of traffic or other accumulations.
3. Implementing the average/actual departure times – departure times are adjusted to 8:44 instead of 8:00 as currently, the average departure time is 8:44, and tracking the departure times every month to see if these change and require to be adjusted. Departure times are calculated from SmartRoute by collecting the first scan minus the travel time according to SmartRoute to these clients.
4. Clarified responsibilities – Couriers always notify pickup descriptions when missing in SmartRoute and/or the courier handbook, and the planner implements the (new) pickup descriptions in both SmartRoute and the courier handbook
5. Clarified expectations on communication and tasks – Uniform decision-making process of the couriers, the client service employees, and the clients. Improve information flows through clustering logistics entities and use information flows for communication of data and analytical systems for optimisation.
6. Visualisation of the standard tasks in the logistics processes and guaranteed correct interpretation of tasks – Create awareness and improve management of the couriers' tasks

To understand the success probability of these solutions, the behavioural intention to use the solutions and usage behaviour from the couriers should be collected. To determine these values, the following statements have been made and should be rated from 1 to 5, where 1 is strongly disagree, 2 is somewhat disagree, 3 is neutral, 4 is somewhat agree and 5 is strongly agree.

Statements	1	2	3	4	5
PE1 - I would find the solutions useful for my job					
PE2 - Implementing the solutions helps me to do my tasks better					
PE3 - Using the solutions will increase my productivity					
EE1 - The expectations from me when implementing these solutions are clear and understandable					
EE2 - It would be easy to implement the suggested solutions					
EE3 - Learning to make the required adjustments is easy for me					
SI1 - Using the solutions will improve the performance of the logistics processes					
SI2 - Other employees will benefit from the implementation of these solutions					
SI3 - The clients will benefit from the implementation of these solutions					
FC1 - I have the resources to implement these solutions					
FC2 - I have the knowledge to implement these solutions					
FC3 - When I experience difficulties with the solutions, I know who to approach and get the help I need					
BI1 - I intend to use the solutions and make the adjustments in the next months					
BI2 - I predict I would use the solutions and make the adjustments in the next months					
BI3 - I plan to use the solutions and make the adjustments in the next months					

Table 32. The statements that represent a behavioural intention to use the solutions.

What are your reasons for rating the above statements lower than 5?

To end this interview your opinion on the separate solutions is also asked to find the differences in the impact and effectiveness of these solutions. These solutions should also be rated from 1 to 5, where 1 is very ineffective, 2 is somewhat ineffective, 3 is neutral, 4 is somewhat effective and 5 is strongly effective.

Solution	1	2	3	4	5
Preparation on expanding The Company					
Implementing the average/actual departure times					
Implementing the correct processing times					
Clarified responsibilities					
Clarified expectations on communication and tasks					
Visualisation of the standard tasks in the logistics processes					

Table 33. The perspectives of the couriers on the presented solutions

What are your reasons for rating the above statements lower than 5?

Appendix S The impact assumptions and reality of the solutions for the different causes of the unreliable driving hours of the couriers

Detected causes	Solution	Implementation	Potential benefit
SmartRoute had a bug that prevented adjusting or not implementing the processing times, Missing or incorrect processing times for clients in the schedules of SmartRoute, Unreliable route and task agreements, Incorrect demand requests & Incorrect flow of delivered and collected products	Implementing the correct processing times	The bug is resolved and implemented by the company, tracking of the long processing times is required and should be researched.	All processing times are considered, fixed adjustments are made, and no manual changes are required anymore. Implementing the correct processing times improve estimated times of arrival, makes more reliable schedules and less delayed services.
Missing or incorrect departure times, Scheduled departure times are not used, Unreliable route and task agreements, Incorrect transport infrastructure, demand requests and flow of delivered and collected products & Missing or incorrect routes	Implementing the average/ actual departure times	The collected average departure time is required to be implemented in SmartRoute.	Leaving The Company at the estimated and average time of 8:44 instead of 8:00 increases the possibility for couriers to follow the schedules and help the clients in the indicated timeslots.
Incorrect transport infrastructure, demand requests and flow of delivered and collected products, Inevitable uncertainties & Service inconvenience	Adjust client timeslots to off-peak hours	Negotiation with clients creates the most convincing timeslots for both The Company and their clients.	The schedules can be made more location efficient as it decreases the chances of visiting clients that cannot be helped yet. This shortens the routes as less driving between the clients is required, increases the possibility for couriers to follow the schedules and help the clients in the indicated timeslots.
Relational embeddedness and different added value opportunities, Dissatisfaction with the relation, needed effort & Service inconvenience	Minimise internal struggle at the client	Repositioning the focus of the couriers and their tasks.	The couriers take the filled crates to the client, even the incorrectly filled crates, improve relational commitment from clients and increase cross-servicing potential where clients make use of both services and products.

Unclear expectations on communication and tasks for the involved parties, Poor communication approaches and inconvenient agreements, Missing or incorrect pickup locations, Service inconvenience, Changing human behaviour, Missing awareness and understanding of logistics processes, No priority/time to clarify the tasks, Incorrect transport infrastructure, Different employee experiences, Unreliable route and task agreements, Missing communication tool, & Missing or incorrect optimisation data on decision-making and prioritisation	Training for clarified expectations on communication and tasks, and responsibilities	Clarifications are done in this research and the training can be held based on this information.	Client service employees communicate the clients' expectations clearly to the clients. Couriers always notify pickup descriptions when missing in SmartRoute and/or the courier handbook, and the planner implements the pickup description in SmartRoute and/or the courier handbook, which decreases the required processing times. When implementing improvements, the opinions and perspectives of the employees involved in the logistics processes are implemented which increases the implementation potential. Decisions on what to do in different situations are clear to the employees, clarified prioritisation improves decision-making, and communication is open and clear to the involved parties. The visualisation of the standard tasks in the logistics processes is clarified in the operations-based exercises as this is part of the validation of the agreements and procedures. The visualisations are shared with new couriers during their onboarding and used in situations where couriers quickly check what tasks/decisions they could and should do.
Changing human behaviour, Incorrect transport infrastructure, Different employee experiences & Inevitable uncertainties	Implementing and improving human behaviour	This is tackled in this research by tracking courier behaviour and adjusting the management based on this	Implementing human behaviour prepares The Company for the inevitable uncertainties of changing human behaviour and different employee experiences and improves communication approaches through improved decision-making.

Limited driving range and low energy dense batteries of electric vehicles & Inevitable uncertainties	Implementing a charging strategy	This is tackled through researching during which temperatures more charging is required and implementing recharging spots	Implementing a charging strategy tackles the inevitable uncertainty of cold weather which improves and clarifies the couriers' decision-making.
Inevitable uncertainties & Regular day time deliveries	Working during off hours	This is tackled by shifting the couriers to off-hours	Off-hours have less traffic which results in faster driving speed and fewer uncertainties, and that results in fewer delayed services.
Missing or incorrect optimisation data on routes	Implementing improvement data on routes	Another research to optimize the routes and implement the uncertainties.	Fuzzy clustering implements the factors that have uncertainties like economic, social, infrastructure, natural environment and business environment factors.
Missing or incorrect optimisation data on demand requests	Implementing improvement data on demand requests	Negotiation with clients creates the most convincing agreements for both The Company and their clients.	The flexibility of resources and processes, implementing all tasks that are required from the couriers in their schedules, and implementing the actual routes and vehicles' times make the processes and the schedules more efficient.
Missing or incorrect optimisation data on pickup locations	Improvements in pickup locations	Negotiation with clients creates the most convincing locations for both The Company and their clients.	Improving pickup locations improves the processing time of a client making the schedules more reliable.
Limitations of equipment and staff, job demand & job resources	Increasing courier equipment and staff	Implemented through the starting the search for extra staff and budgeting for investments of new equipment	Increases in equipment and staff and investments in two-speed transmission vehicles increase the flexibility of the couriers, decrease job demand and increase job resources.

Table 34. The impact assumptions and reality of the solutions for the different causes of the unreliable driving hours of the couriers.