Improving Delivery Performance Through Distribution Process Redesign

A Case Study at ASSA ABLOY Entrance Systems

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Abstract

The order-to-delivery (OTD) process for a specific product group at ASSA ABLOY Entrance Systems (AAES) has been underperforming lately and failing to meet changing customer expectations, especially regarding reliability and speed. The current process configuration has been assessed as outdated and inadequate for efficient distribution of the product. Since the OTD process was configured, supply chain management and distribution have evolved. The development can be explained by technological advances, general macroenvironmental trends, and the COVID-19 pandemic, for instance.

This thesis aims to address the performance-related issues of the OTD process by identifying the main causes of the low delivery performance and present proposals to solve them, ultimately resulting in improved delivery performance. It is done through a case study with a four-stage approach at AAES, combining empirical data gathered at the company with a theoretical background containing relevant fields within supply chain management. The analysis is enabled by a thorough mapping of the current state of the OTD process, providing the necessary knowledge.

In the analysis, nine main causes of low delivery performance are identified. These are related to strategy, supply chain integration, information sharing, and reliability to name a few. With a focus group containing practitioners at the company, together with the empirical data and theoretical background, six improvement proposals are presented related to strategy improvements, enhanced reliability, a new governance structure, improved IT infrastructure, enhanced performance measurement, and a new planning concept. The improvement proposals together form a road map for moving from the current state to a future state with improved delivery performance in terms of reliability and speed.

The thesis can provide insights into how delivery performance at a global, industrial company can be improved. The improvement proposals could be relevant for other similar companies and serve as inspiration. Future research could focus on the implementation of proposed improvements to provide a more thorough understanding of the factors influencing the success of such supply chain transformations.

Contribution: This thesis has been a complete elaboration between the two authors. Each author has been involved in every part of the process and contributed equally.

Keywords: Delivery Performance, Order-to-Delivery Process, Supply Chain Redesign, Supply Chain Integration, Performance Measurement

Glossary

BI – Business Intelligence

CODP – Customer Order Decoupling Point

CRM – Customer Relationship Management

CTO – Configure to Order

ERP – Enterprise Resource Planning

LSP – Logistics Service Provider

OTD – Order-to-Delivery

RQ – Research Question

SCI – Supply Chain Integration

TMS – Transport Management System

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1 Introduction

The purpose of this chapter is to provide a background to the thesis and place it in an academic context as well as to introduce the case company and the problem. Furthermore, in this chapter the purpose and research questions will be presented, together with explanations. The focus and scope of the thesis will also be specified, before lastly presenting the structure of the report.

1.1 Background

Logistics can be defined as a company's activities related to materials management and distribution, as a part of the broader term Supply Chain Management (Rushton et al, 2022). It can be seen as a service industry, that has undergone major changes in recent years (Richey et al., 2021). The view of logistics has changed from being seen as an unavoidable necessity to an opportunity to further add value and create a competitive advantage (Rushton et al., 2022; Sandberg & Abrahamsson, 2011). Furthermore, the COVID-19 pandemic has caused major changes to customer habits, accelerating the growth and transformation of the logistics industry (Moon & Armstrong, 2019). An important part of logistics, also undergoing transformation and development, is distribution.

Distribution is often defined as the process of making goods available to the consumer or business that needs it, often including storage and movement (Rushton et al., 2022; Chopra, 2003). It is considered to play a major part in the success of many organizations (Rushton et al., 2022) and is often the process that contains the most touchpoints with the customer (Cepeda-Carrión et al., 2023). Although the customer buys a physical product, the distribution of it is a service which impacts both the supply chain costs and the customer experience. It is therefore a key driver of overall profitability of organizations (Chopra, 2003). Distribution is about finding the optimal balance between customer service and costs (Rushton et al., 2022) and the trends are pointing towards having a more systemic focus, information synthesis and collaborative relationships (Speranza, 2018). That puts pressure on companies to transform and adapt their distribution processes. A way to assess distribution and the level of customer service is to measure delivery performance.

Delivery performance is seen as a key measure of supply chain excellence (Guiffrida & Nagi, 2006) and has become increasingly important in B2C supply chains (Lal & Narayanswamy, 2022). Customers demand accurate deliveries, real-time delivery tracking, constant communication, and user-friendliness (Joerss et al., 2016). Furthermore, many studies have shown that last-mile delivery, which is often a major part of distribution, is considered an important decision-making criterion for online customers (Vakulenko et al., 2019). Delivery performance is affecting not only the experience of consumers, but business customers' as well, and the increased performance expectations are now spilling over to B2B supply chains.

According to research, 89% of B2B companies believe that customer experience will be their main focus to be competitive in the future (Sorofman et al., 2016). Creating a positive customer experience and thus customer satisfaction is important in creating strategic relationships with customers and in achieving a competitive advantage (Cepeda-Carrión et al., 2023). It is of particularly great importance for organizations competing internationally with global supply chain networks with a high level of complexity (Vachon & Klassen, 2002).

Many studies made on delivery performance were made before 2020 and might have lost relevance in today's post-pandemic environment. Supply chain disruptions occur more regularly (Raj et al., 2022; Panwar et al., 2022), and increased customer requirements together with other trends are creating a new logistics and distribution landscape. Many organizations must evaluate their supply chain design's suitability in today's environment. Studies aiming to investigate and assess delivery performance in global, complex supply chains in a real-world, post-pandemic context could therefore be a useful addition to current literature and work as inspiration for similar companies to increase delivery performance.

1.2 The Case Company

ASSA ABLOY Entrance Systems, in this thesis referred to as "the company", is a part of ASSA ABLOY Group and became a distinct division of the group in 2006 (ASSA ABLOY Group, 2024). It provides automated pedestrian, industrial, and residential doors, as well as additional services. The company is operating globally and has approximately 15.000 employees in 130 countries, with a revenue of 42.8 billion SEK in 2023. It has offices in many places around the world, with its head office in Switzerland. The company structure can be seen in Figure 1.1. For the pedestrian segment, entrance solutions to public places such as stores and schools are developed. In the residential segment, products for people's homes are developed such as garage doors. The industrial segment, where this thesis is conducted, develops industrial solutions for different industries such as manufacturing, logistics, and aviation and produces configure to order (CTO) products. The service offering includes maintenance of doors. The thesis project is facilitated from the Landskrona office, where a part of the industrial business segment's supply chain department is located.

Acquisitions have contributed significantly to the company's growth. As a result, there are many brands under the umbrella of the case company such as Yale, HID and Dynaco. The group's strategic direction is to lead the trend towards the world's most innovative and well-designed access solutions, and its vision is "To be the global leader in providing innovative access solutions that help people feel safe and secure so that they can experience a more open world". The group has four strategic objectives: growth through customer relevance, product leadership through innovation, cost-efficiency in everything we do, and evolution through people.

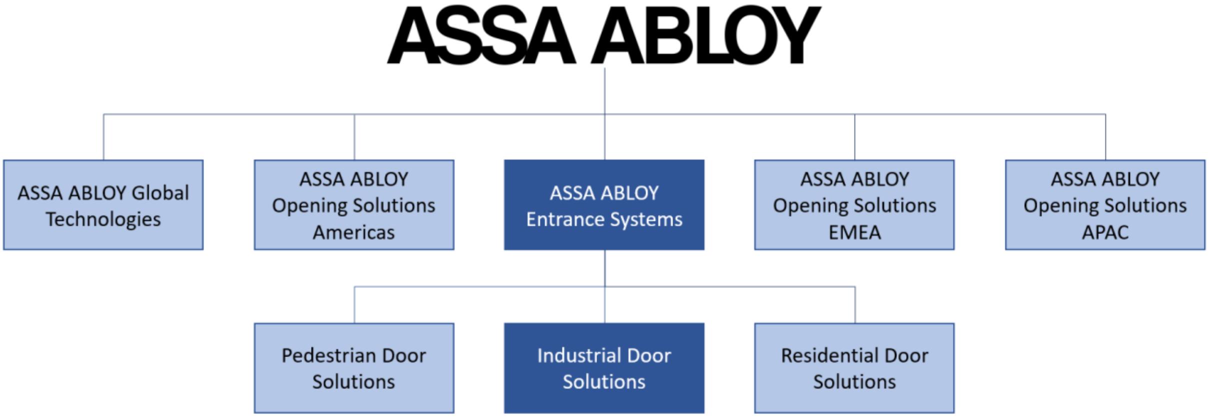

Figure 1.1*. The company structure of ASSA ABLOY Group and ASSA ABLOY Entrance Systems. The darker shade represents the area which this thesis is concerned with.*

1.3 Problem Description

Like other businesses, the company has been affected by macro environmental changes and trends in recent years. A large part of the order-to-delivery (OTD) process was developed in 2011 and there are concerns that it is not as suitable and efficient today as it was when it was introduced. Its main objective is to enable deliveries to be on time, which was an issue in 2011. Today, the company questions if there might be other objectives that are more important with increased interest rates and price levels and changed customer expectations. In addition, there might be other OTD process designs that are more efficient in the new logistics and distribution landscape with new technologies and solutions. These concerns are the foundation of the thesis and the reason for it being conducted.

The company made an assessment of the OTD process in 2021 and identified that delivery performance was below desired levels. Delivery performance can be defined in different ways (Forslund et al., 2008), but in this report it will be defined by the dimensions of reliability and speed. The definition of delivery performance is further discussed and motivated in Section 3.1, and the OTD process is defined in Section 1.5. At the start of this thesis project, the on-time delivery rate at the company, as a measure of reliability, was 86%. However, no precise measure of the average lead time (speed) was known, just that it was assumed to be too long. The company wants to improve delivery performance to improve customer experience and thereby create better and more sustainable relationships with customers. In addition, higher speed of the process, i.e., shorter lead times, was desired by the company to reduce costs related to tied-up capital, storage, and product waste.

There are several factors that make the OTD process complex, hence the challenge of achieving high delivery performance. Firstly, the company produces large, CTO products that are complicated to transport and handle. Customers are allowed to make many modification to the products in terms of size, color, materials, and additional features. Secondly, the physical network of the OTD process is designed such that different components are produced in factories in different countries spread across Europe. The components must therefore be consolidated before the products are ready to be installed. Furthermore, an order is not considered to be fulfilled until the product is installed, not just delivered. All these factors add to the complexity of the OTD process for the company, making it an interesting case to study.

1.4 Research Purpose and Questions

The purpose of this thesis is:

To develop improvement proposals for how the company can achieve improved delivery performance in the OTD process.

To fulfill the purpose, the following research questions (RQ) will be answered:

RQ1: What are the causes of low delivery performance in the OTD process?

This question is important to understand the weaknesses in the OTD process. An as-is analysis of the process will be conducted to provide a picture of the current state. Further, the primary drivers for low delivery performance will be identified and analyzed. To enable development of improvement proposals, it is important to understand the OTD process's weaknesses. The results will be used as a basis to answer the second research question and thus fulfill the purpose of the thesis.

RQ2: How can delivery performance be improved?

The primary drivers identified in RQ1 will be the basis for developing improvement proposals. Objectives and motivations for the proposals will be provided, and the proposals will be divided into categories based on their time scope of possible implementation, short-term, mid-term, and long-term. This research question directly contributes to the fulfillment of the thesis purpose. Furthermore, the findings can serve as inspiration for companies facing similar issues with their OTD process.

1.5 Focus and Delimitations

The focus of the thesis is to analyze and propose improvements to the OTD process for the product group Overhead Sectional Doors within the industrial business segment, further referred to as the product or the door. That includes the physical flow of components from three factories referred to as Factory 1, Factory 2, and Factory 3 located in three Central European countries. The components are distributed to the customers via a hub in the same country as Factory 1 which is run by a Logistics Service Provider (LSP). The scope also includes the relevant information flow related to the OTD process. However, the focus will not be on the financial flows related to the process. The scope of the thesis is visualized in Figure 1.2.

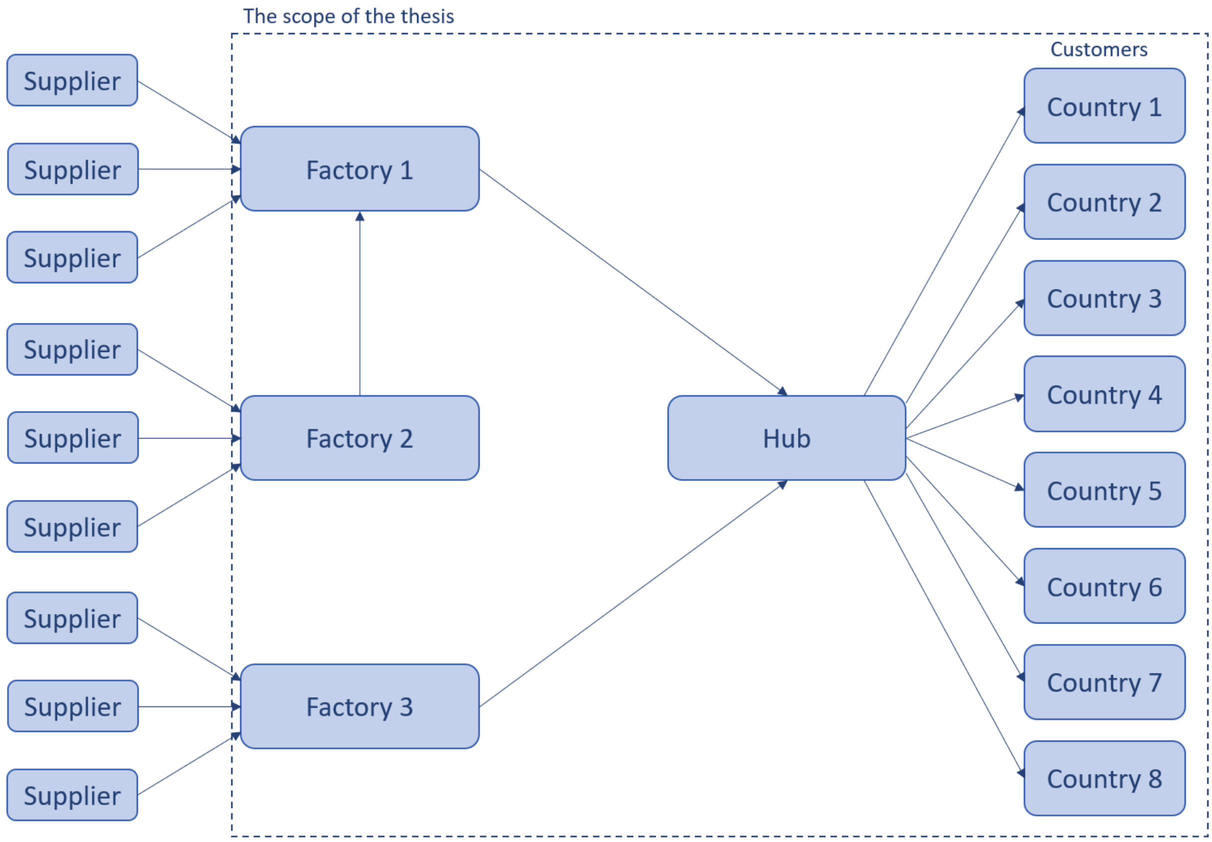

Figure 1.2. The scope of the thesis.

The time scope of the OTD process that will be analyzed is from a complete sales order to start of installation of the product at customer site. This includes the lead time before manufacturing, manufacturing, and the distribution of the product to customer via the hub. The thesis will not be concerned with analyzing or proposing changes to processes in manufacturing such as purchasing or production, but only distribution and planning related activities. It will however consider the lead time of manufacturing since that influences the planning of the OTD process. Processes related to installation, or its duration, will not be considered in the thesis, only the planning of installation and the time up until it starts. Further, the focus will not be on improving the physical network for the OTD process, but rather on the processes, activities, and principles related to it. However, the implications of the physical network design will be discussed.

1.6 Structure of this Thesis

Table 1.1 below presents the disposition of the thesis:

Table 1.1. *The chapters in the report along with the content for each chapter.*

Chapter	Contents
1 Introduction	This chapter introduces the context of delivery performance challenges in the OTD process at ASSA ABLOY Entrance Systems. It outlines the background, problem statement, research purpose, questions, and scope of the study. This chapter prepares the reader for the investigation into how the OTD process can be redesigned to improve delivery performance.
2 Methodology	This chapter details the research approach, methodology, and design, explaining how the study was carried out. It discusses the selection of the case study method, data collection techniques, and the rationale behind these choices. This chapter ensures the research's methodological rigor and credibility.
3 Frame of Reference	This chapter reviews the literature on delivery performance, performance measurement, logistics and distribution and supply chain integration, setting the theoretical foundation for the study. It identifies the key concepts and theories in existing research, providing a theoretical lens for analyzing empirical data and framing the study's research questions.
4 Empirical Study	The empirical study presents the data that was gathered, creating a mapping of the OTD process. It aims to provide in-depth data which can be utilized for analysis. The empirical study follows the structure which is outlined in Chapter 2. This begins by creating an understanding of the overall process design, then mapping the activities, planning processes, and applications. Next, the quantitative data is presented, in the form of performance indicators for the OTD process.
5 Analysis	This chapter analyzes the empirical findings against the theoretical backdrop established in Chapter 3, identifying the root causes of delivery performance issues, and assessing options for improved performance. Improvement proposals in six areas are presented. The chapter also assesses the applicability of these solutions, considering various constraints and the specificities of the OTD process.
6 Conclusion	Chapter 6 concludes the thesis by summarizing the fulfillment of the research purpose and questions, highlighting its contribution to the case company and research, and suggesting areas for further research.

2 Methodology

The purpose of the methodology chapter is to present the research approach, methodology, and design, as well as to discuss the different methods for collecting data. Further, the methodology for the analysis of the data is presented and lastly, the quality of the research is discussed regarding validity and reliability to ensure trustworthy results.

2.1 Research Approach,

The research approach defines the scientific reasoning behind the thesis. Spens and Kovács (2006) argue that there are three main research approaches: inductive, deductive, and abductive. The deductive approach can be seen as a theory-testing process, that seeks to confirm or deny established theory that has been developed prior to the empirical research. The deductive approach lends itself well to research in controlled environments with more structured data. The inductive approach, on the other hand, is particularly effective for exploratory studies in natural settings where data is more unstructured. It is often used to understand or explore a system and begins with empirical observations used to develop hypotheses about the phenomenon (Kotzab et al, 2005). They are then developed into theory using existing literature. Thus, the inductive approach is concerned with theory building as opposed to theory testing used in the deductive approach. The abductive approach, in contrast to this, can be seen as utilizing theory matching. The approach begins with observation, and theory is used iteratively to develop hypotheses or propositions surrounding the system. Per its definition, empirical study and review of the literature are concurrent activities. Figure 2.1 gives a graphical representation of the three approaches, where the inductive and deductive approaches inhibit their own loop of reasoning, while the abductive is seen as a combination (Golicic et al., 2005).

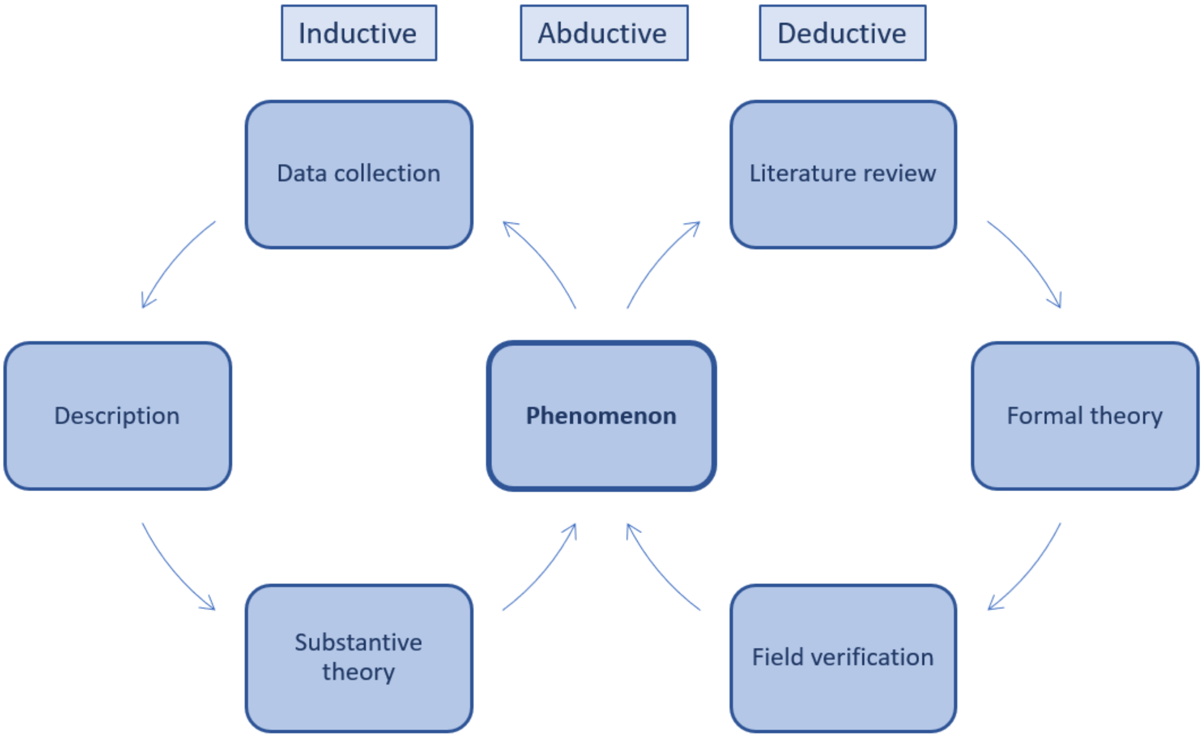

Figure 2.1. The workflow of the inductive and deductive research approaches (Golicic et al., 2005).

This thesis utilized an abductive research approach because of its flexibility in switching between conducting data collection and literature review, which was required to build understanding about the relevant research areas and the company simultaneously. Spens and Kovács (2006) argue that few scientific breakthroughs have utilized an exclusively inductive or deductive process, instead being a combination of them. Additionally, with the purpose of achieving higher performance in the OTD process, the thesis was concerned with building propositions, which fits the abductive workflow of utilizing theory matching. The abductive approach uses both the inductive and the deductive workflows, combining the two loops seen in Figure 2.1 for continuous iteration of data collection in the field as well as of the scientific body of research. That suited this study well since certain elements of the OTD process became apparent first when the empirical study was conducted.

2.2 Research Methodology

This thesis utilizes a case study research method. A case study is generally seen as a method to explore a phenomenon in its natural setting. As outlined by Fisher (2007), a case study suits well with research with less structured data collection and a more descriptive focus, which goes well with this thesis. Yin (2014) argues that exploratory studies generally suit well with the case study methodology. The first research question relates to the understanding and description of the current process, and the second research question explores how it can be improved. Since this thesis treats both the descriptive and the exploratory, a case study is suitable.

Yin (2014) proposes a framework for choosing between different research methodologies using three conditions. The first condition is about how the research questions are posed. The more the questions aim to explain something, the better a case study will fit. Generally, "how" and "why" questions, as well as exploratory "what" questions are suitable. The second condition is whether a controlled environment is needed. The last condition is that the set of events are contemporary. The thesis fits these descriptions well. Thus, other methodologies such as experiments, surveys, archival analysis, and histories can be disregarded, according to the framework.

Two other potentially relevant methodologies for the thesis are design science research and action research. Holmström et al. (2009) state that these are used to develop an artifact to solve a problem. Compared to action research, design science focuses to a greater extent on identifying the underlying mechanisms. It is difficult to utilize action research since the methodology generally requires a longer timeframe than is available for this project. One could argue that the research conducted in this thesis is similar to a design science study. However, a design science study includes the formulation and creation of an artifact, which is not done in this study.

Lastly, Yin (2014) identifies four kinds of cases, depending on the characteristics of the study. It can either focus on a single case or multiple ones, and it can also have one or multiple areas of focus. Since the unit of analysis is a single process at a single company, the case study is singular and holistic.

2.3 Research Design

A research design refers to "the plan used to examine the questions of interest" (Marczyk et al., 2010, p. 22). More specifically, it is a framework for conducting a study and includes all activities and methods used to answer the research questions. In this section, the thesis project is divided into smaller steps and stages. The project started at stage one, the problem description, and ended with proposed improvements, at stage four. The objectives of the improvements were to improve the delivery performance and fulfill the purpose of the thesis. The methods and activities required to move between the different stages and answer the research questions, are explained in this section.

The study was designed to investigate, analyze, and improve the phenomenon of low delivery performance in a global CTO company, namely the company. The unit of analysis in which the phenomenon was studied is the OTD process for the product, and the major parts and flows of it can be seen in Figure 2.2. It is around the phenomenon, unit of analysis, research questions, and thesis purpose that the research was designed.

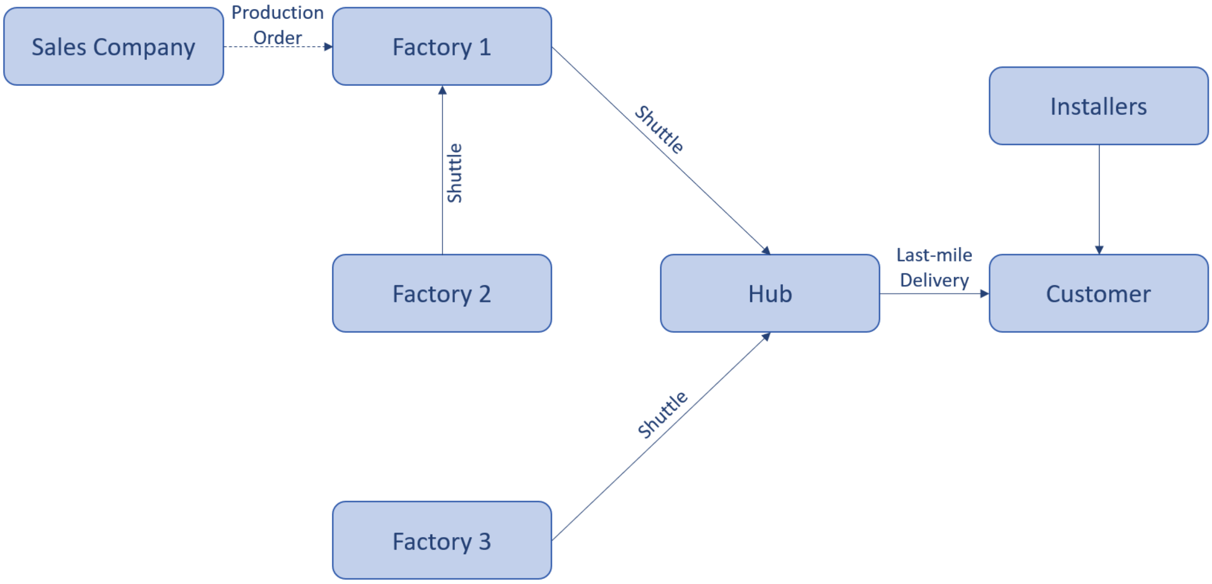

Figure 2.2. The unit of analysis in which the phenomenon is being studied, namely the OTD process of the company.

An overview of the research design can be seen in Figure 2.3. The research was conducted in three major steps which all contributed to answering the research questions and fulfilling the purpose. The steps were supported by either data, literature, analysis, or a focus group to achieve expected deliverables. The deliverables of the first step were an as-is OTD process map and a theoretical background. The as-is map contains explanations and descriptions of the company and its strategy, the physical distribution network, roles and organization, activities, and supporting systems. The deliverable of the second step was to identify causes of low delivery performance, answering RQ1, supported by the OTD process map and theoretical background. The objective of the third step was to propose improvements by utilizing the results from the two first steps, namely the as-is map, theoretical background and identified causes of low delivery performance together with the results from a focus group. The goal of step three was to answer RQ2. Ultimately, all steps contributed to fulfilling the thesis purpose of improving delivery performance for the company.

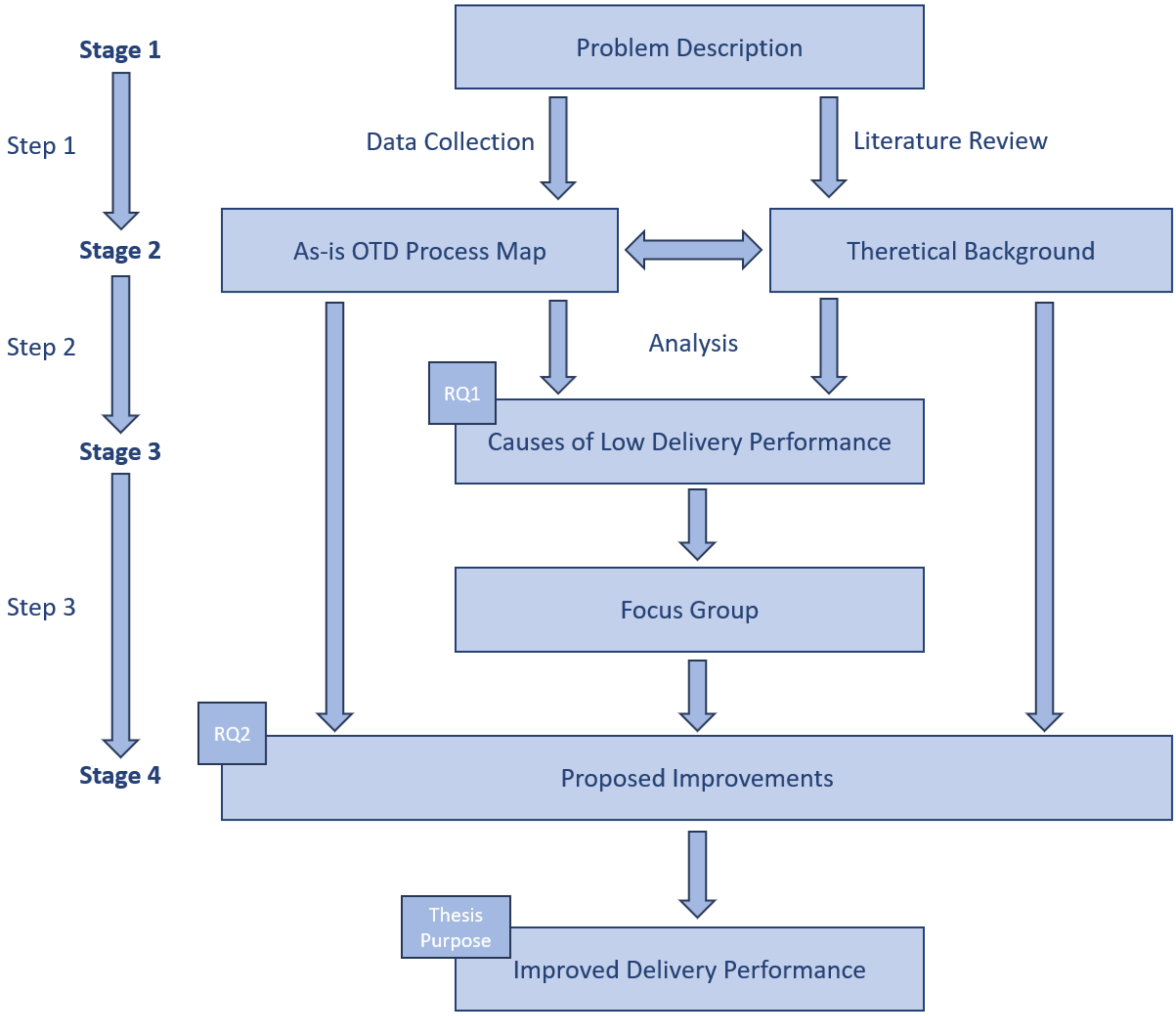

Figure 2.3. An illustration of the research design, with inspiration from Hantelis and Östlund (2022).

Since the research questions are answered using an abductive research approach, data collection and a literature review were done simultaneously. The OTD process map helps in understanding what theoretical background is needed. The theoretical background on the other hand enabled understanding and was utilized when mapping the current process. That is why the research method is abductive, working iteratively between reviewing the literature and collecting empirical data. Both the process map and the academic background were then used to identify causes of low delivery performance. The academic background was used as guidance and benchmarking against the as-is process map to enable identifying the causes. Both the as-is state, theoretical background and identified causes served as basis for proposed improvements to the OTD process, together with inputs from the focus group. The process map was used as a framework for what is possible to change and the reasonability of changes. The theoretical background provided examples of best practices of processes and activities, was used as inspiration, and increased trustworthiness in proposed improvements. The identified causes of low delivery performance were evaluated and ranked to enable prioritization as well as validation. It was done by using what we call the impact-complexity matrix.

The improvements were presented and categorized by time horizon: short-term, mid-term and long-term, along with a roadmap showing how the company could move from the current state to a future state with an improved OTD process. Short-term changes could be implemented immediately. Mid-term proposals are more complex to implement and require more time and/or investment, and long-term proposals even more so. Furthermore, they require some other improvements to be implemented first. The improvement proposals in the roadmap follow naturally after each other. If short-term changes are implemented, that will enable implementation of mid-term changes, finally enabling long-term changes. The impact-complexity matrix, which contains the causes, was used for the purpose of categorizing the improvements as short-term, mid-term, or long-term.

2.4 Data Collection

The data collection process was divided into two main parts. The first part contained the collection of empirical data from the case company. The purpose was to create an understanding of the current OTD process to function as a basis for further analysis. The data, which was gathered between January and April 2024, provided the empirical evidence required to answer the research questions. The second part contained a literature review, which helped in framing the research questions, developing a theoretical background for the study, and identifying gaps in the existing literature. Through a literature review, the relevance of the research and how it builds upon or diverges from previous studies was established.

The empirical chapter focuses on three overarching areas. Firstly, the focus is on the company, the product, and its characteristics. Secondly, the focus is on mapping the OTD process, which was done in four main steps, see Figure 2.4. The first part, overall process design, is concerned with the overarching design of the OTD process, which includes the supply chain strategy, order characteristics, physical network, and organizational structure. The second part, activities, explains all processes and activities required to execute the OTD process. Further, planning and coordination explains the planning concept used to coordinate the processes. Systems and information sharing describes and explains the systems' infrastructure. The third and final part of the empirical study contains the gathering of performance data and an understanding of what data gathering the company is regularly conducting and what performance indicators are being used.

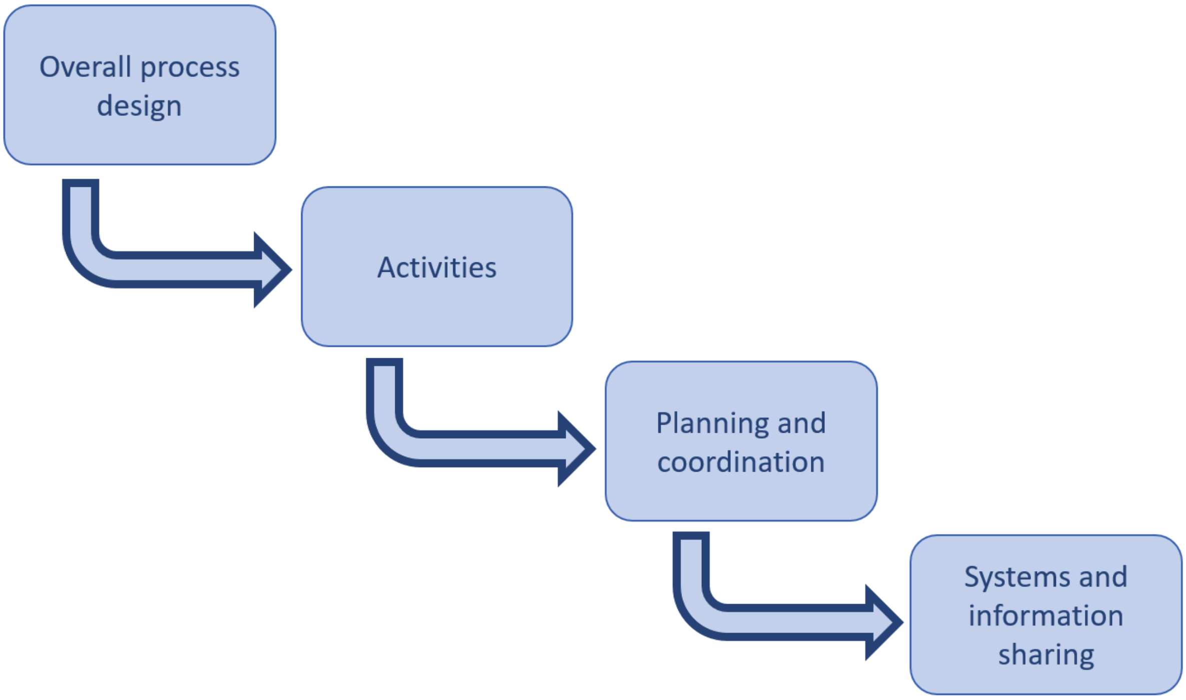

Figure 2.4. Steps in mapping the OTD process.

This thesis utilizes multiple sources of information. Yin (2014) outlines six sources of evidence: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts. For the empirical study in this thesis, documentation, interviews, and observations are the main sources of information.

2.4.1 Documentation

Both qualitative and quantitative data have been collected from documents at the company. Qualitative data includes information about processes, activities, roles and responsibilities, and current systems and applications. Documentation comes in various forms such as process maps, company reports and presentations, product documentation, emails, meeting minutes, and others. Quantitative data was collected mainly for delivery performance metrics, which include data on delivery reliability and speed, but also for OTD process data such as production lead times, transport times to hubs, storage duration at hubs, and last-mile delivery times.

2.4.2 Interviews

Interviews have been conducted for further collection of qualitative data on the four focus areas: overall process design, activities, planning and coordination, and applications and systems. It was expected that the interviews would aid in the collection of documentation as well, since interviewees may have access to useful data. Interviews were conducted with relevant people at the three factories, the hub, the sales company, and people in management with influence over the design of the OTD process. The interviews were chosen to cover all aspects of the OTD process to enable a complete understanding. Employees with the titles logistics director, logistics manager, field operations manager, master coordinator, project manager, factory manager, and supply chain manager were interviewed. A summary of the interviews is provided in Table 2.1. An illustration of what areas of the OTD process the different interviewees helped to map and understand can be seen in Figure 2.5.

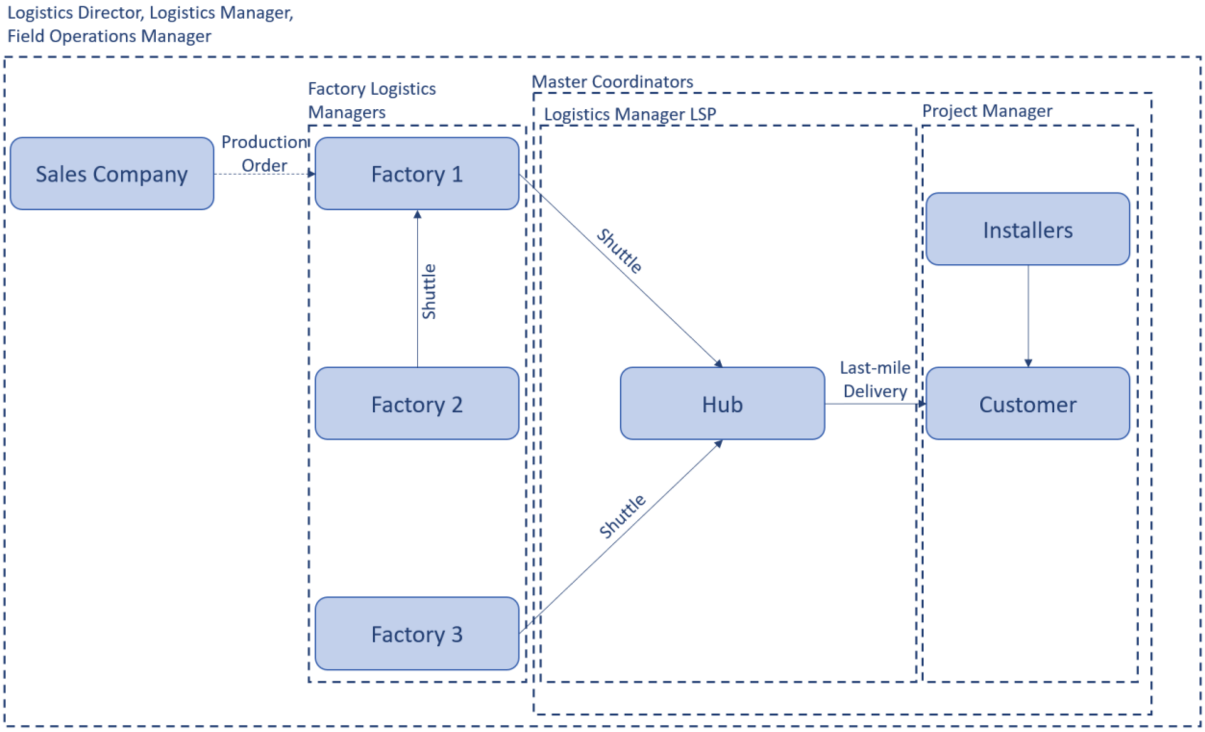

Figure 2.5. An illustration of what parts of the OTD process the different interviewees helped to understand.

The interviews mainly followed a semi-structured approach to be able to alter questions and allow follow-up questions, while keeping a defined structure. The only exception to this is the first interview which was unstructured. It focused on obtaining an initial understanding of the problem, where there was no previous knowledge or suitable questions to guide the conversation. The preparation for each interview was inspired by Kvale (2007). Firstly, the purpose and objectives of the interview were defined. Next, an interview guide with relevant questions to understand the OTD process was created. Interviews were used both for general descriptions and understanding of processes, as well as for problem areas and possible improvements. An interview guide can be found in Appendix 1.

Table 2.1. Summary of the conducted interviews.

Date	Position	Purpose	Type	Duration	Int. nbr
2024-02-01	Logistic Director Europe	Initial understanding of the problem areas in the OTD process	Unstructured	2 hours	1

2024-02-26	Logistics Manager	Understand the overall strategy, design, objectives of the OTD process, its activities, as well as opportunities for improvements.	Semi-structured	1 hour	2
2024-02-28	Field Operations Manager	Understand the overall strategy, design, and objectives of the OTD process, its activities, as well as opportunities for improvements.	Semi-structured	1 hour	3
2024-02-28	Logistics Manager, Factory 2	Understand the overall strategy and objectives of Factory 2, important activities, planning routines, as well as opportunities of improvement.	Semi-structured	1 hour	4
52024-062-29	Logistics Manager, Factory 3	Understand the overall strategy and objectives of Factory 3, important activities, planning routines, as well as opportunities of improvement.	Semi-structured	1 hour	5
2024-03-05	Logistics Manager, LSP	Understand the role of the LSP in the OTD process, its strategy, objectives as well as opportunities for improvement.	Semi-structured	1 hour	6
2024-03-05	Master Coordinators	Understand the overall strategy, design, and objectives of the OTD process, its activities, as well as opportunities for improvements.	Semi-structured	1 hour	7
2024-03-14	Project Manager	Understand the installation process and the planning related to it in the OTD process.	Semi-structured	1 hour	8
2024-03-25	Factory Manager, Factory 1	Understand the overall strategy and objectives of Factory 1, important activities, planning routines, as well as opportunities of improvement.	Semi-structured	1 hour	9

2024-04-22	Manager Operations and Business Development	Understand how the company works with following up with customers, their requirements, and what information they collect.	Semi-structured	30 mins	10

2.4.3 Observations

Observations were made to gain a better understanding of current processes and the product. According to Yin (2014), observations are a useful tool in providing more information about the topic being studied. For this thesis, observations were made in the form of visits to the R&D department and observations of the distribution hub in the form of a digital tour. At the R&D department, observations of the product were made. It was important to see the door to understand the potential implications of its size, different parts, and general characteristics. The tour of the distribution hub provided understanding and visualization of the door being in the OTD process where different components are packed separately. Furthermore, it provided an understanding of the processes at the hub and potential challenges connected to them. All observations were of the nature of non-participating, as the contribution did not actively impact current operations. This contrasts with participant observation, where the researcher takes an active role in the system (Yin, 2014).

2.4.4 Literature review

A literature review is presented in Chapter 3. The chapter aids in several aspects of the study. Firstly, it is used to develop an understanding of the problem area. This in turn is used to formulate the background, problem description, and research questions. The theory forms the basis for identifying improvements to the OTD process. As a result of the research design choices, the methodology for reviewing literature has continually evolved during the thesis. This dynamic approach ensures that the literature review process remains aligned with the evolving understanding of the OTD process and allows for the incorporation of new findings and theories that may emerge during the study.

In this study, the citation pearl growing technique was utilized as a method to deepen the literature review. It involves starting with key documents and expanding the search by exploring both the works they cite and the studies citing them (Rowley & Slack, 2004). This method helps uncover a wider range of relevant literature beyond traditional searches, ensuring a thorough review. A general approach of using multiple sources for data triangulation was utilized in the later stages of the thesis to increase validity.

Research was primarily carried out using *Google Scholar* and Lund University library's database *LubSearch*. Key terms such *as delivery performance, supply chain integration, supply chain reengineering, information sharing, distribution logistics, order-to-delivery process*, were used to find initial papers. Further precision was then added to yield more relevant results. To gain an overview of subjects, the terms previously mentioned were used together with "*literature review*", which yielded results of literature studies. Only studies that were peer-reviewed were considered for the thesis. Priority was given to sources with a large number of citations.

2.5 Data Analysis

After the data collection, the data analysis began. In this thesis, both qualitative and quantitative data were collected. The nature of the data guides the way it is analyzed. Denscombe (2010) provides a framework outlining five steps of data analysis, as seen in Table 2.2 below. This framework provides a basis for the data analysis methodology used in this thesis. The five steps are: 1) data preparation, 2) exploration, 3) analysis, 4) presentation, and 5) validation. Depending on whether the data is qualitative or quantitative, the activity for each step differs. The main difference is that statistical methods and numerical data are used for quantitative analysis, while qualitative analysis relies on coding, describing, and categorizing.

Table 2.2. *The five main stages of data analysis (Denscombe, 2010).*

Step	Qualitative data	Quantitative data
1 Data preparation	Coding Categorizing Checking	Cataloguing Transcribing Preparation
2 Initial exploration	Look for trends or correlations.	Look for recurring themes or issues. Add notes. Capture ideas.
3 Analysis	Statistical tests	Code the data Group codes into categories Comparison of categories Look for concepts that encapsulate the categories
4 Presentation	Tables Figures Written interpretation	Written interpretation Models, figures and tables
5 Validation	External benchmarks Internal consistency Comparison with alternative explanations	Data and method triangulation Member validation Comparison with alternative explanations

The analysis was divided into three parts. The first part was concerned with understanding and mapping the causes behind the low delivery performance, to answer the first research question. The first step of that process was to review the empirical evidence regarding the performance levels. That was done to understand whether the original problem statement remained valid and to establish an updated point of view of the performance. The next step was to combine the empirical evidence and theoretical knowledge regarding the identified weaknesses. This was done through the pattern matching technique, one of five data analysis methods outlined by Yin (2014), where the empirical findings and literature are compared to assess whether they match. These weaknesses were then developed into problem areas which constitute causes of low delivery performance.

The next step in the analysis was to understand the causes better through a focus group. Supply chain professionals at the company were invited to provide the practitioner's view on the identified causes and how to improve delivery performance. The participants were asked to rank the causes' impact on delivery performance as well as their complexity, i.e. difficulty to improve, through a survey. The average scores were then calculated and presented in the impact-complexity matrix. This analytical method aids in choosing what causes to improve. The survey was followed up with group discussions which provided a more dynamic environment for the practitioners to express their views on the causes and their implications for performance.

In the final part of the data analysis, the focus was on providing improvement proposals to solve the causes of low delivery performance. The input for part two of the analysis was the prioritized causes from the first part, the mapping of the current state, as well as the theoretical background to support proposed changes to the OTD process of the company. In other words, pattern matching was used, comparing the empirical findings, literature, and identified causes.

2.6 Research Quality

The quality of the research can be measured to ensure high trustworthiness. It was measured using two dimensions: validity and reliability. Validity is concerned with whether the study achieves accurate results, and reliability of whether the results are easily reproducible (Yin, 2014). An illustration of these dimensions is seen in Figure 2.6.

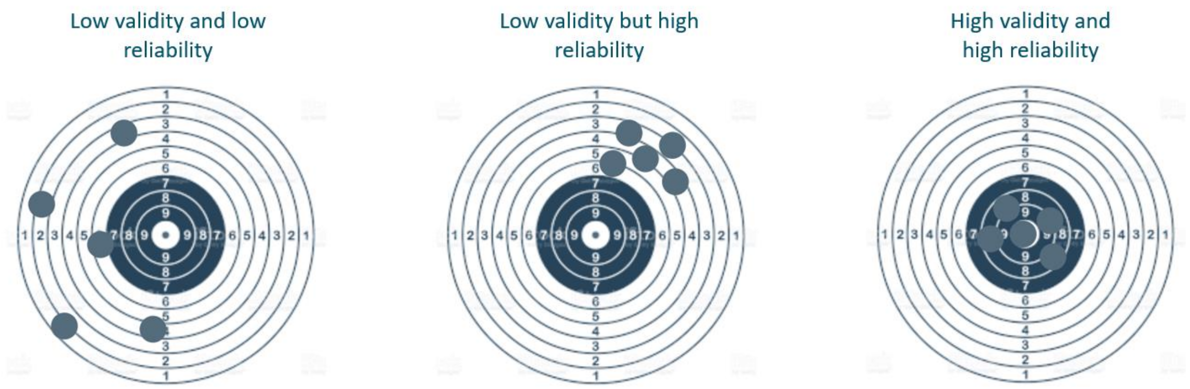

Figure 2.6. *An illustration of the interaction between validity and reliability (Paulsson & Björklund, 2012).*

Yin (2014) presents a framework to test the trustworthiness of a case study using three dimensions for validity, and one for reliability: construct validity, internal validity, external validity, along with reliability. These four tests are common in all kinds of empirical social research and are judged to be applicable to this thesis.

2.6.1 Validity

Three aspects of validity are tested: construct validity, internal validity, and external validity. By examining these dimensions, the study aims to solidify its foundation and enhance the generalizability of its results.

Construct validity is concerned with using the correct method for the concepts being studied (Yin, 2014). This means that the methodology is constructed in such a way that it captures information about the phenomenon well. Two tactics have been utilized to increase construct validity. The first is to use multiple sources of evidence, also known as data triangulation. Multiple sources of data, such as interviews, documentation, and observations, are used in the thesis, which are then compared and used to develop converging lines of inquiry. Through an iterative process, data has been presented to the case company for validation of the conclusions. The second tactic is to maintain a chain of evidence (Yin 2014). This process involved systematically collecting, documenting, and analyzing data in a manner that preserves its integrity from collection to analysis. This allows the reader to trace the steps that have been taken in the study and ensures they can follow the methodology employed.

Internal validity can be explained as whether there is causality between variables in the experiment, which could cause the researcher to reach a faulty conclusion (Yin 2014). This means ensuring that the conclusions drawn are directly attributable to the study's interventions, rather than external factors. This study, however, is not concerned with interventions in which causal relationships need to be established. Yin (2014) confirms that the logic of internal validity is inapplicable for descriptive and exploratory case studies and no measures to increase internal validity are therefore applied

External validity is concerned with whether the findings of the study are generalizable beyond the immediate scope of the study (Yin 2014). External validity depends on the design of the study, and whether an applicable methodology is used from the beginning. Yin (2014) outlines how using "how" or "why" questions in the research questions may lead to outcomes in which it is easier to make analytic generalizations. In this thesis, the focus group also contributes to validating the causes of low performance. Furthermore, external validity is ensured through the use of theory, along with the focus group, in the creation of improvement proposals and design recommendations. This is needed as the thesis is designed as a single case study. This is combined with a high degree of contextualization throughout the study through rigid explanations of the empirical findings. This high level of detail helps in assessing the transferability to other situations.

2.6.2 Reliability

Reliability in research refers to the consistency of the measurements or findings over time (Yin 2014). If the study was replicated under the same conditions, reliability would imply obtaining similar results. The most important method to increase reliability in contemporary studies is meticulous documentation, as it is extremely difficult to repeat a study in the exact same context. This enables other researchers to follow the study as closely as possible. As previously outlined, this is done by keeping a chain of evidence, as well as: 1) Providing clear definitions for all variables and constructs used in the thesis to ensure they can be consistently understood by other researchers. 2) Using standardized methods for data collection and analysis. This means applying the same procedures under the same conditions to all participants or data points. An example of this is that all interview guides in the study are formatted the same way, and personnel with similar responsibilities have similar interview guides.

3 Frame of Reference

The purpose of this chapter is to present the theoretical findings of the thesis. It outlines four main areas: delivery performance, performance measurement, logistics and distribution, and integration and coordination. It provides the theoretical background to which the empirical findings are compared, allowing for analysis to answer the research questions.

3.1 Delivery Performance

Delivery performance is a strategic-level supply chain performance measure (Guiffrida & Nagi, 2006) used by companies for benchmarking purposes. Supply chain performance measurement refers to several different metrics with the purpose of understanding a company's supply chain performance. Strategic-level performance measurement refers to metrics measured against industry norms or suppliers against the market. Peng and Lu (2017) argue that delivery performance consists of two high-level dimensions: reliability and speed. Another definition is provided by Rao et al. (2011, p. 205) state that: "Delivery performance can be defined as the level up to which products and services supplied by an organization meet the customer expectation". In this thesis, these definitions are combined so that delivery performance also incorporates communication with customers and customer service to a greater degree.

Reliability refers to a company's ability to provide complete and reliable information regarding deliveries and ensure that the goods are delivered on-time with the correct items. Peng and Lu (2017) define reliability with three metrics: 1) on-time delivery rate, 2) early delivery inaccuracy, and 3) late delivery inaccuracy. However, since customer request dates are often earlier than the delivery date, early delivery is often seen as on-time delivery (Handfield & Pannesi, 1992). Reliability also refers to the dependability of the information provided. That includes the ability to give the customer a delivery date early in the OTD process. The ability to achieve dependable deliveries has important strategic applications (Sarmiento et al., 2007). Delivery reliability can be a way of competing or creating a competitive advantage. Furthermore, in some cases it may be an order-qualifier instead of an order-winning criteria. In a study of Swedish manufacturing companies by Hörte et al. (1991), delivery reliability was ranked as the second most important strategic priority.

Speed refers to the elapsed time from order to delivery in the distribution process (Handfield & Pannesi, 1992). This is a critical measurement and is directly related to customer service, which determines the company's competitiveness, since a firm with delivery speed capabilities can deliver quicker than its competitors and meet a requested delivery date when the competition cannot. Vachon and Klassen (2002) measure delivery speed using two variables. Firstly, there is delivery lead time, which refers to the actual time that elapses from the placement of an order until its shipment. Secondly, there is throughput time which is defined as the time required to complete an order from beginning to completion of the production.

3.1.1 Interaction between reliability and speed

The delivery speed and reliability grid provide a framework to analyze a company's capabilities regarding these dimensions, see Figure 3.1 (Handfield & Pannesi, 1992). Four possible combinations can exist: 1) Poor speed and reliability, which means the market does not value these capabilities, or that the company is failing. 2) Good reliability and poor speed, where a company might have long lead times but good precision. 3) Poor reliability and good speed mean short lead times but often late deliveries, and lastly, 4) Good reliability and good speed, which is the ideal situation. The model suggests higher reliability is achieved through planning and scheduling improvements, while increases in delivery speed are achieved through process improvements.

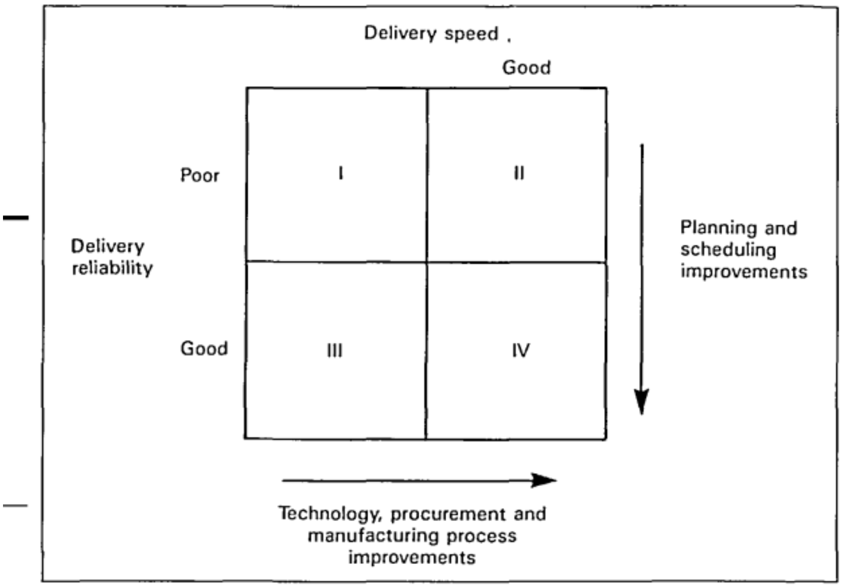

Figure 3.1. *The delivery speed and reliability grid (Handfield & Pannesi, 1992)*

3.1.2 Factors affecting delivery performance

This section will outline the various factors influencing delivery performance. Rather than providing an exhaustive list, the focus will be on the most frequently mentioned factors in the literature, since any element of the supply chain can potentially affect delivery reliability and speed.

- The most basic aspect that affects performance is the supply chain structure (George & Pillai, 2019). The complexity of the structure is dependent on the number of facilities and stages, as well as the informational and material flows. Research shows strong support between process complexity and delivery performance, and that reduced complexity can increase delivery performance (Vachon & Klassen, 2002).
- Information sharing refers to the extent to which the information meets the requirements the organization and has been described as the biggest driver of performance in the supply chain (George & Pillai, 2019). Studies show that exchanging high-quality information improves the overall responsiveness and coordination of the supply chain (Bartlett et al., 2007). Further, information sharing

can speed up the flow of information in the supply chain, which improves productivity and effectiveness (George & Pillai, 2019). A study by Cachon and Fisher (2000) showed that information sharing can reduce supply chain costs by 22%.

- According to Rosenzweig et al. (2003), low delivery performance is often connected to a lack of supply chain integration, and Fawcett et al. (1997) indicated that a lack of integration between operations and logistics functions can lead to poor delivery capability. However, integration does not always lead to performance improvement (Fabbe-Costes & Jahre, 2008).
- Strategy decisions can also affect delivery performance. Lockamy and McCormack (2004, p. 1207) state that “creation of an operations strategy team was found to have an impact on supply chain performance”. The authors explain that the team should be cross-functional and hold regular meetings. Further, there should be a process owner to ensure its effectiveness.
- Chopra and Meindl (2007) argue that a lack of coordination within the supply chain can influence performance, including lead times, costs, and availability. As actors try to optimize their local objectives, the total performance decreases. An example of that is the bullwhip effect, which is a widely observed phenomenon.

3.2 Performance Measurement

Neely et al. (1995, p. 80) define performance measurement as “the process of quantifying the efficiency and effectiveness of action” and a performance measure as “a metric used to quantify the efficiency and/or the effectiveness of an action”. Further, the authors define a performance measurement system as “the set of metrics used to quantify both the efficiency and effectiveness of actions”. Effectiveness refers to how well customer expectations are met, and efficiency refers to how well an organization utilizes its resources in doing that. A performance measurement system can be analyzed on three different levels. Firstly, on the level of the individual measures. Secondly, on the level of the set of measures (the performance measurement system) and lastly, on the relationship between the measurement system and the environment within which it operates. The levels are visualized in Figure 3.2.

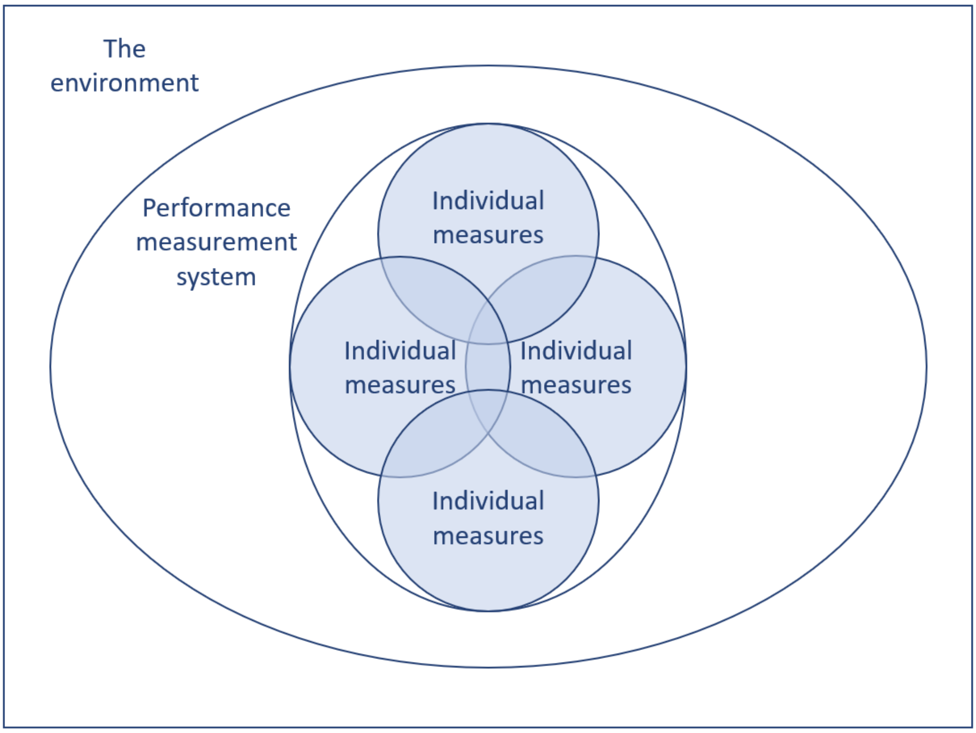

Figure 3.2. The relationship between performance measures, performance measurement system, and the environment within which it operates visualized (Neely et al., 1995).

There are several reasons to measure the performance of a business. Firstly, for an activity or process to be able to be managed and improved, it must be measured. According to Fawcett and Cooper (1998), performance measurement is critical to the success for most organizations since it creates understanding, molds behavior, and leads to competitive results. Performance measurement can be used to measure and benchmark the performance of a firm, its success in fulfilling the strategy, find improvement opportunities, function as communication within the firm, and enable control and management of important functions. Furthermore, performance measurement can be used to make sure that decisions are fact-based and not based on emotion or intuition (Parker, 2000).

Bourne et al. (2000) view performance measurement system design as the process of translating customer needs into business objectives and appropriate performance measures. The authors define creating a performance measurement system with three steps:

1. The design of performance measures
2. The implementation of the performance measures
3. The use of performance measures

The first step includes the processes of identifying the key objectives to be measured and subsequently designing the measures. It is important that the measures are derived from the business's strategy (Bourne et al., 2000). That is, measures should be designed such that they encourage behavior that will support the strategy. Measures should be easy to use, provide fast feedback and be designed so that they stimulate continuous improvement, not only monitoring (Neely et al. 1995). The implementation phase includes the activities of putting in place systems and processes to collect and process data enabling frequent measurements. It can relate to data collection that is not made or enabling the use of already collected data. Lastly, the authors define the use of performance measures as either measuring the success of implementing the company strategy or using the feedback from them to test the validity of the strategy, or for both purposes. However, both approaches connect back to the importance of deriving the measures from strategy.

It is important for organizations to have a strategy for measuring not only overall performance but logistics performance as well (Andersson et al., 1989). Logistics performance measurement can be used to reduce operating costs, drive revenue growth, or increase customer value (Keebler & Plank, 2009). It has been shown to have a positive impact on overall firm performance. It should be utilized to supply the right information to the right decision-maker and can be seen as its own performance measurement system (Andersson et al., 1989). Except for providing feedback on the organization's success in achieving goals and objectives, performance measures should influence the behavior of involved employees (Fawcett & Cooper, 1998). Andersson et al. (1989) list four reasons for measuring logistics performance: illustrating different logistics activities, managing direct flow of materials, setting goals, and controlling the fulfillment of objectives.

It is important that the performance aspects an organization wants to measure are measurable, but also that it is possible to act upon those measures (Keebler & Plank, 2009). Upper management support and resource availability, especially within the IT function, are important enablers in measuring logistics performance. According to Fawcett and Cooper (1998), firms with high performance tend to have better access to measurement information. "These firms believe that performance measurement is the platform on which competitive position, distinctive value-added capabilities, and channel integration are built" (Fawcett & Cooper, 1998, p. 356). In conclusion, measuring logistics performance is important for delivering value-added logistics activities and being able to manage logistics functions successfully. Keebler and Plank (2009) list five different types of logistics performance measures:

1. Effectiveness measure involving a trading partner (supplier or customer)
2. Effectiveness measure with internal focused
3. Efficiency measure focused on cost
4. Efficiency measure focused on productivity
5. Efficiency measure focused on utilization

Oftentimes, a lack of measurement is due to a lack of available information. Many businesses attribute the lack of accurate, timely, and actionable information to the absence and incompatibility of IT systems, as well as a shortage of organizational resources. That is common if management has not yet been convinced that logistics performance measurement has a positive impact on business value, which is key in achieving good logistics measurement. More collaboration on linking activities and processes to the metrics of their performance is needed in many firms. In addition, most firms measure internal performance only and not performance between and across firms. (Keebler & Plank, 2009).

3.3 Logistics and Distribution

Logistics can be defined as a company's activities related to material management and distribution. "The scope of the logistics function is to integrate the activities performed by conventional departments (purchasing, manufacturing, etc.) in order to achieve an effective flow of materials" (Andersson et al., 1989, p. 254). Distribution can be defined as the activities related to making a product available to the customer or business that needs it (Rushton et al., 2022). It often includes the moving and storing of the product from the supplier stage to the customer (Chopra, 2003). It is a key driver of profitability since it affects both supply chain costs and customer experience. Logistics and distribution can provide a positive contribution to the value of the product by enabling it to reach the customer in correct condition and location. If focus is put on logistics in the strategy of a firm, it can be a driver for corporate-level profitability and growth, and enable a competitive advantage (Sandberg & Abrahamsson, 2011).

3.3.1 Trends

The COVID-19 pandemic created a large shock in the world affecting people, societies, and companies. Not least was the impact on global supply chains and distribution channels, initially with major disruptions, decreased demand and economic uncertainty. After that there was a rapid economic recovery, rise in demand, and continued and worsened supply chain disruptions with the stoppage in the Suez Canal, spike in container prices, and truck driver shortages. According to Panwar et al. (2022), supply chain management practices will, and should be completely different in the post-COVID world that we live in now. The authors believe that companies will cooperate closer with suppliers and be more watchful of how they act. They believe in the increased importance of greater visibility through technology-enabled integration and in utilizing new technologies such as machine learning, AI, and internet of things to forecast demand.

3.3.2 Logistics strategy

Formulating a strategy enables companies to achieve their objectives (Waters, 1999). A logistics strategy aims to structure and regulate the operational processes related to logistics within an organization. It should be developed with a downward approach from the corporate strategy and support in achieving a firm's objectives. Rushton et al. (2022) present a framework for logistics network design (Figure 3.3). The basis for the framework is that the logistics network should be designed with the logistics strategy as a foundation. The logistics strategy should be defined to support the competitive strategy, which should support the overall corporate strategy. The framework defines that a logistics network design includes four different design elements: logistics process design, logistics network design, logistics information system design, and logistics organizational structure. The purpose of a logistics strategy is to enable a synchronized overall physical flow and should work as an interaction between the firm and its environment (Waters, 1999).

Logistics process design refers to aligning and organizing the activities across traditional company functions to make them streamlined, also across functional boundaries. For example, the OTD process, which often involves many different functions such as production, warehousing, and transportation, should be designed as a seamless process, from order to delivery, and not as a fragmented series of different processes. Logistics network design is concerned with the physical aspects of logistics, such as the locations of production units and warehouses, inventories, and number of hubs, for instance. Logistics information system design refers to the system infrastructure supporting information sharing within the logistics network and the whole company. Lastly, logistics organizational structure is the structural relationships between different functions participating in logistics processes. Ideally, different functions should not focus on their operations in isolation from the whole logistics process. Within the scope of this thesis are all design elements except logistics network design. (Rushton et al., 2022)

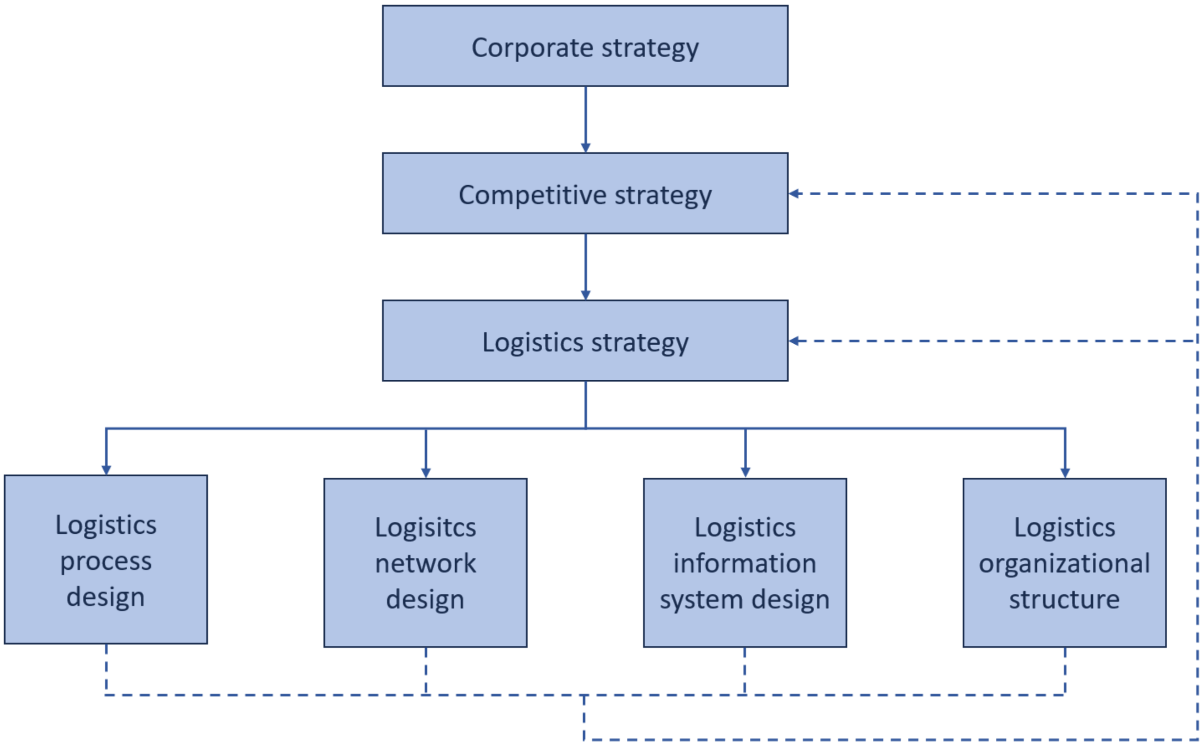

***Figure 3.3**. A framework developed by Rushton et al (2022) for logistics network design.*

Waters (1999) presents an alternative way of viewing logistics strategy and instead discusses strategic logistics as a motor and source for corporate strategy (Figure 3.4). The author views logistics strategy as a reactive approach and strategic logistics as an active approach in working with logistics. To enable strategic logistics, logistics as a function must be recognized as a key factor for the success of an organization. By applying the strategic logistics approach, the organization must develop the overall corporate strategy with the logistics strategy already in mind. Logistics should work as a foundation for the development of the corporate strategy, which requires people with logistics knowledge to be present during that process. (Waters, 1999).

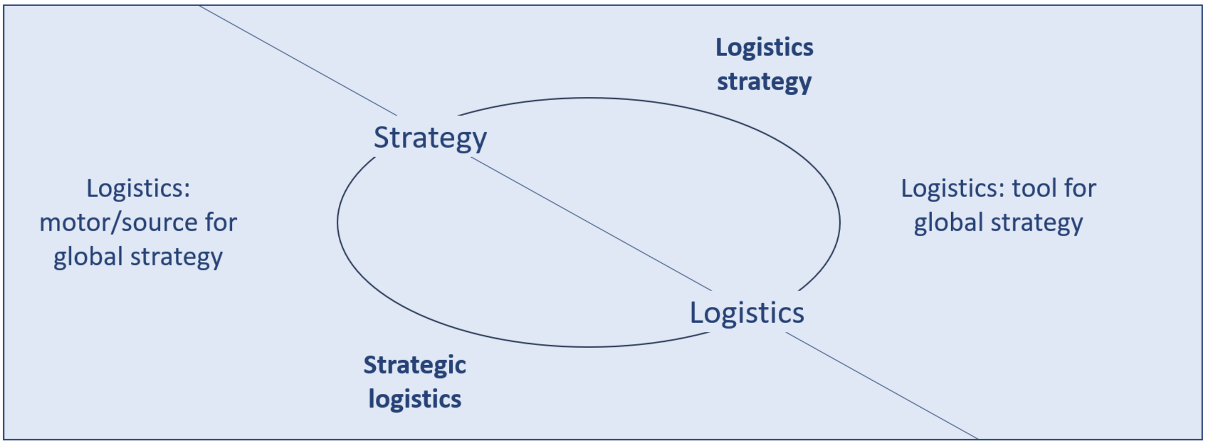

Figure 3.4. *Different perspectives of logistics and its relationship with strategy (Waters, 1999).*

The term total logistics is used to describe the integration of all different logistics elements in an organization into a single system (Rushton et al, 2022). The basis for total logistics is that all logistics activities should be considered, analyzed, and improved within the context of the total logistics network. Thus, individual logistics elements should not be considered in isolation. Local optimization or improvement might lead to decreased performance for the system as a whole and it is thus important to understand the interrelationships between different logistics activities.

3.3.3 Customer satisfaction

Logistics and distribution are strongly linked to customer satisfaction (Rushton et al., 2022). Ghoumrassi and Ţigu (2017) showed that logistics skills and knowledge were the most important factors in achieving increased customer satisfaction. High customer satisfaction is a way of ensuring continuity of the business and loyalty from customers. Creating a positive customer experience and thus customer satisfaction is important in creating strategic relationships with customers and in achieving a competitive advantage (Cepeda-Carrión et al., 2023). Research shows that it is more important than ever to fulfill the expectations on logistics services from customers to remain competitive (Uvet, 2020). Thus, competitive businesses must be able to predict customer's needs and expectations in order to fulfill them.

According to Uvet (2020), there is a significant correlation between many different logistics elements and customer satisfaction, such as timeliness, operational information sharing and personnel contact quality. Timeliness refers to the firm's ability to deliver an order at the correct time and can be seen as the most important factor affecting logistics service quality (Mentzer et al., 1999). Operational information consists of external and internal information. External information sharing refers to real-time information sharing with customers and can be used to close the gap of expected service quality. Internal information sharing on the other hand enables the firm to enhance service quality by increasing timeliness and accuracy. The contact quality aspect refers to how well the firm interacts with the customer during the whole order process, from order placement to delivery as well as after sales.

3.4 Integration and Coordination

Supply chain integration (SCI) can be explained as the key driver in transforming logistics into supply chain management (Kotzab et al., 2021). It can be defined as the integration of the three inter-firm flows of the supply chain, namely materials, information, and finances (Rai et al., 2006). Information flow refers to strategic, tactical, and operational information that is shared between supply chain partners (Rai et al. 2006). This information is often demand-related, such as inventory position, lead times, delivery schedules, or performance metrics. Physical flow integration refers to the degree to which a company uses global optimization to manage the storage and flow of materials. Financial flow integration is defined as the degree to which supply chain partners exchange financial resources. SCI is often divided into external and internal integration (Kotzab et al., 2021). External integration refers to the collaboration between different companies, while internal integration regards processes and strategies within a single company. It can also be divided into either backward or forward integration, referring to whether the integration moves from customers to suppliers or vice versa.

Zhu et al. (2017) identify three dimensions of SCI. The first dimension, informational integration, encompasses the coordination of information flow, collaborative communication, and the technologies that support them. The second, operational integration, pertains to collaboration in process and activity development within the supply chain. The third dimension, relational integration, focuses on the extent of trust and commitment among supply chain partners.

Improvements in integration can be achieved in many ways. Mirzabeiki and Saghiri (2020) studied ten UK manufacturing and retailing companies in a multiple case study on the effects of integration for both B2B and B2C companies. They outline an approach that includes 1) The implementation of centralized data storage systems. The study finds that many companies lack central databases for inquiries such as traceability checks, even though data is being shared. This results in more time spent on time-consuming activities, such as email correspondence or the sharing of Excel files. Moreover, the study underscores that the discrepancies in data management and the resulting inaccuracies due to the lack of an integrated data infrastructure significantly undermine B2B relations and the perception of companies as reliable partners. 2) Adherence to standardized data formats. The handling of data should be seamless, and therefore all parties need to adhere to the same labels and protocols. This reduces manual data handling, such as re-labelling items and creating new files. It also streamlines data sharing, reduces errors, and enhances efficiency by ensuring that all parties access consistent and accurate product information. 3) Adoption of compatible information systems across the supply chain entities. A unified system architecture not only streamlines the supply chain but also lays the groundwork for strong, collaborative networks, essential for managing the complexities of contemporary supply chains. 4) The use of track-and-trace capabilities. Mirzabeiki and Saghiri (2020) argue that an integrated system is enabled by these technologies. Insufficient track-and-trace capabilities are associated with more frequent data inconsistencies, errors, and inefficiencies.

3.4.1 SCI effect on performance

The effects of SCI on organizational performance have been researched. Rai et al (2006) suggest that IT infrastructure enables supply chain process integration, which has positive effects on performance. However, other studies find that this relationship might be more complicated and that more integration does not always lead to better results (Fabbe-Costes & Jahre, 2008). The authors argue that most of the research made in the area of SCI state that its positive effects on performance can be accepted as a fact. However, they believe there is not enough actual evidence of this. Furthermore, they argue that the reason for potential negative outcomes due to integration activities is not well researched. Ahmed et al (2019) argue that companies with different competitive priorities should prioritize integrating different practices. For example, a company using a cost strategy is more likely to be successful when implementing operational communications with low-cost suppliers. On the other hand, a company specializing in striving for high flexibility is more likely to be successful when integrating performance management and KPI communication with supply chain actors. Conversely, certain practices may be less effective in different contexts. Harfeldt-Berg and Olhager (2024) argue that the placement of the customer order decoupling point (CODP) creates different conditions through the supply chain, and that the different activities and processes warrant different needs for integration.

3.4.2 Customer order decoupling point

The CODP refers to the point in the supply chain when an order is linked to a specific customer (Harfeldt-Berg & Olhager, 2024). It can be explained as the point where the product specification and is also the last point at which inventory should be held (Sharman, 1984). There are different configurations possible for the position of the CODP, with the main ones being make to stock, assemble to order, make to order, and engineering to order, see Figure 3.5 (Olhager, 2010). Make to stock refers to a configuration where the customer order is fulfilled from manufactured inventory. On the opposite side of the spectrum, engineer to order refers to a configuration where the customer order is created based on a problem to solve, prior to engineering or design activities. In between these, make to order and assemble to order pose as alternatives where engineering or/and manufacturing activities are done without a customer order, depending on the configuration. Different products require different CODP situations and might not adhere strictly to any of the said configurations. Beyond the four configurations proposed by Olhager (2010), there are also CTO products. CTO implies that customers can influence the size, materials, and other features to create a unique product, but not typically influence the underlying engineering (Cheng et al., 2002). This can be seen as a variant of make to order which incorporates parts of the engineering phase.

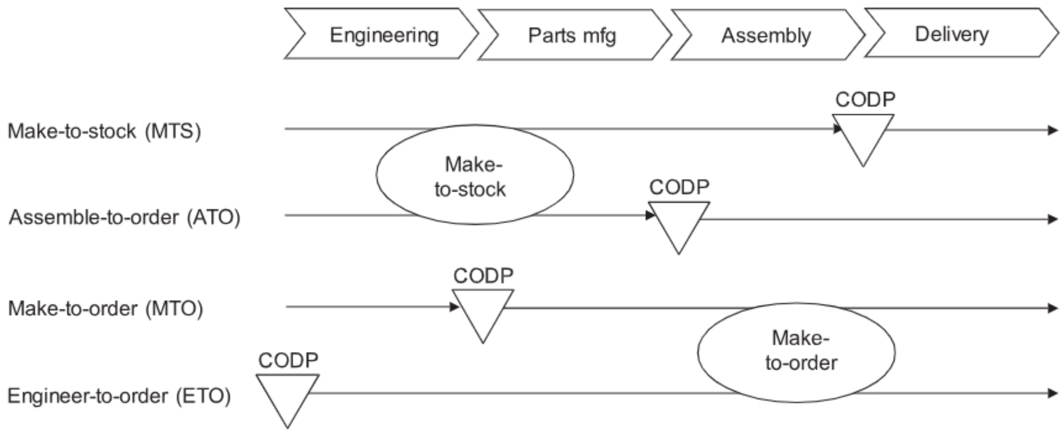

Figure 3.5. Different positions of the CODP in the supply chain (Olhager, 2010).

The research shows that there are large differences between upstream make to order operations, which are forecast driven, and downstream make to stock operations, which are customer order driven (Sharman, 1984). Firms must adopt a dual approach, designing different systems for pre-CODP and post-CODP operations to align with their distinct characteristics and objectives. Harfeldt-Berg and Olhager (2024) outline four main areas where operations differ: 1) market and product factors, 2) supply chain decisions, 3) operational decisions, and 4) performance effects. In general, the activities upstream the CODP are focused on efficiency, standardization, and cost optimization. Post the CODP, the focus is shifted towards customization, responsiveness, and flexibility. The design of the supply chain needs to accommodate these differences. For example, pre-CODP operations benefit from lean principles while post-CODP operations usually utilize agile principles better. The positioning of the CODP itself is not crucial for performance, but the design choices surrounding it are. The order-winning criteria for make to stock operations is cost, and for make to order operations it is flexibility. Subsequently, the key difference in design lies in these differences, see Table 3.1.

Table 3.1. Differences in supply chain characteristics upstream and downstream the CODP.

Aspect	Upstream the CODP	Downstream the CODP
Product	Standard components, high volumes, predictable demand	Fully customized, unpredictable demand, Job shop type
Process	Assembly line type	Market-responsive
Supply chain	Physically efficient, high utilization, low-cost	
Planning and control	Make to stock, Kanban	Make to order

Only three performance metrics were perceived to be impacted by the position of the CODP: cost, on-time delivery, and delivery-lead time. In make to order operations, lead times were found to be longer and inventory holding costs higher. As make to order operations have a higher degree of uncertainty, on-time delivery is harder to achieve.

3.4.3 Information sharing

SCI refers to many types of means to integrate, such as utilization of IT, collaboration, new product development, and information sharing. The last dimension usually gets more attention in research, as it is more strongly linked to performance. Research finds that a key success factor in achieving a high level of internal integration is information sharing (Boon-itt & Yew Wong, 2010; Lofti et al., 2013). Information sharing can be defined as "the exchange of data, information, and/or knowledge between independent organizations" (Kembro et al., 2014, p. 610). For this thesis, the scope is widened to include information sharing within organizations as well. Furthermore, information sharing occurs at three levels: operational, tactical, and strategic (Kembro & Selviaridis, 2015). On the operational level, companies share information such as order data, sales data, or demand data. On the tactical level, companies share longer-term plans such as forecasts. Strategic-level information sharing refers to the sharing of yearly forecasts, promotions, or other long-term strategic plans.

Three aspects can be considered regarding information sharing: information quality, information content, and information sharing support technology (Zhou & Benton Jr., 2007). Information quality measures the degree to which the information meets the needs of the organization. Among other things, it is important for the usefulness of an information system. Information content relates to how the organization uses the information. Researchers found that sharing information alone is not enough to affect performance, but that the appropriate information content needs to be emphasized as well. The last aspect is the technology needed to support information sharing.

Kembro et al. (2014) outline a six-step approach for companies to formulate their own information sharing strategy. The following should be outlined: 1) reasons to share information, 2) reasons not to share information, 3) what to share with whom, 4) means of sharing information, 5) identification of barriers and drivers, and 6) selecting appropriate governance mechanisms. The authors emphasize the importance of tailoring information sharing initiatives to the specific context in which they are applied, which can be seen in the second step "why not to share", where excessive information sharing can yield negative effects. They also stress the importance of having incentives for all involved partners since, per definition, it is a collaborative effort.

In a Delphi study by Kembro et al., 2017, the antecedents for information sharing in dyadic relationships were explored. The study found 22 challenges that firms must overcome, which include power structures, culture, legal aspects, processes, information technology utilization, and information quality. The study also found certain challenges posing as barriers to higher degrees of information sharing. One important such challenge was trust, which is essential in promoting collaboration in the supply chain and discouraging opportunistic behavior. Connected to the question of trust is the concept of silos in the supply chain. This refers to the phenomenon of entities in the organization that work independently of the rest of the company, often due to a lack of shared identity and mission, which can be damaging to performance and hinder information sharing (Giacoman & Ribeiro, 2016). They outline several strategies for breaking down silos, which include building governance and aligning leaders, creating cross-functional teams, creating clear roles and responsibilities, and creating joint incentives, among others. Silos have been linked to several performance-degrading activities, such as poor customer service, low morale, and high inefficiency (Supply Chain Digital, 2020).

3.4.4 Information systems

IT developments enable integration as they give firms more ways to connect with each other. Rai et al. (2006) find that information systems do not directly affect performance, but that they facilitate process integration, which has the ability to do so. Furthermore, they find that a poor IT infrastructure can affect SCI negatively. The paper outlines two constructs that lead to higher IT integration capability, namely data consistency and cross-functional application integration. Data consistency refers to having consistent and standardized data across an organization. This means that when data is uniform and reliable across different systems and departments, IT integration is more likely to be successful. The second construct suggests that the ability to integrate applications across different functions or departments also positively influences the IT integration capability, but to a smaller extent than data consistency. The study suggests that firms achieving IT-enabled supply chain integration capability experience improvements in operational excellence and revenue growth. It emphasizes that "managerial initiatives should focus on developing an integrated IT infrastructure and leveraging it to create process capabilities for integrating resource flows between a firm and its supply chain partners" (Rai et al., 2006, p. 225).

IT improvements are often complicated endeavors, that can take a long time to implement and be costly. In a study by Olhager and Selldin (2003), 173 manufacturing companies were surveyed regarding the implementation of new ERP-systems. The study found that implementation of an ERP-system most often takes 13-18 months, and that the cost of implementation is around 0.5% of annual revenue for larger companies, and around 3.5% for smaller ones. IT implementations also often fail to create the expected benefits, and sometimes implementation activities fail altogether (Haug et al., 2010).

3.4.5 Planning

The purpose of supply chain operations planning is to "coordinate the release of materials and resources in the supply network under considerations such that customer service constraints are met at minimal cost" (De Kok & Fransoo, 2003, p. 597). Planning within a supply chain can be done at three different intervals: long-term, mid-term and short-term (Stadtler et al., 2011). The different levels and their connected tasks are illustrated in the Supply Chain Planning Matrix in Figure 3.6. There are several differences between the different levels, such as planning interval, type of decisions being made, impact of the planning, level of detail, and responsibilities. The planning intervals range from several years on the top level to a few weeks on the lower level. Long-term planning decisions are usually made by upper management, impact the whole company, and often concern the design of the physical network such as the locations of production units and warehouses. It is highly aggregated and has a low level of detail. Short-term planning and decisions are made by local or operational planners, more on a day-to-day basis. The decisions are so detailed that they can contain order numbers, times, and exact locations. The decisions impact specific units such as logistics or production and are highly operational. Short-term planning can regard quantities and schedules for instance (Stadtler et al., 2011).

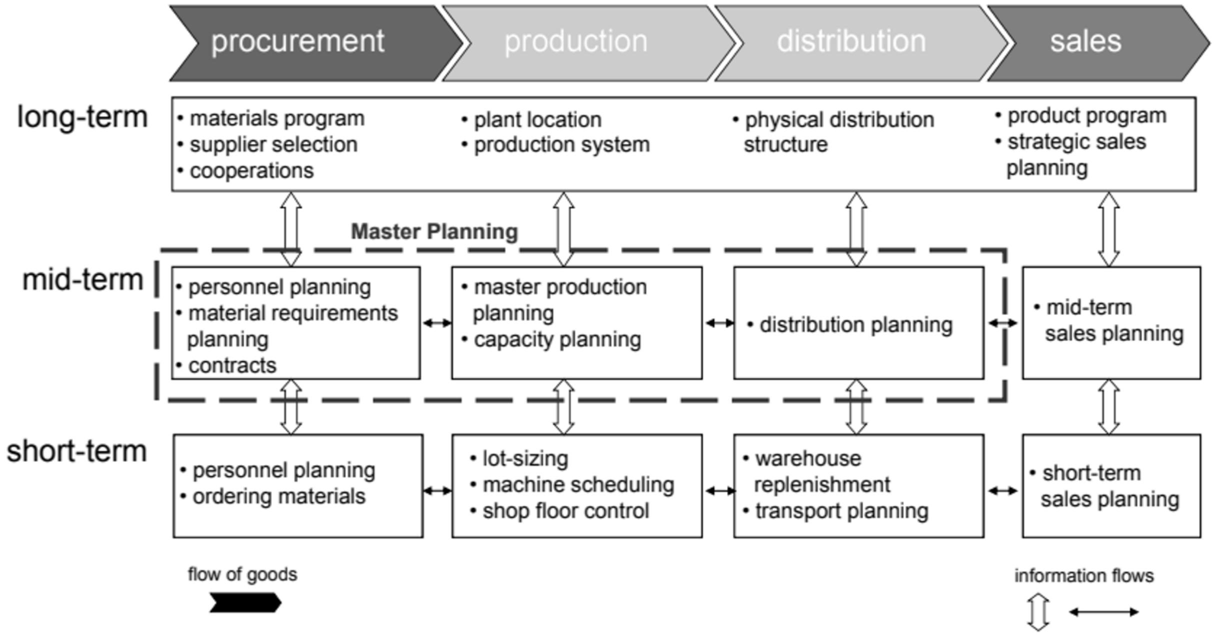

Figure 3.6. *The Supply Chain Planning Matrix illustrating the different planning levels and connected tasks (Stadtler et al., 2011).*

4 Empirical Study

The purpose of this chapter is to present the collected data. For context, data about the case company is presented to provide a basic understanding and to enable further investigation into the OTD process. The data from this chapter is used as a basis for the analysis to answer the research questions and fulfill the purpose. It has been collected at the company through internal documents, interviews, and observations, as described in the Methodology chapter. The interviews, which are summarized in Table 2.1 in Section 2.4.2, are referred to in text using their interview numbers in brackets.

4.1 Description of the Case Company

ASSA ABLOY Group was founded in 1994 following the merger of the companies ASSA and Abloy (ASSA ABLOY Group, 2024). The company has since then adopted a strategy focusing on acquisitions of other companies to enter new markets and strengthen its position in existing ones. Today, the company operates in over 70 countries with over 200 brands. It has five divisions, where Entrance Systems is one of the largest constituting about a third of the revenue and profit. The headquarter is situated in Switzerland, overseeing a team of 16 000 employees. It has a global presence with sales organizations in 40 countries (ASSA ABLOY, 2023). ASSA ABLOY Entrance Systems is divided into four main divisions: pedestrian, industrial, residential and perimeter security. The industrial segment, which is in focus in this thesis, is the largest. It offers solutions for industrial doors, loading dock equipment, high performance doors, hangar doors, service, and digital solutions (ASSA ABLOY, 2023).

4.1.1 The product

The product group is called “overhead sectional doors”. It is a group of industrial doors used for warehouses, distribution centers, or garages. An illustration of it can be found in Figure 4.1. The door consists of three main components, namely panels, operators, and hardware. The horizontal panels are held together by hinges. The door slides through a tracking system and is kept in balance by springs. A door can be completely manual or electric. For a door with electric motors, the operator is used to open and close the door. The door can be customized by the customer in multiple ways, such as size, color, materials, or special additions to the door. The height and width of the door range from three to nine meters. There are over 30 options that can be added to the product upon request, such as pass-through doors, windows, additional springs, or a remote control. Per these characteristics, the product can be considered to be CTO.

Figure 4.1. Sketch of the industrial door in focus in the thesis.

The last-mile delivery of the product is performed by trucks, more specifically rack trailers or stackable trucks. Figure 4.2 shows how a standard door looks when packaged. Approximately 50-80 doors usually fit into a truck depending on the size of the doors and truck. There is sometimes a possibility to use trucks that are adapted with rails, enabling space for 80 doors to be transported [5]. When the goods arrive at the customer site, they are offloaded by the truck driver and await installation. Uninstalled doors are valuable and can be subjects to theft. Therefore, it is desirable to have the doors installed as soon as possible after arrival at customer site.

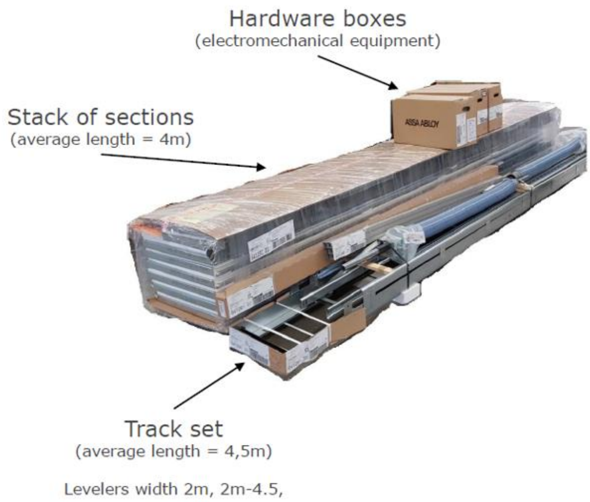

Figure 4.2. The components of a door packaged.

4.1.2 Corporate strategy

To enable understanding and analysis of the logistics strategy of the company, the corporate strategy will first be presented in this section. The object of analysis, the OTD process, is supported by the logistics strategy, which should be supported by corporate strategy. As previously mentioned, the company has a focused acquisition strategy. In 2023 alone, 24 companies were acquired. The company's vision is to be the global leader in access solutions, which include doors, locks, and safety solutions.

ASSA ABLOY Group has four main strategic objectives, which are 1) *growth through customer relevance* – which states that growth starts with understanding the customer and being relevant to their needs. 2) *Product leadership through innovation* – that the long-term competitive advantage is achieved through product innovation, 3) *cost-efficiency in everything we do* – that cost efficiency is key in supporting innovation, and 4) *evolution through people* – that employees can succeed within the company. For each strategic objective, eight focus areas are listed. The strategic objectives are supported by several "shared priorities", which include more concrete activities to support growth. These are divided into "growth enablers", such as logistics optimization, product cost reduction, and "growth accelerators", such as increased service penetration and continued acquisitions. Each division also has its own strategic areas. Entrance Systems has eight areas that are of particular importance: 1) safety, 2) develop our people, 3) customer satisfaction, 4) go-to-market, 5) M&A, 6) footprint rationalization, 7) commercial excellence, and 8) digitalization. The company's service operations have become the primary driver of profit, while sales of new doors have yielded lower margins.

4.2 Order-to-Delivery Process

This section provides a map of the most vital parts of the OTD process. The data is based on interviews, observations, and documentation. As outlined in Section 2.4, the areas of focus are: 1) overall process design, 2) activities, 3) planning and coordination and 4) systems and information sharing. Overall process design involves the supply chain strategy, order characteristics, physical network, and roles and organizational structure. Figure 2.2 has been extended and now also shows the different areas of responsibility in the OTD process, see Figure 4.3.

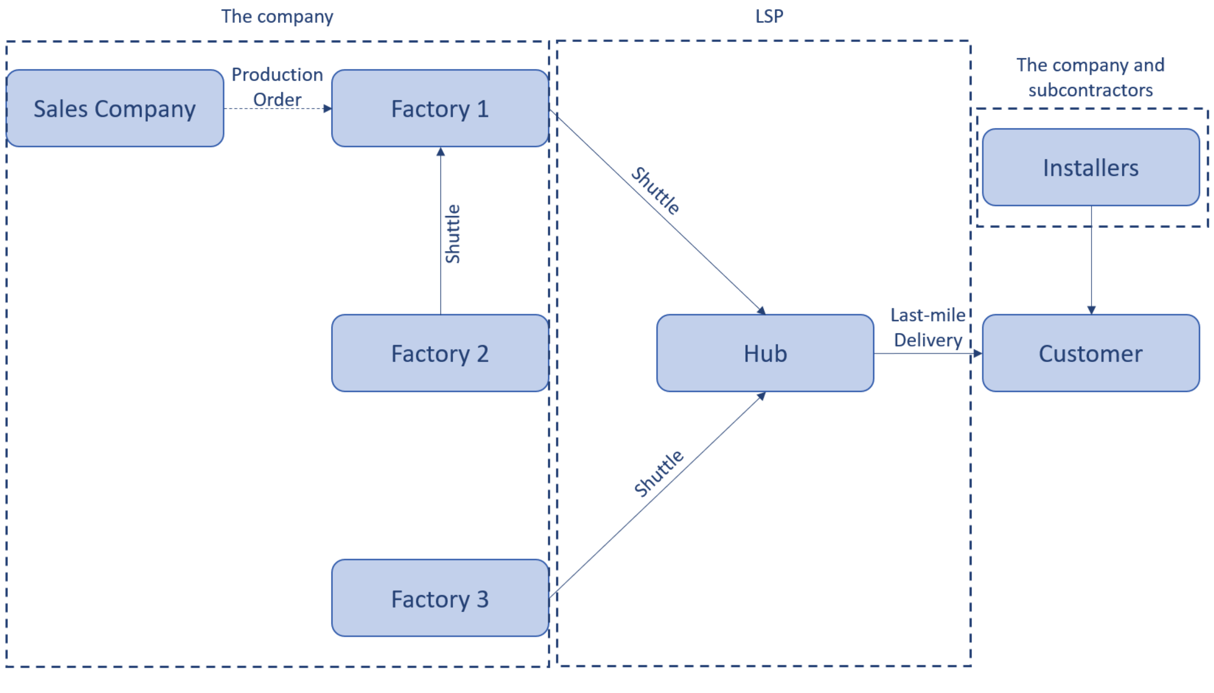

Figure 4.3. The OTD process and an overview of areas of responsibility divided among the company, the LSP and external parties.

4.2.1 Supply chain strategy

The company does not have an explicitly defined supply chain strategy with clear goals and objectives. However, there has historically been a large focus on reducing costs across the chain. That can be identified in the corporate strategy outlined in Section 4.1.2, under *cost-efficiency in everything we do*, where logistics is one of the eight focus areas. Logistics activities are also mentioned in the "shared activities" explained in the same chapter, in the context of logistics optimization as a growth enabler. In interviews, there is a similar view that no explicit supply chain strategy has been formulated but that during the last ten years there has been a large focus on reducing costs and not enough on reliability and short lead times [2]. Many of the projects have focused on reducing costs, and logistics managers' bonuses are based on the level of cost reductions made. There have been talks about creating leaner logistics processes, but there is no explicit lean supply chain strategy in place [2]. On the contrary, over the last few years, processes have become less and less lean with reduced reliability and increased buffers, according to the Logistics Manager.

Due to reliability problems, there have been projects aimed at enhancing the reliability of Factory 3 through more reliable sourcing [1]. The company is planning to launch similar projects aimed at increasing reliability for the other factories as well. Both the Logistics Manager and the Field Operations Manager stress the importance of prioritizing reliability over low costs in the OTD process [3]. In Table 4.1, the answers from six of the interviewees are shown on the question of what the current strategy and objectives of the OTD process are.

Table 4.1. *Shows the answers when interviewees were asked about what the strategy and objectives of the OTD process are.*

Stakeholder	Strategy/Objectives
Factory 1	Reliability
Factory 2	Short lead time, reliability
Factory 3	Reliability over cost, tight cooperation with Factory 1
Logistics Manager	Reduce costs
Manager LSP	Efficiency, visibility
Field Operations Manager	Reduce costs

4.2.2 Order characteristics

In Table 4.2, the distribution of order sizes can be found. The average order contains 1.7 doors. 73.3% of orders consist of 1-2 doors and account for 24% of delivered volume. 19.3% of orders consist of 3-9 doors and account for 24% of delivered volume. Orders with 10-49 doors account for another 34% of orders. These order segments together account for 82% of delivered volume and 99.2% of orders and are called regular orders. Orders of more than 50 doors are called project orders and the distribution of them is handled differently compared to regular orders. Project orders are often made for new, large industrial buildings. The quantity can fill up and utilize a whole or many whole trucks and are therefore generally delivered directly from the factories to customer site without passing through the hub. This report only investigates normal orders, and an order will further in this report refer to a regular order.

Table 4.2. The distribution of order sizes.

Order Size (Number of doors)	Share of Orders (%)	Share of Volume (%)
50+	0.8	18
20-49	2.5	19
10-19	4.1	15
3-9	19.3	24
1-2	73.3	24

4.2.3 Physical network

The physical network supporting the OTD process consists of three factories and one hub. The three factories are in three Central European countries. The panels are produced in Factory 1, the operators in Factory 2 and the hardware in Factory 3. The factories were from the beginning independent companies that were acquired by ASSA ABLOY. The factories are still largely operating independently. Factory 3 still has its own brand name, despite being owned by the company. The factory manager at Factory 3 explains that they are producing components for other companies as well, but that it is an advantage that there must be no focus on payments when producing components for the case company. Factories 1 and 2 however are under the company's brand. According to some interviewees, the factories are functioning more as external suppliers to the company than internal entities.

The company has a LSP operating the hub where components are consolidated, as well as shuttles from factories to hub, and planning and execution of last-mile delivery. It is an independent family business with storage hubs spread around north and central Europe with 500 trucks. The company makes up 70% of the hub's total volume. A reason for choosing the specific LSP is that they fulfill the requirement of being able to perform the offloading of collies when delivered to site. The hub is in close proximity to a large highway. It is in the same country as Factory 1 and approximately a 1.5-hour drive away, supplying eight Central European countries with the product. Every country has a national sales company responsible for sales and installations.

4.2.4 Activities

In this section, all relevant activities in the OTD process are explained in chronological order. They are visualized in Figure 4.4.

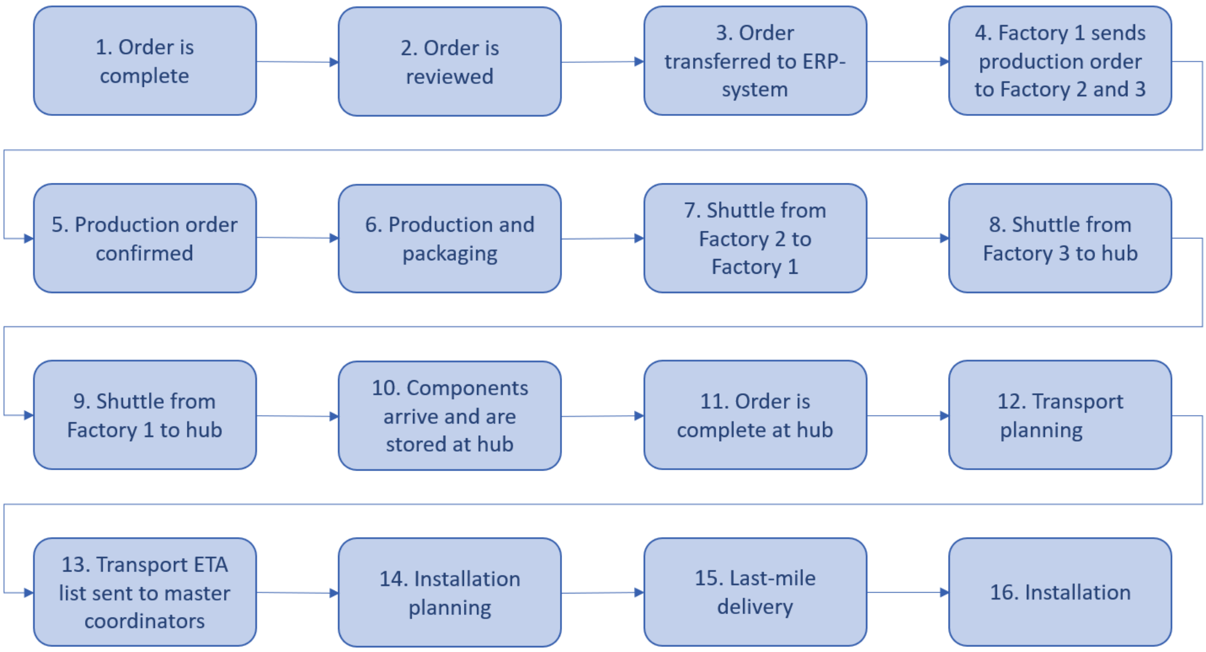

Figure 4.4. The activities of the OTD process that are explained in this section.

1 Order is complete

Each sales company has a Customer Relationship Management System (CRM) and an Enterprise Resource Planning system (ERP). An order has different statuses in the systems depending on the phase it is in from being a customer lead to being a delivered product. When the designing and configuration of the door are finished by engineers together with the customer, and all technical specifications are final, the salesperson changes the status of the order to *Complete order* in the CRM-system [3]. After that point, no further modifications to the door can be made since the customer order will turn into a production order for Factory 1. A complete order consists of information about the door such as measurements, drawings, colors, materials, etc. Commercial terms and conditions, installation requirements, distribution and installation costs, and delivery week should also be agreed upon. Calculations of distribution costs are made using formulas that consider volumes, measurements, and the special requirements of the doors [1]. If the order is for a replacement of an old door, there are supposed to be pictures of the door so that the installers know which one to change. All sales companies are not using the same CRM-system and/or ERP-system.

The delivery week is decided by the requirements from the customer. If the door is a replacement for an old one, the wish is often to get it replaced as soon as possible. However, sometimes customers order a door for a new building months or years in advance. To provide the customer a delivery week, the salesperson checks an Excel list with expected production lead times, which are based on the order backlog of the factories [7]. The list is provided by Factory 1 and forwarded to the sales companies by the master coordinator once a week. Factory 1 is checking with the other factories about their lead times to be able to provide the lead times of the whole OTD process to the end-customer.

2 Order is reviewed

Once the status is changed to *Complete order* in the CRM-system, it is reviewed by an Order Assurance Responsible at the sales company [8]. It is making sure that all information is filled in, that the correct costs are calculated and that there is nothing missing for the factory to be able to produce the product. The review is done within 24 hours and if the order review fails, the status *Complete order* is removed, and it returns to the salesperson and the engineer for modification.

3 Order is transferred to the ERP-system

If the order review is approved, it is transferred to the sales company's ERP-system. The order has different statuses in the system and starts with the order status *Complete order*, see Figure 4.5. If the order is not supposed to be delivered immediately, it is not transferred to the ERP-system until later, because once it has been transferred, no changes can be made to the order specification [2]. When it has been transferred to the ERP-system, a material coordinator at the sales company places a production order to Factory 1 and double checks that it will be able to produce to the agreed delivery week [8]. The order status is updated to *Production order*.

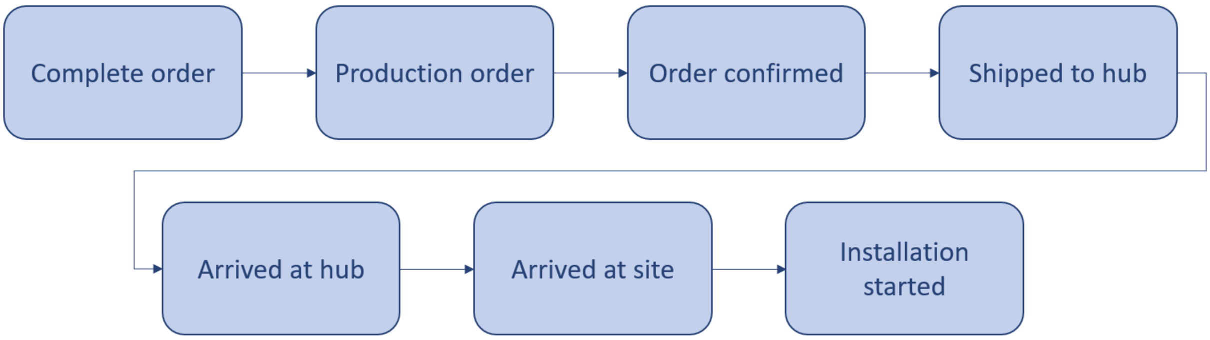

Figure 4.5. *An illustration of the different order statuses an order has in the ERP-system of the company during the OTD process. There are more statuses in the system but only these are relevant for the scope of this thesis.*

Once it is transferred to the ERP-system, the master coordinator starts to work as a link between production and sales. If no deviations happen, the customer will from now on have no contact with the company until it is contacted by installation planners. That can sometimes take up to two months. The master coordinator makes frequent extracts of orders from the different sales companies' ERP-systems into Excel lists, where it keeps track of all orders in different tabs sorted by the week they are supposed to be delivered. It also keeps track of order status, order number, quantities, customers, addresses, and customer delivery requirements. It has a column for each order where important information that cannot be found in the ERP-system is added. That information is communicated to the master coordinator by responsible salesperson. If customers want to change any of the delivery requirements, they contact the salesperson who then manually contacts the master coordinator who changes that in the Excel list. The master coordinator has the responsibility to communicate deviations or delays from the LSP or factories to the sales companies. If there are no deviations or delays to an order, the master coordinator must not do anything but routine tasks. [7].

4 Factory 1 send production order to Factory 2 and 3

Factory 1 receives the order through its ERP-system with information about the week it is required to deliver to the hub for the order to be delivered to the customer the agreed-upon week. This triggers production orders to factories 2 and 3 automatically, which they receive through their ERP-systems. The factories must then confirm that they are able to deliver to the hub the specified date. [9].

5 Production order confirmed

If the factories can deliver to the requested date, it is confirmed to Factory 1. Factory 1 confirms with the sales company, and the salesperson notifies the customer about the order confirmation and delivery week. The order status is updated to *Order confirmed.* If any of the factories cannot make the requested delivery week, they will notify Factory 1 and the date will be postponed a necessary number of weeks. [9].

6 Production and packaging

Production and packaging of the components are performed at the three factories. Production lead times can be seen in Section 4.3.2. Factory 1 manually informs the sales companies and master coordinators in case there are production delays. Factories 1 and 2 do not know how many collies an order will contain until after production and packaging [5] [9]. Even then, that information is not shared with the transport planner at the LSP [6]. Factory 1 usually has the longest lead times due to the complexity of the components that are produced, which has caused many issues in recent years. Particularly complex is the purchasing process of materials [9]. Many of the delays in Factory 1 are due to raw material shortages. Because of low reliability at Factory 1 and historical low reliability at Factory 3, an extra buffer week has been introduced in production for the two factories [2]. That is, if an order is supposed to be at the hub a certain week according to the promised delivery week to customer, factories 1 and 3 will try to deliver components to the hub already the week before. This is a deviation from the planning concept, explained in Section 4.2.5, to compensate for late deliveries from the factories and enable delivery to customers the agreed-upon week.

7 Shuttle from Factory 2 to Factory 1

Components from Factory 2 are not delivered directly to the hub but to Factory 1 and then to the hub. The reason for that is that it is cheaper and that it gives more control to Factory 1. It then knows exactly what components are shipped from factories 1 and 2 to the hub. Trucks from Factory 2 are departing on Mondays and Thursdays after 2 p.m. and take approximately two days. The shuttle is not performed by the LSP but by another third-party logistics company. [4].

8 Shuttle from Factory 3 to hub

The shuttle is planned by the factory and performed by the LSP. The planning of transports is made based on production orders from Factory 1 and the desired dates they should be at the hub. Factory 3 makes the production plan based on the transport plan. The LSP sends the desired number of empty trucks to Factory 3. While being loaded onto trucks, the collies are scanned. The LSP does not get any information about what collies the trucks contain until they are offloaded at the hub. However, the information that an order is on its way to the hub is available in the company's ERP-system. [5] [6].

9 Shuttle from Factory 1 to hub

Factory 1 produces approximately 100 doors per day but can only store 40 doors. Therefore, the shuttle requires approximately three trucks per day, and it is performed by the LSP. On Fridays, Factory 1 informs the LSP of how many trucks it requires for the following week and for what days. Once a truck has departed from Factory 1, the order status in the ERP-system is updated to *Shipped to hub*. The trucks carry components from both Factory 1 and Factory 2. [6] [9].

10 Components arrive and are stored at hub

Once collies arrive at the hub from Factory 1 and Factory 3, they are offloaded and scanned. The LSP does not know what collies to receive until they are scanned upon arrival at the hub. The components are stored in cantilever racks and moved by side loader forklifts. The average lead time at the hub for a collie is 22 days as can be seen in Section 4.3.2. [6].

11 Order is complete at the hub

Once all collies belonging to an order have arrived at the hub, the order is complete. The status of the order in the ERP-system is then automatically updated to *Arrived at hub* [3]. Orders are never delivered to customer incomplete. There is an important deadline at 4 p.m. on Wednesdays the week before agreed delivery week to customer when orders must be complete at the hub, more thoroughly explained in Section 4.2.5 [7]. Orders that are complete in the hub by the deadline will be included in the transport plan for the following week. Until 4 p.m. on Wednesdays, the sales companies can make changes to the delivery requirements by changing information in the ERP-system. After that deadline however, changes cannot be made in the system. Then, the master coordinator makes an extract from the ERP-system with the orders that are supposed to be delivered the following week into a list in an Excel file. They check the list and make sure that all collies belonging to the order have arrived at the hub. Sometimes the master coordinator includes orders that they believe will become complete later during the day. However, communication of production delays happens after the 10 a.m. deadline so the orders might not become complete in time. In addition to the information that is extracted from the ERP-system into Excel, the master coordinator adds information about the customer and delivery specifications, which are not available in the ERP-system. [7].

If an order is complete in the hub earlier than expected, the master coordinator informs the salesperson, who asks the customer if the order can be delivered earlier than agreed. On Thursday morning at 10 AM, the complete Excel list of orders that are supposed to be delivered is forwarded to the LSP by email for transport planning. If the salesperson requests a change of transport after the 4 PM deadline, the LSP must be notified manually, and collies might have to be offloaded from trucks, which can result in a fee for the customer. It is common that sales companies, on request from customers, want to change the delivery week late in the process. In some countries, such as Belgium, the Netherlands, and the UK, it happens often. There is nothing hindering customers from requesting a postponed delivery unless it’s done very late resulting in an extra fee. While the exact frequency of late changes is unknown, the master coordinators perceive that they occur often. [7].

12 Transport planning

When the LSP receives the list of orders that the company wants delivered during the next week at 10 AM on Thursdays, it starts planning immediately. The transport planners must double check that the order is complete and that there are no damages. Since the master coordinators may have included orders that are not yet complete, there might be orders on the list that are not complete. Those orders must be removed from the list and are to be considered the following week instead. [6].

When an order is confirmed to be complete and without damages, it is transferred to the Transport Management System (TMS) of the LSP. Transport planner then starts to plan the routes for the following week. They consider the different delivery requirements connected to the different orders. For instance, there could be a requirement that the order must be delivered on a certain day or at a certain time. These requirements can be found in the Excel list provided by the master coordinator and must be read and considered manually by the transport planners when the transport plan is made. The planning is largely a manual process. [6].

13 Transport ETA list is sent to master coordinators

Once the transport plan is made at 1 p.m. on the Friday, the LSP sends an ETA list to the master coordinator containing what orders are to be delivered on which days, but not specific times unless that is a special requirement from the customer. The list is forwarded to the sales companies by the master coordinators. The accuracy of the ETA list is low, and orders are often late. There is a weekend between the creation and execution of the transport plan and unforeseen issues can arise, such as a truck driver falling ill or goods being damaged. On Friday afternoons, the sales companies inform the customers about the planned delivery day. [6] [7].

14 Installation planning

There is no explicit rule for when the installation planner should begin with the planning, but usually it contacts the customer to check if there are any special requests regarding installation, such as the day or time, three weeks in advance. The preliminary installation date is usually given two weeks in advance. The planner does not want to do installation planning too early because of the difficulty of changing it. If it is done too late however, it might be difficult to find available installers. When the installation plan is made two weeks prior to installation, the components are yet to arrive at the hub. Production or transportation disruptions can still occur, preventing the door from being installed. During delivery week, the installation planner often ensures the door has arrived and that the agreed installation date still suits the customer. [8].

According to the company’s planning concept, installation is always planned to be made the week after delivery. Approximately 75% of installations are made by subcontractors, and 25% are made by the company’s own installers. Installation planning is a parallel job of matching installation demand with the available capacity of the subcontractors and the company’s installers, as well as satisfying customer requests for specific days or times. The planner has a tool to calculate the estimated duration of installation depending on the size and technical specifications of the door which is used for the planning. [8].

15 Last-mile delivery

Loading of trucks leaving on Mondays starts on the Thursday the week before as soon as the transport plan is completed. During the loading process, it is often discovered that orders are not complete and that deliveries must be postponed to the following week. Deliveries are made from Monday to Friday, from 8 a.m. until 5 p.m. and are performed by the LSP. Truck drivers have reported problems regarding the last-mile delivery process. Sometimes, the customer is not present on site when trucks arrive meaning the order cannot be delivered. Another commonly occurring problem is that delivery addresses are wrong. That is a problem especially for deliveries being made to new, not yet finished, buildings that have no address. [6].

The door has special last-mile delivery requirements since it is large and sometimes fragile. The truck driver offloads the freight with special equipment. It is common that the truck driver must offload other products to get to the ones supposed to be offloaded on site. Once offloaded, collies are scanned and photographed. The status of the order is updated to *Arrived at site* in the ERP-system. In addition, the LSP forwards a list of the times when orders were delivered to the master coordinators twice a day. If customers want an update on when their order is going to be delivered, the master coordinator can check those lists, compare to the transport plan, and give an estimate [2] [3].

16 Installation

An installation can be a replacement of an old door or to a completely new building where there is no old door to replace. Therefore, either the existing door must be removed before installation, or the new door will be installed in a prepared opening. The duration of an installation varies depending on the door size and special requirements but is usually between 5 and 32 manhours. Once the installation starts, the order status is updated to *Installation started*. [8].

4.2.5 Planning and coordination

The company is using a planning concept for the OTD process that was inherited through the acquisition of another company that originally produced the doors in 2011. An overview of the planning concept can be seen in Figure 4.6. The concept was first introduced in 2009, as a way to secure the delivery process to the site, achieve timely deliveries, and enable planning far ahead of delivery. Furthermore, it was introduced to reduce tariffs by letting a forwarder plan last-mile delivery. It uses the principle of what the company calls "backward planning" from the delivery week, called week X, to the current week. All activities are planned in weekly buckets, and the exact day of delivery is not decided until the week prior. The agreed-upon delivery week with the customer is determined by the order backlog at the factories. During the weeks prior to delivery week, there are deadlines for when different activities must have been performed for the order to follow the schedule. The process of last-mile delivery planning is made in weekly buckets as well, meaning that all deliveries are determined on the Thursday the week before, based on what orders are complete at the hub on the Wednesday at 4 p.m. Thus, the planner does not consider information about what orders are to become complete before departure of the trucks, except for certain exceptions explained in Section 4.2.4. Regardless of whether an order becomes complete at 4.01 p.m. on the Wednesday in any given week Z or at 3.59 p.m. on the Wednesday in week Z + 1, it will be delivered in week Z + 2. Transport planning for the following week is always made on the Thursday and the Friday. For an order to be delivered during the planned week X, it must be complete in the hub on Wednesday in week X - 1 at 4 p.m. the latest. As described in Section 4.2.4, an additional buffer week, not part of the original planning concept, has been introduced as a standard in production at factories 1 and 3. It only exists because of low reliability of the factories and the desire is to eliminate it.

Different entities have responsibility for different steps of the OTD process and have different internal deadlines to follow the planning concept. However, Factory 1 has a coordinating responsibility of the three factories. When Factory 1 sends production orders to the two other factories, it informs them of the date the factories should deliver the goods to the hub. That is always the Wednesday before 4 p.m., the week before the order is supposed to be delivered. However, according to the planning concept, the factories are allowed to deliver to the hub up to seven days earlier, to level out their production. In other words, there is one deadline per week but five days (weekdays) to meet the deadline.

A consequence of the planning being made in weekly buckets, and not on a continuous basis, is that if a deadline is missed by just a minute, the order becomes delayed by one whole week. In addition, the minimum lead time from a sales order to installation is five weeks, independent of how early different activities in the weekly buckets are finished. In case an order is complete at the hub on the Monday for instance, there is a buffer of seven to eleven days before it will be delivered to the customer. Another consequence of the planning concept is that customers are not given an exact delivery day until the Friday the week before delivery.

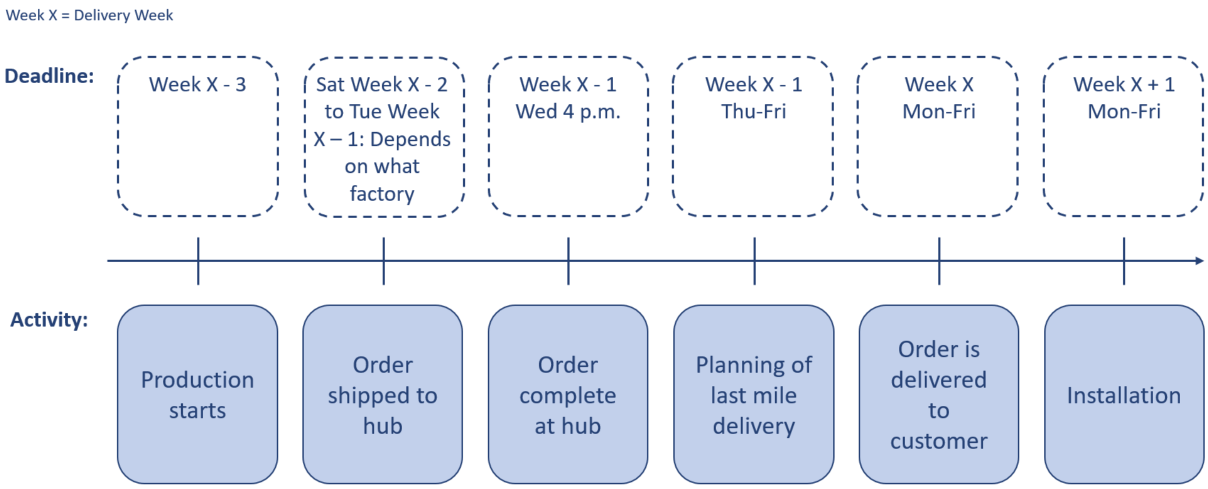

Figure 4.6. An illustration of the planning concept, the activities, and deadlines. Shows that the shortest possible lead time is five weeks with the current planning concept.

4.2.6 Roles and organizational structure

All interviewees and employee roles discussed in Section 4.2.4 are listed in Figure 4.7 below.

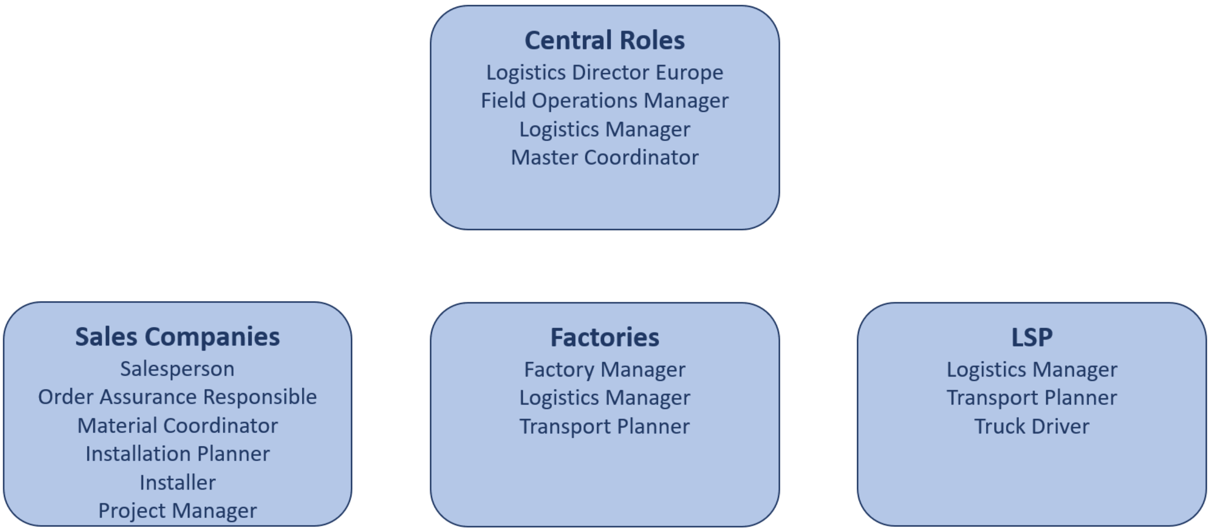

Figure 4.7. *Showing all involved and/or interviewed employees.*

The company is decentralized, and every country has its own functions such as management, finance, HR, marketing, service, and sales. The sales companies in different countries have their own principles and ways of working. For instance, sales companies have different rules and principles for how generous they are with late customer changes, and some countries have an old CRM system that has been ruled out in most other countries. The master coordinators notice many differences in how customers are treated depending on what sales company is responsible. For example, in Belgium and France, there are many late changes of delivery weeks. According to the master coordinators, that is due to the culture and principles of working. In those countries, the culture allows for late changes, but it has also been very easy and accepted by the sales companies. Late changes of delivery week result in orders being stored for a longer time at the hub and thereby increases tied-up capital. In Germany on the other hand, customers tend to stick to the agreed upon delivery week to a greater extent. There are no common directives or principles provided by the company on how the sales companies are to deal with changes of delivery week.

4.2.7 Systems and information sharing

Several different systems are used throughout the OTD process by the different involved entities. A visualization of the system infrastructure can be seen in Figure 4.8. The sales companies have two different systems. The CRM-system is used before the point of a complete order. A potential customer could be added to the system regardless of whether they are only a lead, or even as soon as they show interest. The salesperson adds basic contact information about the customer and later more specific information about the order and product specifications. It is not until the order is complete that it is added to the second system of the sales company, the ERP-system. Note that most sales companies have the same CRM and ERP-systems, but not all of them. A few sales companies send production orders to Factory 1 through email because of system incompatibility. The CRM-system and ERP-system used by most companies, as well as the ERP-system used by Factory 2 are supposed to be company standard systems and there are discussions about implementing them in all sales companies and factories. Factory 1 just recently implemented a new version of one of their ERP-systems.

Through the ERP-system of the sales company, a production order is sent to the first ERP-system of Factory 1. The factory has one system for receiving sales orders from the sales companies and another one for sending production orders to other factories. Therefore, order data must be transferred between the systems within Factory 1. It then sends production orders to the ERP-systems of factories 2 and 3. Only the ERP-systems of the sales companies and Factory 2 are from the same system provider. All other systems are different and largely incompatible. The system incompatibility has been solved partly by having master coordinators. One of their roles is to provide data from the company's systems to the LSP. Data from the sales companies' ERP-systems is extracted by the master coordinator into excel files, and then forwarded to the LSP. The LSP then inputs the transport plan into its TMS-system. All changes and deviations at the factories or the LSP are also communicated through the master coordinator, not a system. The material coordinator steps in and manually shares data when placing the production order to Factory 1 from the ERP-system of the sales company.

The main way to follow an order is through the order status updates made in the ERP-system of the sales company, shown earlier in Figure 4.5. However, not all entities have access to that information. The LSP does not know when and what collies are shipped to the hub. It does not get any information about the order until collies start to arrive at the hub. How the order status is updated in the ERP-system depends on what step it is. Some steps are automatically updated, and some are done manually by a person. The LSP sends EDI signals to the system updating *Arrived at hub* and *Arrived at site*. That happens automatically when collies are scanned upon arrival and drop-off at site. However, sometimes the order status does not seem to update, requiring manual interaction between the master coordinator and the LSP.

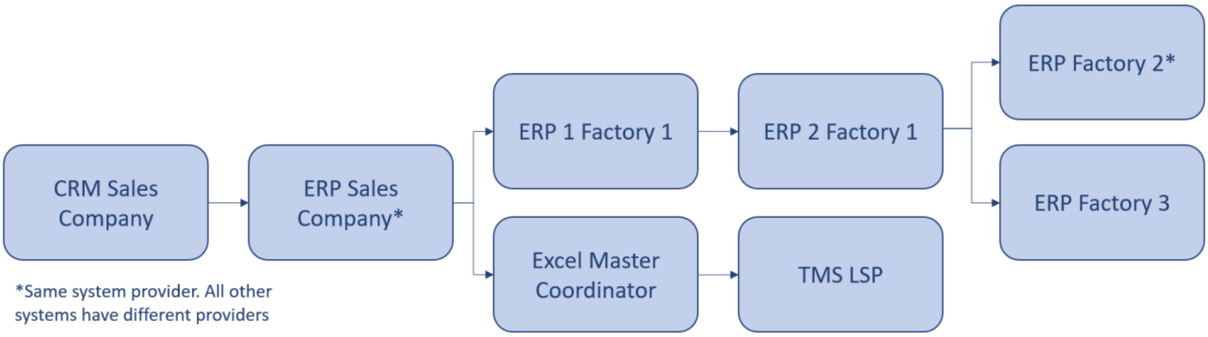

Figure 4.8. *Showing the different systems used in the OTD process.*

4.3 Performance

4.3.1 Observations

Generally, the process of gathering performance measures at the company was complicated. To be able to measure the current delivery performance, metrics on reliability and speed of the

OTD process are required, see the definition of delivery performance in Section 3.1. Both are internally focused effectiveness measures, assuming that factories and LSP are being viewed as internal entities. A problem with gathering performance indicators on reliability is related to the planning concept of the company. Since the first confirmed delivery date only specifies a certain week of delivery and not a weekday, an order is considered to be delivered on time if it is delivered within that week. That is quite a generous window within which the order will be considered to be on time and therefore not a very accurate measure of the reliability capability of the company.

The factories are obliged to report four different performance measures every month: lost time injuries, cost of poor quality, order fill rate, and productivity. However, the company does not define order fill rate the way it is most often defined in literature. The company's definition is "% of time deliveries that was made in the month according to agreement with the customer". order fill rate in literature is most often defined as "percentage of orders fulfilled by stock on hand" and used by make-to-stock companies. In this report, the company definition of order fill rate will be referred to as on-time delivery and be seen as a measure of reliability. The company is also to a small extent gathering and utilizing data from the ERP-system to make BI-reports on reliability. This is only possible for Factory 2, as the ERP at Factory 1 and 3 is not compatible with the business intelligence (BI) system. Therefore, it is not possible to aggregate or compare data from the three factories. The reliability is often lower in the BI report than what Factory 2 is reporting.

It was even more complicated to gather metrics related to the speed of the OTD process. The company is not measuring or monitoring the average lead time of the door. It seems to be due to a lack of data, system incompatibility or a lack of interest in measuring the dimension of speed performance. The data of historical times and dates of different order statuses required to calculate the average lead time for the door are hard to access. It would have to be manually extracted from different systems at different entities in the organization. The data of when sales orders become production orders exists in the ERP-system of Factory 1. The data of when orders are delivered and/or installed exists in the CRM and ERP-systems of the sales companies. However, the systems are different and the data that can be extracted is incompatible. It is not possible to gather it in the company's BI-tool in a convenient way. Therefore, the average lead time of the door is not being measured.

4.3.2 Speed

Below is a summary of available approximations of lead times in the OTD process (Table 4.3 and Figure 4.9). This refers to the elapsed time between a complete order and installation, along with the lead time between different steps of the process. Data was obtained from both documentation and interviews. One limiting factor currently for improvements in the lead time stems from the planning concept, which creates the theoretical shortest possible lead time of 5 weeks, explained in detail in Section 4.2.5. No estimate of the average lead time based on data was available at the company, as previously outlined. However, data from a customer survey outlines that the customers estimate the average lead time from order to installation to be 5-8 weeks. Customer expectations for lead times were around 2 weeks lower for most countries, around 3-6 weeks. There is also an estimated lead time for future orders communicated from the factory to the sales companies, updated every week. By aggregating that data, and using the most recent estimate for each week, the approximated lead times for

2023 were calculated to be 7.82 weeks. Note that this data is purely based on forecasts for production lead time and represents a best-case scenario without delays or deviations for orders.

Table 4.3. Estimation of lead times in the OTD process

Lead time	Time
Shortest possible for the OTD	5 weeks
OTD estimated based on forecasts	7.82 weeks
Production Factory 1	5 days
Transportation Factory 1 - hub	1 day
Production Factory 2	5 days
Transport Factory 2 – Factory 1	1 day
Production Factory 3	-
Transport Factory 3 - hub	2 days
Storage duration at hub	22 days
Transport from hub to customer	1-3 days

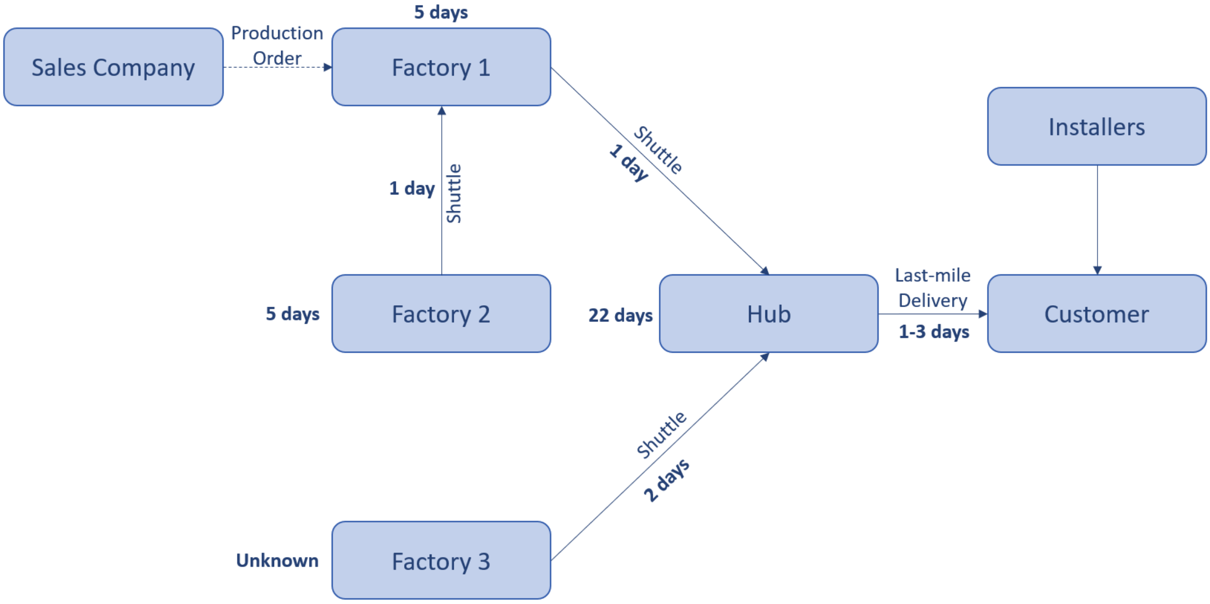

Figure 4.9. Network model with the estimated lead times for each step.

4.3.3 Reliability

To estimate the reliability of the process, measures of on-time deliveries were collected. On-time delivery refers in this report to the percentage of orders that are delivered within the last agreed-upon delivery week. Therefore, a perfect order fill rate would, in this case, only refer to all orders being delivered in the correct week, not on the correct day that was agreed upon the week before. If the first confirmed delivery week at the creation of the complete order is postponed two weeks ahead of delivery and the company delivers to that week, it is considered an on-time delivery. Any deviations that are handled prior to production and agreed upon with the customer are also not seen as delays. Table 4.4 shows that the performance for 2023 was below target, reaching it in only three weeks. The production in Factory 1 causes 80% of deviations. Factories 1 and 2 have high reliability levels in 2023 at 100%.

Table 4.4. *The reliability at the factories and the supply chain in 2023.*

Logistics entity	Reliability
Factory 1	89%
Factory 2	100%
Factory 3	100%
Last-mile delivery	98%
Total	86%
Target for factories	95%

4.3.4 Customer survey

None of the sales companies are regularly conducting surveys with customers or are trying to follow up and assess the customer experience of the product, customer service, or distribution [10]. That is only done in Sweden which is outside the scope of this thesis. However, recently a larger assessment of customer experience and expectations was made. It concluded that customers generally would prefer the lead time of the product to be shortened by two weeks, compared to the lead time they were offered prior to the survey. Customers were also asked to rank the importance of 1) getting the order delivered as confirmed, which could be interpreted as reliability, 2) short lead times, and 3) low transportation costs. It concluded that customers valued reliability first, short lead times second and low costs third.

4.4 Synthesis of Empirical Study

There are several things that stand out in the empirical study. The following points are of particular interest and will be discussed in the analysis:

- The high number of activities in the OTD process.
- The different views on the supply chain strategy
- The complicated IT-setup consists of many different and incompatible systems.
- The occurrence of manual intervention throughout the process to share information and solve issues.
- The long lead time at the hub (22 days) stands out in comparison to the other lead times in the process, see Figure 4.9.
- The much lower production reliability (89%) at Factory 1 compared to the other factories.
- The additional buffer week used by Factory 1 and 3 and other built-in buffers throughout the process.

- The lack of knowledge about the performance of the OTD process.
- The long OTD process lead time of 7.8 weeks

5 Analysis

The purpose of this chapter is to combine the findings from the empirical study with the theoretical background. Firstly, the current performance of the OTD process will be discussed and assessed. Secondly, RQ1 will be answered by identifying causes of low delivery performance. To validate the causes and enable further analysis, a focus group discussion has been conducted. Further, improvement proposals to enhance delivery performance are presented, discussed, and motivated, to answer RQ2. Lastly, the applicability of improvements will be discussed before summarizing and presenting the desired future to-be state of the OTD process.

5.1 Current Performance

The problem formulation was built on the hypothesis that delivery performance was low. This has been confirmed by the empirical data. Delivery reliability was found to be too low, around 86%. In addition, the measure considers only the company's ability to deliver on the last confirmed delivery date. In other words, not the delivery date that was confirmed in connection with the creation of the complete order. In terms of delivery speed, an exact measure of the average lead time based on delivery data has not been found. However, there is evidence that the time from order to delivery is often longer than expected. The shortest possible theoretical lead time is 5 weeks, due to the planning concept. The lead time as estimated made by customers was 5-8 weeks. The estimated lead time based on forecasts made before production was 7.8 weeks, not considering deviations which often occur in production. Regardless of which measure is correct, the evidence strongly suggests the lead time significantly exceeds the theoretical five weeks and is likely closer to the 7.8-week estimate based on production forecasts. In any case, the lead time is below customer expectations of 3-6 weeks.

Several findings highlight inefficiencies in the process. For example, the average lead time for components at the hub is 22 days, effectively making it a stocking point in the OTD process. The CODP occurs when an order becomes a complete order. According to the theory, the CODP should mark the end of the last stocking point, suggesting that this additional lead time is unnecessary. As the product is CTO, the entire OTD process should be characterized by MTO activities. Furthermore, there are excessive buffers built into the process. While these buffers are intended to enhance reliability, they significantly increase lead time. One example of this is that an additional week of production buffer time is added by factories one and three to mitigate the negative effects of the low reliability. Another finding pointing towards low performance was the high number of changes to order agreements made throughout the process. The order changes cause delays amplified by the planning concept, coordination problems, and extra costs.

5.2 Causes of Low Delivery Performance

The list below is a summary of the main identified causes of low delivery performance at the company. They have been identified by analyzing the empirical data together with the theoretical background.

1. Complex physical network
2. Strategy-related issues
3. Low reliability
4. Local optimization and silo-thinking
5. Fragmented IT-setup
6. Insufficient planning concept
7. Poor customer communication
8. Lack of internal information sharing
9. Insufficient performance measurement system

In the following section, the problem areas will be explained. Evidence is provided as to how they affect delivery performance and how they relate to literature on the topic. Many of the causes are intertwined and affect each other, but the objective is to provide topics that can be seen as mutually exclusive.

1. Complex physical network

The physical network of the OTD process has been identified as a reason for low delivery performance. The fulfillment of orders to customers is achieved through production of components at three different facilities, which are consolidated and sent to customers through a hub. The complexity is not necessarily an issue if coordination works efficiently. However, due to many identified issues in the OTD process, the complex physical network further adds to the low delivery performance. For example, one of the main reasons for the long average lead time at the hub is poor coordination of material from the different factories. That would not be as big an issue if all parts were produced in one location.

The network also exposes the supply chain to a larger number of threats and disruptions without improving resilience, as production is not complementary. There is no reasoning behind the location of the facilities, other than keeping the existing infrastructure when acquiring new companies. One interviewee identified the physical setup as being one of the primary drivers of low performance, because of the added complexity. According to research, it is established that a higher degree of supply chain complexity can impact delivery performance negatively, which seems to match our findings.

2. Strategy-related issues

Three main issues were identified related to the strategy:

1. No common strategy and objectives followed by all entities
2. Wrong strategic focus
3. Supply chain and corporate strategies not aligned

The main issue identified related to strategy is that there seems to be no common supply chain strategy or clear goals and objectives for the OTD process. When asking different stakeholders, different perceptions of the supply chain strategy were presented. None of the answers presented a common strategy or common goals for the OTD process. One logistics manager said that the main objective in the last 10 years has been to cut costs and that the strategy has lacked focus on reliability and shorter lead times, something that is demanded by customers. The different views on strategy and objectives result in the OTD process being seen as many different processes, and not as one process where different entities contribute to the success and performance of the whole process. Instead, the factories and sales companies optimize locally and to fulfill their own goals. This is closely connected to the issue of silo-thinking presented later in this section.

As outlined in the literature, logistics is an important factor in achieving customer satisfaction and in the long-term loyal customers and business continuity. Both timeliness and contact quality with customers has been shown to have an impact on customer satisfaction. With that in mind, there is a lack of focus on customers in the supply chain strategy at the company. The distribution of the product is seen as a costly necessity and not as a part of the offering or a way of achieving a competitive advantage. Furthermore, the focus on cutting costs is not aligned with the customer's preferences identified in surveys. They value timeliness and short lead times more than low distribution costs. That should be reflected in the logistics strategy and the main focus should therefore not be on lowering costs, but on providing excellent customer service. In addition, the company's strategy of having a planning concept with time buffers and the fact that lead times at the hub are long is not in accordance with CODP theory. No stock points should exist after the CODP, and the supply chain should be responsive and flexible. However, the company is not managing the OTD process in that way, but instead has time buffers and a low ability to adjust speed and volumes.

Lastly, as described in the literature, it is important that the supply chain strategy is aligned with corporate strategy to achieve corporate objectives. The strategy should be defined either to support corporate strategy or together with the development of the corporate strategy. The corporate strategy at the company focuses on customer relevance, innovation, cost-efficiency, and evolution through people. The supply chain strategy is not defined to support those objectives. Even though focus has been put on cost cutting, the process is still not cost efficient. There is no focus on customers, innovation, or evolution through people either. In conclusion, the supply chain strategy is not defined to support in the achievement of corporate objectives or strategies. It is believed that all the above listed strategic issues indirectly affect the OTD process and its performance negatively.

3. Low reliability

Another discovery considered to have a direct, negative effect on delivery performance is low reliability, especially in Factory 1. A consequence of the physical setup with three different factories is that low reliability at just one of the factories, in this case Factory 1, results in low reliability for the whole OTD process. The low reliability makes it difficult to coordinate the material flows at the hub and results in low trust at other entities of the process towards Factory 1. That has shown to result in the introduction of extra time buffers contributing to the inefficiency, longer lead times and low performance of the OTD process. The planning concept is designed to not allow even small delays of orders to the hub. The low reliability therefore creates large delays to the customer. Since the reliability at the two other factories is high, components from those factories will be stored at the hub for long periods, waiting for goods to arrive from Factory 1. This is presumed to be one of the reasons for the average time at the hub being 22 days, showing inefficiency and resulting in tied-up capital and costs.

A related issue to this is the defined reliability target of 95% for each of the factories. Even theoretically, if the targets were met, the accumulated reliability level at the hub with added uncertainty in transportation would be approximately 81%. That is low and not even the theoretical reliability delivered to customer but only the reliability at the hub. It could still be expected to exist some uncertainty in last-mile delivery and then the reliability delivered to customer is below 80%. Therefore, it is assessed that the reliability targets of the factories of 95% are too low to be able to both satisfy customers and to achieve an efficient flow of materials through the OTD process. The implications of the 95% reliability targets at the factories are visualized in Figure 5.1.

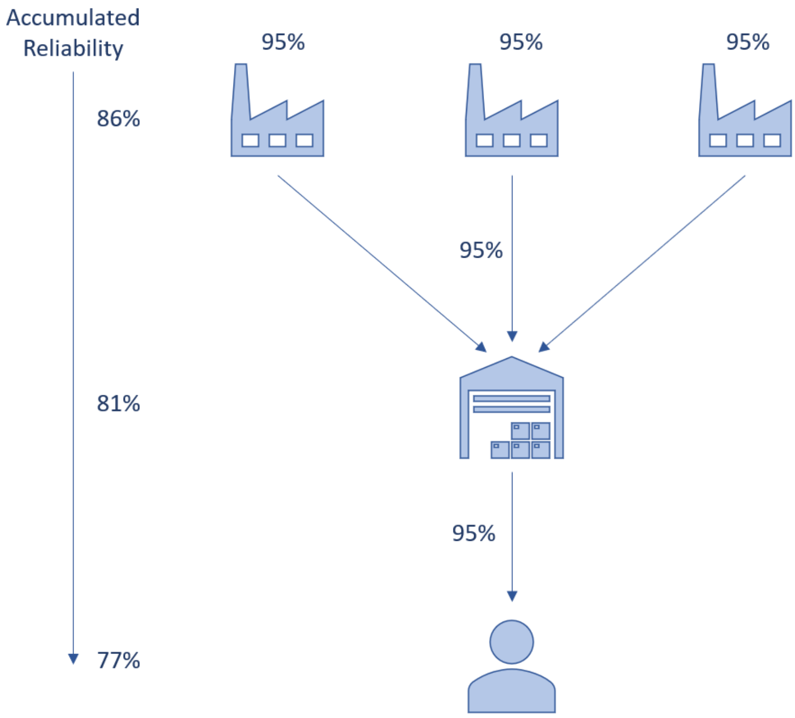

Figure 5.1. Visualizing the accumulated reliability to end-customer with 95% reliability at the factories and in the transportation stages.

4. Local optimization and silo-thinking

Silo-thinking has been identified as a contributor to poor performance as it is a root cause behind the high number of changes to customer orders that occur throughout the process. This has been identified in multiple parts of the supply chain. The sales companies have been identified as not having a standardized way of working, which creates local optimization for each unit. It has been seen that many offer extremely high levels of flexibility towards customers and allow changes without considering the entire supply chain. The sales companies also sometimes wait with transferring complete orders to the ERP-system to delay the creation of a production order to Factory 1 and thereby enable making changes to the order. This affects the planning capability of the factory. Furthermore, the factories seem to work in an isolated manner. During the interviews with the factory managers, it became clear that they almost considered themselves separate entities. Like the complex physical setup, local optimization can be explained by the company pursuing an aggressive growth strategy with many acquisitions, where new entities are not integrated sufficiently into the existing organization.

It is assessed that many of the issues regarding local optimization and silo-thinking are connected to the lack of a clear supply chain strategy. As outlined in the literature, without a common goal and objective, entities start to optimize for their own benefit. It is also connected to a lack of trust in the supply chain, which is connected to the degree of information sharing. As outlined in the literature, trust is seen as a barrier that needs to be overcome before information sharing can be improved. This becomes evident in the example of the extra week of buffer time that factories 1 and 3 add. That is a direct result of local optimization, while not communicating this to the rest of the supply chain. The low level of trust towards the factories creates an additional week of held inventory. Finally, this low level of trust can be explained by a low degree of relational integration, one of the three dimensions of supply chain integration. It is broadly acknowledged in the literature that silos need to be mitigated to improve supply chain performance.

5. Fragmented IT-setup

The IT-setup consists of multiple systems for different purposes that are often not compatible with each other. For instance, the factories use different ERP-systems, where Factory 1 cannot share data with the BI-system. This negatively affects the performance measurement of the process, hurting the company's ability to understand its weaknesses, improve the process, and follow up on strategic objectives. There are other examples of information systems that are not compatible, between the company and the LSP, as well as between the ERP-system and the CRM-system. Compatibility is referred to in the literature as cross-functional application integration and is considered important for IT integration to be successful. The literature points out that higher IT integration does not necessarily increase performance, but that poor IT infrastructure can affect SCI negatively, which in turn can affect performance.

Furthermore, the IT-setup has a high degree of complexity. A customer order passes through at least six systems, from beginning to end, and five sales/purchase orders are created for each order. The process could theoretically utilize a much less complicated setup. The added complexity reduces the possibility of high standardization, which is another important aspect of facilitating high IT integration, referred to as data consistency in the literature. The high degree of complexity creates inefficiencies in the process in the form of manual work and more frequent occurrences of errors. There have been clear examples of information sharing being carried out using mail and Excel because information systems cannot adequately support the processes. The complexity is also detrimental to information sharing efforts and reduces general visibility. This refers to the term information sharing support technology, as outlined by Zhou and Benton Jr. (2007), which is important for information sharing.

6. Insufficient planning concept

There are several aspects considered to be issues with the current planning concept at the company that are mainly negatively affecting the lead time:

1. Only one deadline per week

2. Not using data to plan, only physical position at hub
3. Inflexible

Firstly, the planning concept refers to short-term and mid-term distribution decisions according to the Supply Chain Planning Matrix by Stadtler et al. (2011). The concept of only having one deadline per week for orders to be complete at the hub negatively affects the delivery performance in different ways. Firstly, it automatically leads to increased lead time and tied up capital. The factories cannot produce all goods on the Tuesday and have them arrive on the Wednesday before the 4 p.m. deadline. Instead, they must level out that volume throughout the week, presumably leading to some collies being produced a week in advance and others the day before. That will presumably add an extra $\frac{7}{2} = 3.5$ days on average to the lead time compared to if orders were delivered from the hub as soon as they arrived. Another implication of having just one deadline per week is that any delay incurs severe consequences. A one-hour delay on the Wednesday leads to minimum one extra week at the hub. With the current planning concept, even if no delays happen, the storing time at the hub can theoretically be 5-16 days. This contradicts the theory saying that there should be no storing of components after the CODP. The hub should only be used to coordinate the components from different factories to enable aggregation of last-mile delivery. During the 5-16 days at the hub, or the average of $\frac{5+16}{2} = 10.5$ days, no value is added to the product. On the contrary, it is only a delay before being able to be delivered to customer, increasing possibility of product damages, and adding to the tied-up capital. Also, it should be mentioned that the theoretical average of 10.5 days at the hub is 22 days in reality.

Another weakness with the planning concept is that the planning of last-mile deliveries only includes orders that are physically complete at the hub and not orders that will become complete. In fact, when deliveries are made the week after they have been planned (on the Thursday and Friday according to the concept), some orders that are complete will not be delivered because they became complete on the Thursday or Friday, i.e. after the 4 p.m. Wednesday deadline. The reason for the concept to not include orders that are to become complete is because the company does not have that visibility. The many delays in production are not effectively communicated downstream the OTD process and the LSP, responsible for last-mile planning, does not know exactly what collies are to arrive on which day. This is connected to the general issues with internal information sharing which is a consequence of the IT-setup being fragmented.

Lastly, the planning concept is inflexible which is considered to lead to low delivery performance. It is inflexible in the sense that it has a predetermined number of weeks containing different activities such as production, delivery, storing at hub, last-mile delivery and installation. The different activities are always planned to be performed different weeks. For instance, if an order becomes complete in the hub on a Thursday, it will not be delivered until the week after next week, because of the rules of the concept. In other words, it has built-in time buffers to make sure that activities are completed in time before the supposed start of the next activity. However, the buffers add to the lead time of the OTD process which has been shown in the conducted customer survey to be undesirable by customers.

7. Poor customer communication

There are three main issues related to the company's communication with customers:

1. Late communication of exact delivery day
2. Lack of order status updates and long period of no communication
3. No integrated system to communicate with customers

The customer receives an expected delivery week when ordering a product, but the exact delivery day is not communicated until Friday the week before. That, together with the fact that there is a void of sometimes two months before the customer is contacted by the installation planner regarding installation requirements, creates problems. Those two are assessed as reasons for the high level of late delivery week changes initiated by customers. It is difficult for the customer to plan and be available to receive a delivery when the exact delivery day is communicated that late. This is reported to lead to postponements and extra costs. The fact that the customer is not updated about the order during the OTD process is also assessed as resulting in postponements of deliveries. If customers were updated regularly about their order and expected delivery, delivery changes would be avoided or at least discovered earlier, reducing their effects on the OTD process. Lastly, there is no system for automatic communication with customers. All communication happens manually from a salesperson or installation planner through email or phone. There is no communication through automatic emails, or a system integrated with the ERP communicating information about order statuses and other important information.

As explained in the literature, external contact quality with customers is important for having satisfied customers. Real-time information sharing with customers can be a tool to close the gap of expected service quality, and the above-mentioned issues with the company's customer communication hinder them from getting satisfied and loyal customers and achieving a sustainable competitive advantage. This is another example of what was mentioned in relation to the strategy-related issues, that there is an overall lack of focus on the customer in the OTD process.

8. Lack of internal information sharing

Another aspect that has been identified as a cause of low delivery performance is the low level of internal information sharing throughout the process. It is clear from the literature that information sharing is regarded as one of the most critical aspects of improving delivery performance, since it has been shown to increase service quality by increasing timeliness and accuracy. According to Zhou and Benton Jr. (2007) there are three aspects to consider: information quality, information content, and information sharing support technology. The quality of the data in the OTD process is often low. One example is the unreliable and sometimes missing order status updates from the LSP to the company. Another is the lack of information shared with installers, who sometimes are not notified about changes of delivery dates efficiently. Truck drivers face similar issues regarding inaccurate drop-off points and locations. Another example of this is that the number of collies for an order is not visible in the ERP-system, which means that information is not available to the transport planner before it arrives to the hub. Similarly, the height dimension for the doors is not available in the files that are shared with the LSP. The LSP therefore has bad visibility of the orders arriving, and transport planning cannot begin before all collies have arrived at the hub, which affects the lead time. In the literature, information content relates to how a company uses the available information, where some inefficiencies have been discovered. One example of this is a lack of communication and information sharing between production and logistics, even though information exists. The last aspect to consider as outlined by Zhou and Benton Jr. (2007), is the information sharing support technology. This has been discussed in the "Fragmented IT-setup" section and it is found to be highly complex with low compatibility.

The lack of information sharing is highly connected to the issues regarding silo-thinking and can be seen as a leading cause behind it. Many of the information sharing issues are also regarded with information the company does not share, for example regarding deviations of orders and performance dimensions, such as the long lead time at the LSP hub. Potential improvements are not communicated, and issues in the process stay persistent as these are not highlighted. It can also be assumed that the fragmented IT-setup plays a large role in inhibiting information sharing in the process.

9. Insufficient performance measurement system

The importance of measuring performance has been emphasized in this report and described as a means to quantify the efficiency and effectiveness of actions connected to both customer satisfaction and internal operations. When analyzing the empirical study there are many examples of the performance measurement system at the company being insufficient. That was described as common by Keebler and Plank (2009) in companies where management has not yet become convinced that logistics performance measurement has a positive impact on business value, which seems to be the case at the company. The purpose of the thesis and the desire from the company was to improve delivery performance, defined as a company's ability to perform deliveries accurately and quickly, i.e., by the dimensions of reliability and speed. However, to be able to manage and improve performance, it is important to measure the right things. The company is not measuring many things at all connected to the OTD process, which makes it difficult to accurately assess the delivery performance.

Firstly, it has been identified that the company is not measuring the lead time of the OTD process and does not have relevant measures of reliability. The only measure related to lead time that has been collected is the average lead time at the hub, namely 22 days. Production lead times or the lead time of the whole OTD process are not measured. The figures presented in Section 4.3.2 are only estimations. Regarding reliability, the factories report the percentage of orders delivered to the hub the correct week on a monthly basis to the company. That measure is generous in that it counts a delivery as being on time as long as it is delivered the correct week. The company does not measure the factories abilities to deliver on time on a daily level. That reduces both the pressure on the factories to improve reliability and the knowledge of how well the factories could deliver on specific days. It is somehow relevant since the planning concept only requires deliveries to be made the correct week, but it hinders improvements of the process.

Furthermore, the company has no performance measurement connected to the customers. None of the sales companies are measuring customer experience or satisfaction. Thus, it is difficult to know what customers expect and demand with regard to deliveries. However, the recent surveys have now highlighted that customer expectations are not being satisfied with regard to lead times. That could have been identified earlier if customer experience and expectations were tracked on a more regular basis.

There are several explanations for the performance measurement system being insufficient. Since the development of it should be based on strategy and objectives, and the company lacks those, it is difficult to create an efficient performance measurement system. In addition, the fragmented IT-setup leads to difficulties with being able to share and collect the relevant information. It was difficult to collect the data required to assess performance at the company because of the many systems and incompatibility of data. As with the issue of insufficient performance measurement, many of the causes previously presented in this section are interrelated and affect each other.

5.3 Focus Group

After identifying the causes of low performance, based on the empirical findings and the theoretical evidence on the topic, a discussion with a focus group was conducted. The focus group consisted of seven supply chain practitioners at the company. The purpose of the focus group was to:

- Validate that the identified causes have a negative impact on delivery performance
- Collect the practitioners’ view on how to improve delivery performance at the company

The focus group was held during a 2-hour session. Firstly, a synthesis of the as-is analysis was presented to the participants. The next step was a presentation of the nine problem areas that were identified as causing low performance. The participants were then presented with a survey in which they ranked the nine causes on two dimensions, which can be seen in Appendix 2. The first dimension regarded the negative impact the cause has on the delivery performance, i.e., speed and reliability. The second dimension regarded the complexity or difficulty of improving or fixing the cause in question, i.e., how large of an investment would be required in terms of time and money. Hence, the second dimension is referred to as complexity. The next part of the session was dedicated to discussions about the causes of low performance and ways to address them.

5.3.1 Impact-complexity matrix

The results of the focus group were collected using a form where the participants were asked to rank the two dimensions on a scale of 1-7, which was then used to create the impact-complexity matrix, seen in Figure 5.2 below. The matrix is useful in multiple ways. Firstly, by aggregating the answers it is easy to determine the participants’ views on the importance of the different problem areas. Secondly, prioritizing the causes of low performance based on their complexity helps determine which ones might be too complex and difficult to address. Thirdly, the rankings provide a way to prioritize between different measures of improvement, depending on what causes of low performance they address. Finally, the matrix enables comparison between the views of the practitioners and the theoretical background.

The four quadrants of the matrix were added to enable categorization. The area in the first quadrant consists of causes that are difficult to improve but have a big impact on performance. The second quadrant relates to causes with high complexity but small performance impact, i.e., not ideal to improve. The third quadrant can be characterized as “low-hanging fruit”-causes. They are easy to improve but not particularly impactful. The fourth quadrant refers to causes that have a large impact on delivery performance but are easy to improve. They should be prioritized to improve since the benefits would outweigh the complexity. However, the implications of the exact positioning of each cause should be assessed with some caution, since the rankings are the result of the subjective opinions of the participants. More weight should be attributed to the internal order of the problem areas. The participants’ answers were collected, and the average score was calculated for each of the problem areas.

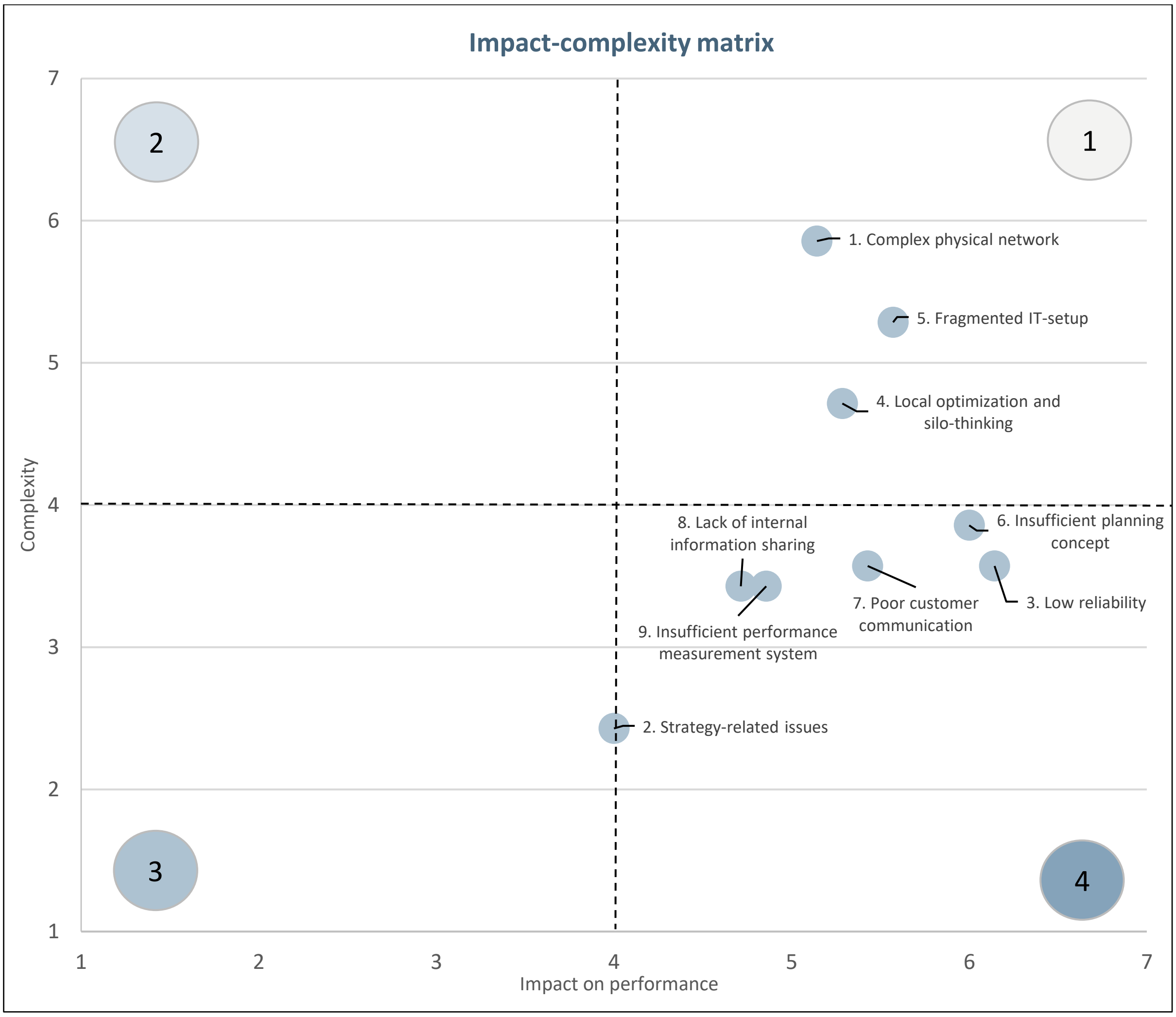

Figure 5.2. *The impact-complexity matrix.*

The result of the survey presents some interesting findings. Firstly, all problem areas except the complex physical setup have been ranked as having a bigger impact on performance than its complexity to improve, implying that addressing those would be beneficial for the company. Making changes to the physical setup of the supply chain is a highly time-consuming and costly task. Its high complexity therefore comes as no surprise. The area ranked the second most difficult to improve was the IT-setup, which aligns with the literature on the topic. According to the research, IT improvements often fail and are associated with high costs and long integration times. Furthermore, low reliability in Factory 1 was ranked as having the biggest impact on performance. That is consistent with the empirical findings, which suggest that deviations in Factory 1 constitute 80% of the total number of deviations. More surprising was the low ranking of its complexity, suggesting that it could be addressed more easily than for example local optimization, silo thinking or the insufficient planning concept. The insufficient performance measurement system, lack of information sharing, and poor customer communication are in quadrant 4 as well, suggesting that these areas should be prioritized.

5.3.2 Implications for improvement activities

When analyzing the impact-complexity matrix and combining the findings with the observations during the discussions, several aspects affecting the direction of the improvement activities are identified. In understanding how to improve delivery performance, the practitioners seemed to “prefer” activities that were clear and tangible. For instance, the complexity ranking of the low reliability at Factory 1 is lower than the aspects of local optimization and silo-thinking. The project management activities required to solve it might be seen as more difficult compared to improving reliability at a single factory because it is not as clear of a task. Furthermore, the perceived complexity related to improving the IT infrastructure suggests that improvements in that area should be addressed with caution. During the discussions there was a clear consensus of the time-consuming nature of IT projects. It indicates that improvement suggestions in this area need to have clear goals that are achievable and measurable.

There are several areas where the practitioners’ opinions deviate from the literature. The importance of having a clearly defined supply chain strategy is one example. That was ranked as having a relatively low impact on performance, in fact, the lowest impact of all problem areas. As outlined in the literature, a clearly defined strategy followed by all entities is often a prerequisite for other improvements, for example performance measurement activities and silo-thinking. This notion was also echoed by one of the participants during the discussions. Therefore, one could argue that the too narrow strategy is a barrier for improved delivery performance and therefore should be prioritized early. The low ranking of impact of the lack of information sharing also presented a deviation, as the literature emphasizes this area heavily. One paper even cited this as being the biggest driver of performance in the supply chain (George & Pillai, 2019). Like the low perceived importance of a clear strategy, the differences might be due to low perceived tangibility, as previously discussed.

The planning concept was also ranked as a big contributor to low performance. The literature on the topic of operational planning regarding planning frequency is scarce and not mentioned as a driver of low performance. However, the empirical study showed that it had a large impact on reliability and speed. The perceived impact highlights that practitioners to a greater extent see the operational planning configuration as a driver compared to the literature. However, this could also be a specific result for the case company, as it relies heavily on this process. Regardless, this is judged to be one of the most important ways to improve long-term delivery performance.

5.4 Improvement Proposals

In this section, proposals for improvements are presented, answering RQ2 and fulfilling the purpose of this report to improve delivery performance. The structure of the report is such that all chapters have built upon each other, ultimately contributing to and supporting this section, the improvement proposals. The proposals have been developed through finding gaps between the empirical study and the theory to solve identified causes of low performance, as well as on inputs from the focus group. In addition, the improvement proposals are based on the expertise, ideas, creativity, and experience of the authors. The objectives and visions of the improvements are to result in an integrated, constantly improving OTD process with efficient internal and external information flow, supporting a well-coordinated material flow. That should be enabled by clearly defined strategy and objectives with customer experience in focus. The strategy and its relevance will continuously be followed up and assessed by a well-designed performance measurement system aiming to motivate all entities in the OTD process to contribute to the fulfillment of the strategy and objectives. The improvements will ultimately result in short lead times and high reliability, i.e. high delivery performance.

The improvements are divided into six, concrete steps with explanations and motivations about what issues each of them solves respectively. The order in which the improvement proposals are presented represents the order in which they should be implemented. Many of them build upon each other and are feasible only if the previous improvements are implemented first. The improvement proposals are shown in the correct order in Figure 5.3. It visualizes a roadmap showing the improvements, collectively resulting in improved delivery performance. If the improvement proposals are implemented, the average lead time would theoretically be reduced to approximately 25 days, compared to the 55 days today (7.8 weeks). More ambitious reliability targets and reliability enhancement projects together with improvements in other areas are believed to enable a reliability enhancement to approximately 95% at the hub. Today, it is 86% to the customer with a generous definition of the reliability measure.

The order of the improvements is not completely fixed, and some of them can be implemented simultaneously. However, they have been divided into three different groups, short-term, mid-term, and long-term. It should be stated that the implementation of all proposed improvements is no short or simple project. Some of the individual improvement proposals alone will take years to complete, and if all of them were implemented it could be expected to take multiple years. The short-term improvements can, and should be implemented immediately since they do not build upon any other improvement. Enhanced reliability will be required to regain control of the delivery performance regardless of which other improvement is implemented. The new strategy will guide the decisions in all other implementations. One of the tasks of the process owner group will be to communicate, motivate and implement the strategy defined in step two. It must therefore be implemented after the definition of the new strategy. The work with reliability however will probably run simultaneously with other proposals since it can be a complex task. The process group should also provide necessary instructions for the team working with IT improvements. The improved IT infrastructure will enable extraction of compatible data required to measure relevant processes. However, some attempts to access relevant data for improved measurement can be done before the implementation of the new IT-setup. Ultimately, all improvements will contribute to enabling a redesign of the planning concept which aims to greatly decrease the lead time of the OTD process and thereby increase performance.

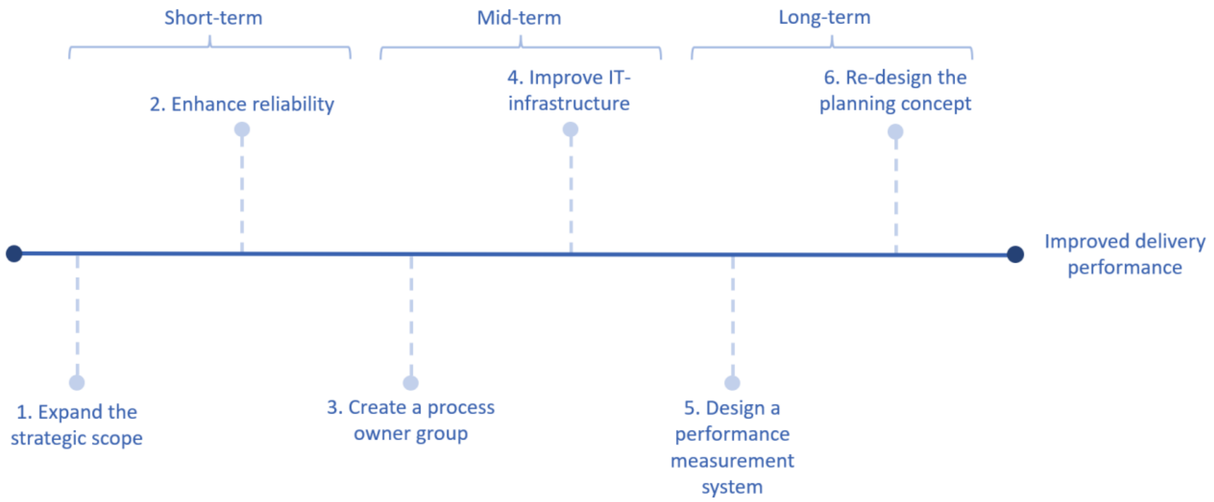

Figure 5.3. A roadmap of the improvement proposals presented in this section.

1. Expand the strategic scope

Three main issues were identified regarding the strategy at the company, namely that there was no supply chain strategy or objectives defined that were being followed by all entities, wrong strategic focus, and no alignment with corporate strategy. The strategy should be the foundation of everything the company does and guide all decisions. All processes and activities at different entities in the supply chain should support achieving the common objectives. A clear and expanded strategy for the whole OTD process will help to eliminate local optimization and silo-thinking at different steps and instead make all parties work in the same direction. Therefore, it is suggested that the company start the improvement process of the OTD process by expanding the logistics strategy. The strategy should address the three main issues that were identified with the current strategy. Using the framework for developing a logistics strategy presented in Section 3.3.2 and shown again in Figure 5.4, the strategy should support the design of processes, physical network, information systems and the organizational structure. The later presented improvement proposals in this section will be guided by the strategic focus and objectives with more detailed strategies for the design of logistics process design, information system design and organizational structure. However, it is outside the scope of this thesis to present proposals connected to the physical network design.

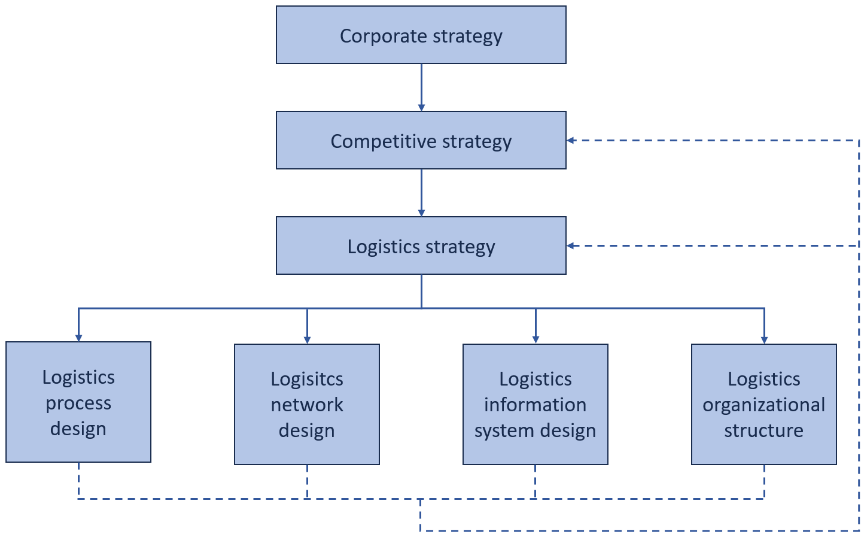

Figure 5.4. A framework developed by Rushton et al. (2022) for logistics network design.

It is suggested that the company follows the concept of total logistics and that all logistics elements are seen as an integrated system. All parts should be considered within the context of the whole logistics network. The next step, which should be strived towards taking in the future, is to work with the more active approach of strategic logistics rather than logistics strategy. That means recognizing logistics as a key factor in the success of the company and developing the logistics strategy together with the corporate strategy rather than just basing it on it. That should be the target for the future to ensure continuous competitiveness and the ability to adapt to new customer demands.

Firstly, the logistics strategy should be aligned with the corporate strategy and support in achieving corporate objectives, namely 1) growth through customer relevance, 2) product leadership through innovation, 3) cost-efficiency in everything we, and 4) evolution through people. When expanding the existing strategy, the distribution of the product should be viewed as a means of achieving competitiveness rather than a costly necessity. Studies show the effect logistics has on customer experience and its ability to enable strategic relationships with customers and achieve continuity of the business. A lack of focus on customers and their experience of the OTD process has been identified in this report. The recently conducted survey presented in Section 4.3.4 showed that customers value on-time and fast deliveries before low costs, while the main strategic focus the last years has been cost reductions. Therefore, the strategy should focus on satisfying those customer expectations of timeliness and speed, supporting the corporate objective of customer relevance. That is also better in line with the theory of CODP to focus on responsiveness and flexibility in the downstream flow. It should be done by viewing distribution of the product as a part of the total offering to the customer, as important as the functionality and quality of the door. Customer satisfaction should be a shared responsibility between sales, production, and logistics and the customer experience should be evaluated on those different aspects.

Further, strategic objectives should be formulated and regard both the customers and internal logistics operations. Considering the survey made on customer expectations and general trends, the first objective should be to achieve high customer satisfaction through offering fast and on-time deliveries with clear and seamless communication throughout the whole process. To achieve and support that, internal objectives should be to ensure reliability at all steps achieved through visibility, coordination and effective internal communication while efficiently utilizing company resources. Company resources should relate to human and financial resources. The strategic focus and objectives presented in this section support the corporate objectives and solve the issues identified with the current strategy.

2. Enhance reliability

The low reliability identified, especially in Factory 1, is assessed to negatively impact the delivery performance at the company by preventing good coordination of material at the hub, prolonging lead times, and negatively affecting customer experience. Many improvement projects of the OTD process would not actually improve delivery performance due to the current low reliability. It is judged to be a bottleneck and the company should put significant efforts to enhance the reliability in Factory 1 before putting much effort into other enhancement projects. A new planning concept, improved IT infrastructure, or better organizational alignment would improve delivery performance only if the reliability was improved first. Low reliability at just one of the factories will always bring coordination issues at the hub which has shown to largely impact delivery performance.

How to go about reliability enhancement is outside the scope of this thesis. It is included in the listed improvements since it has such a big impact on delivery performance and future improvement possibilities, which was confirmed by the focus group. However, the company should initiate a project focusing on overcoming the reliability issues at Factory 1. It should start with a root-cause analysis to enable the relevant approach to deal with the issues. There have been some suggestions in the empirical findings that the issues are caused by problems related to raw material shortages. That could possibly be solved with a new inventory management strategy with increased raw material buffers or a new sourcing strategy with more reliable suppliers. Even when high reliability is achieved, it is suggested that the company continuously works with reliability enhancement and the maintenance of it in all factories and at all parts of the OTD process. On-time deliveries is a demand from customers and an important part of the suggested new strategic direction. It should therefore always be in focus.

The current factory reliability target of 95%, accumulating to a theoretical reliability at the hub of 81%, was judged to be too low to enable good coordination of components at the hub. The target should therefore be increased. It is difficult to assess what reliability would be required to achieve acceptable performance towards the customer. It depends on choices made to the design of other parts of the OTD process, requiring different levels of reliability. However, a precision of 95% at the hub for instance would require an individual reliability target at each of the three factories of $0.95^{1/4} = 98.7\%$, including some uncertainty in the shuttles to hub, see Figure 5.5.

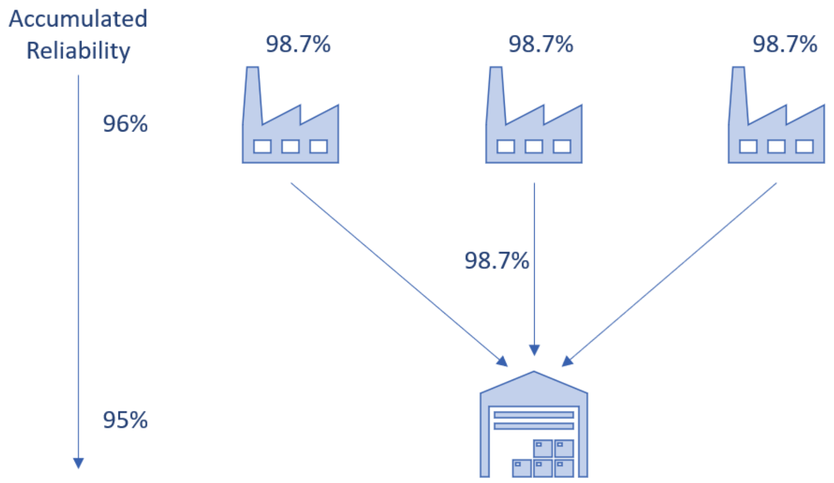

Figure 5.5*. Showing the accumulated reliability* in the OTD process assuming production reliability at 98.7%.

3. Create a process owner group

Several causes of low performance have been linked to organizational misalignment. For instance, silo-thinking and local optimization, a lack of trust between supply chain partners, and entities acting in their own self-interest have been discovered. The OTD process must be managed as a single entity with common goals and objectives. It is essential in achieving a high enough level of reliability to enable redesign of the planning concept. The problems that affect the OTD process, for example the low reliability at Factory 1, need to be seen as a collective issue, as this affects the performance of the entire distribution process.

The proposal is to create a process owner group, responsible for the OTD process and its future development. It should consist of a cross-functional team that oversees and is the owner of the whole process. This has several implications for addressing the causes of low performance. Firstly, the literature outlines that a silo-mentality can be broken down through greater collaboration and governance, specifically by employing a cross-functional team and creating joint incentives. Overcoming the lack of trust in the OTD process requires more communication between different stakeholders. One such example was the discovered extra buffer week in production to mitigate the effects of delays from factories 1 and 2. Enhancing relational integration also has positive effects on internal information sharing, further contributing to increased performance.

The cross-functional process owner group should consist of the following roles:

1. Supply chain director responsible for strategy
2. Managers from each of the three factories
3. Manager at the LSP
4. Sales representative
5. Installation planner

The group should remain small to be effective, while still touching on all points in the supply chain. The group should meet at least once per quarter, depending on the urgency of the current topics. The group should focus on the following activities:

1. Communicate and motivate the new strategic focus: The first task of the group will be to communicate and motivate the newly defined strategy and the objectives of the OTD process. That is important to create belief in the strategy and its suitability for the company. It is not possible to demand that the entities follow the strategy if they are not convinced that it is good. Therefore, the communication of the strategy is an important step in creating alignment throughout the organization.
2. Follow up and evaluate performance: An important task for the group should be to follow up on the performance of the OTD process and the individual entities every month and provide necessary feedback. That will be done by following up on the measures presented later in the new performance measurement system.
3. Initiate an IT infrastructure improvement project: The process owner group should put together the group that will conduct the project of improving the IT infrastructure, an improvement proposal presented later in the report. The process owner group will define clear goals and objectives of the project and requirements for what the IT-setup has to be able to perform in terms of what information should be available in different systems for instance.
4. Align the sales companies: The sales companies' different ways of working have been identified as a major contributor to changes and deviations to orders. The group should first begin to understand how different sales companies work. The easiest way to do this is to analyze individual sales representatives and create a pareto analysis of how they work with late changes and deviations. To begin aligning cultures, clear expectations need to be set for the sales companies. Furthermore, common principles for the sales companies to follow in order to achieve more unity across the OTD process need to be formulated.
5. Work for continuous improvement: Today, there is a lack of coordinated efforts to improve the process. Many individual entities provide good ideas for improvements, however, due to the lack of governance, these are rarely implemented. The group should work to continuously improve communication and trust within the organization by discussing potential improvements that are raised by the group members.

4. Improve the IT infrastructure

A large part of improving the performance of the OTD process requires the integration of different entities to enable better coordination. Integration issues have been identified as a cause of low performance in multiple areas of the OTD process. The measures for integration improvements in this section follow an approach combining three aspects. Firstly, following the framework presented in Figure 3.3, the logistics strategy guides the logistics information system design as well. As outlined, the logistics strategy should be focused on achieving high customer satisfaction through high reliability and good communication. The information system infrastructure and design need to be tailored specifically for this need. As outlined in the literature, IT improvements and information sharing are efficient ways to improve performance only if they are implemented correctly. Secondly, the choices of what to integrate should take the position of the CODP into consideration. An MTO flow requires customization, responsiveness, and flexibility which in turn require efficient customer communication. This also aligns with the strategy suggestions. Thirdly, integration improvements need to follow a cautious approach, as outlined in research, and subsequently confirmed by the focus group. Presented in the framework presented in Section 3.4.3, it is a critical aspect to ask the question “why not to share” along the more obvious question “why to share”.

The identified causes along with the literature on supply chain integration suggest that an objective should be to consolidate information systems and/or increase compatibility between them. That is essential to achieving integration and visibility in the OTD process and enabling a redesign of the planning concept. Further, it is in line with the opinion of Panwar et al. (2022), that technology-enabled integration is suitable in the post-pandemic world. Improved integration will reduce the need for manual intervention, reduce lead times, and improve the reliability and communication with customers. This has also been heavily emphasized in the literature as a core means to improve supply chain integration according to Mirzabeiki and Saghiri (2020) and Rai et al. (2006). The end results will be reduced supply chain costs and higher customer satisfaction. In the longer term, it will serve as a competitive advantage. As the company continuously acquires new companies, these need to be integrated into the existing structure either through onboarding with the ERP-system or building compatibility with their existing systems. Working toward this vision requires continuous improvements to the current process. Considering the strategy, CODP, and focus group findings, along with the identified causes, integration improvements are outlined on three verticals, internally, between the company and the LSP, and between the company and the customers. In the following part, improvements will be outlined for each of the verticals.

Internal integration

Measures to improve internal integration are primarily concerned with informational integration and operational integration. The objective of these improvements is to target the weaknesses found in the system and to develop them in line with strategy considerations. This means a focus on performance measurement IT activities, preparatory work for continued visibility for the LSP, and longer-term IT infrastructure planning:

1. Implement all necessary order statuses: In the current ERP-system used by the sales companies, all necessary order statues are not defined. In Figure 5.6 below all necessary order statuses are included (compare to Figure 4.5). The following order statuses should be added to create the necessary visibility of an order and its status: Production started (for each of the factories), production finished (for each of the factories), and shipped from hub. Furthermore, the statuses shipped to hub and arrived at hub should distinguish the statuses of components from the different factories. The added statuses are supposed to increase the visibility in the OTD process, enable better coordination and function as communication throughout the process. It is first when all factories have, for instance started production, that the status will switch to Production started. However, it will be possible to see the status of each of the factories as well, for example knowing that production started in Factory 1 and 2 but not in Factory 3.

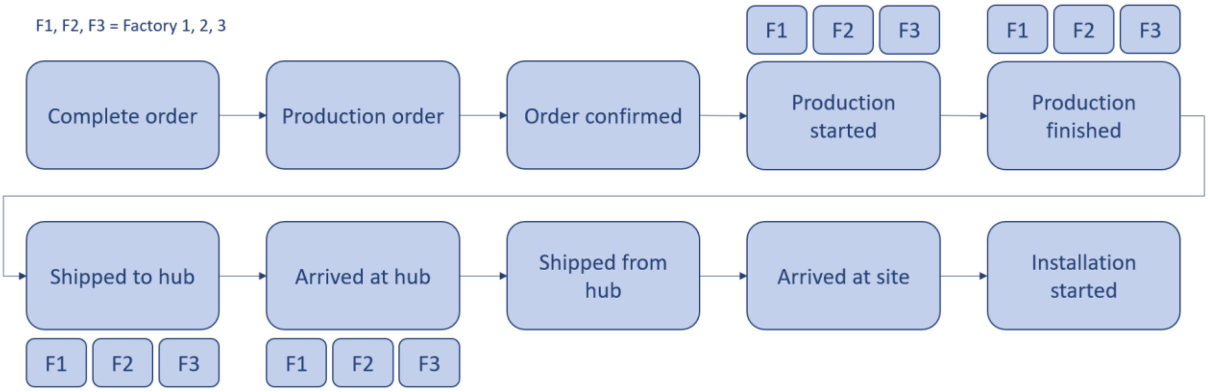

Figure 5.6. The suggested order statuses in the ERP-system.

2. Begin working to align production and logistics: Continuing the prior point, it is of high importance that there is high visibility between production and logistics. Since there is no additional storage capacity at the factories, once production has begun, any delays will per definition lead to holding time at the hub. To ensure this does not happen, the status for each of the different components at the different factories needs to be visible in the ERP-system. Each factory needs to communicate the expected delivery date to hub and notify of changes. For example, if an order is delayed at Factory 1, and production is delayed by a certain number of days, this information is visible to Factory 2 and 3, so they can change their own production plan to fit this new deadline.
3. Enable performance measurement: To successfully develop and implement an improved performance measurement system, the IT-setup must accommodate that. The first step in achieving this is connecting the ERP-system at factories 1 and 3 to the BI system. Moreover, the performance measurement system is highly reliant on the order statuses, along with the proposed additions. Status signal reliability therefore needs to be ensured.
4. Create a long-term plan for system consolidation: Initiatives at the company to onboard entities to the ERP-system have been shown to be a slow process. To make sure the long-term goal of consolidation and compatibility is achieved, the process owner group should create a clear IT infrastructure timeline, outlining the goals and progress for the entities in the OTD process. The timeline provides clarity and visibility and reduces uncertainty. It should be evaluated every quarter, to establish whether the planning remains on track.

Integration between the company and the LSP

The systems of the LSP are currently not integrated with the systems of the company and all communication is therefore made manually. Since they conduct transport planning, there can be large performance gains in sharing more information and enabling closer collaboration. The following improvement potentials have been identified:

1. Share customer coordinates with truck drivers: One easily solved improvement is adding additional support to truck drivers in the form of coordinates to the drop-off location. This reduces the costly returns of products to the hub. It will be achieved by adding the coordinates to the ERP-system which will automatically be shared with the LSP.
2. Share the height dimension: One aspect that is missing from the information provided to the LSP, which makes transport planning more difficult, is the lack of a height dimension. That will also be added to the ERP-system.

3. Calculate the number of collies associated with an order: Today, the number of collies in an order is unknown to the LSP before it arrives at the hub, which hinders planning. That can be solved by developing an algorithm that calculates the number of collies based on the order specification. It can easily be calculated by using historical data on order specifications and the number of collies that were needed.
4. System integration with the LSP: Longer term, assuming the prior suggestions are implemented, the company should work to enable system integration with the LSP, as opposed to the manual information sharing that occurs today. This could be achieved with a joint system between the two entities. Preferably, this system would work with other logistics service providers as well. The system would need to include information regarding the order number, order description, number of collies, order status, delivery date, dimensions, weight, end customer, delivery location and country, and special requirements. This information should be automatically transferred from the sales company's ERP-system. This enables the LSP to know the current status of all products that will arrive. The LSP can then communicate with the company using this system. By implementing automatic updates between the CRM-system and the ERP-system, direct changes to orders can be updated in the new system. This enables quick and seamless information sharing from customers, the company and the LSP. There are several benefits to this. Firstly, it solves the problem of the order status updates made through EDI-communication between the company and LSP being unreliable. Secondly, it enables transport planning to begin before goods physically arrive at the hub. Thirdly, it enables improved coordination, as the LSP and the company can work better to make sure orders are not delivered to the hub before being complete, assuming the previously discussed order statuses are added. This could greatly reduce the lead time at the hub. It also leads to changes being communicated faster. Lastly, it removes large portions of manual work that can be automated. In sharing more information between the two entities, it is of high importance that the correct information is shared. One way to achieve that is to utilize the framework for creating an information sharing strategy presented in Section 3.4.3 by Kembro et al. (2014).

Integration between the company and the customer
Following the expanded supply chain strategy with a larger focus on customer service, it is sensible to improve integration in all three dimensions: informational, operational, and relational. The following actions should be evaluated:

1. Guidelines for continuous follow-up with customers: To manage late changes made to orders, additional contact with the customer throughout the process is needed. It has been identified that customers can go up to two months without being contacted by the company, in which many changes of the delivery site, and consequently delivery window, can occur. It also leads to customers forgetting about orders, and not being ready for delivery when it occurs. If they get more updates, the risk that they want to change week decreases. Some changes will still occur, but most likely earlier than before reducing their impact on performance. One solution to this is to establish clear guidelines for how sales companies should work with continuous communication toward the customer. This needs to be standardized throughout all countries that are supplied by the hub. This improvement is highly connected to the governance and organizational alignment discussed prior. The first step in this process is to map how sales companies work with customer communication today and what guidelines are in use. The next step is to develop

guidelines, for example by contacting all customers biweekly. The information that should be provided is the order status and delivery date. An email template can be created to increase standardization. This initiative needs to be followed up, and the track record of each sales representative needs to be evaluated.
2. Implementing a track-and-trace system: A longer term solution to increase communication with customers is to implement a track-and-trace system. This has been emphasized in the literature as a core measure to improve supply chain integration. This should be paired with automatic updates to customers regarding their order via email every time the order status in the ERP-system changes. Providing visibility from order creation to delivery is also essential to improving customer satisfaction.

5. Design a performance measurement system

The proposed new strategy and objectives are to work as a foundation for the decisions made regarding the OTD process and should influence all activities. To make sure the strategy is followed and the objectives are achieved, a well-designed performance measurement system is required. With such a system, deviations from objectives can be detected early, enabling changes to be made to eliminate the causes. An identified issue was that the current knowledge of OTD process performance at the company is low. It is therefore difficult to understand, manage, and improve. The new performance measurement system should resolve the issues identified in Section 5.2 and follow the guidelines presented in Section 3.2. It should measure both effectiveness, referring to customer expectations, and efficiency, referring to how well company resources are utilized in doing that. The set of chosen measures together form the performance measurement system. The process of creating a performance measurement system can be divided into the three steps presented in Section 3.2 (Bourne et al., 2000):

1. The design of performance measures
2. The implementation of the performance measures
3. The use of performance measures

First, the company should define measures for the performance of the whole OTD process, closely connected to the strategy. The company should therefore have speed and reliability as overall performance measures for the OTD process. Those measures encourage behavior that supports strategy, are easy to use, and provide fast feedback and stimulate continuous improvement. The lead time should be measured from complete order to finished installation. The reliability measure should be defined as the fraction of orders delivered on first agreed and last agreed delivery date respectively, and not allow for an order to be delivered early. Unlike today, it should be judged on the ability to deliver on correct day, and not week. However, as long as the current planning concept is used, it is relevant to measure ability to deliver only within the correct week as well.

Further, measures for the different entities in the OTD process should be defined. The measures should incentivize the entities to support the common strategy and objectives of the OTD process. The factories should be measured on reliability (measured on daily level), average backlog time, and average production time. In order for the OTD process to deliver orders on-time and achieve high reliability towards customers, the coordination of components at the hub must work well. Thus, the factories must be able to deliver to the hub with high reliability. That is important for the overall efficiency of the OTD process, ensuring short lead times for all components at the hub and low levels of tied-up capital. The average backlog and production time measures are important in understanding which one of the factories is the bottleneck for lead time reduction. The factory with the longest average backlog time + average production time should be in focus if lead time is to be reduced. The two measures provide fast feedback and stimulate continuous development, particularly lead time reduction.

The sales companies in different countries should also have performance measures incentivizing them to support the common strategy. It is important that all sales companies are assessed individually since large differences in the way of working at different sales companies have been identified. It is proposed that all sales companies have the measures “fraction of orders without changes” and “lead lime between delivery and installation”. The first measure should be defined as the fraction of the total number of orders where the first confirmed delivery date is not changed by the customer at any stage of the OTD process. Late order changes have been identified as an issue affecting coordination and increasing lead times and tied-up capital. The measure is needed to incentivize sales companies to achieve good communication with customers by making sure the first date will really work for the customer and then regularly providing order status updates. The measure of lead time between delivery and installation is needed to incentivize installation planners to decrease that lead time, trying to plan installation as early as possible after delivery to customer site, without jeopardizing reliability.

The last entity to define performance measures for is the LSP. It plays an important role for activities from the hub and downstream until performed delivery. The planning and execution of last-mile delivery largely affects the total reliability to end-customer, and the LSP should therefore be assessed on its ability to perform that with timeliness. The LSP should have the measure reliability which should be defined as “the fraction of orders delivered to customer site on-time, of orders that are complete on-time at the hub”. Thus, the LSP should not be punished for deliveries that are late to the hub since it has no influence on that except for the factory shuttles.

Unlike today, the company should, apart from measuring internal operational efficiency, regularly measure and evaluate customer expectations and satisfaction on a country-level. The proposed new strategy is to focus more on the customers. It is important however that expectations and satisfaction are followed up on a regular basis to detect changes or deviations. If customer expectations change, it is important that the company acts on that rather than react to decreased satisfaction levels. That will be important to keep being relevant and competitive. Further, satisfaction should be a measure of how well customer expectations are met and is therefore measuring the OTD process’ ability to satisfy customers. More concrete, the sales companies should make surveys with customers assessing their satisfaction regarding the distribution process such as the reliability, lead time, cost, and communication quality. All measures should be made in each country since large differences between countries have been found. The surveys can be used to harmonize practices among different sales companies.

The work with implementing the performance measurement system, step two of the framework from Bourne et al. (2000), should be conducted along with improving the IT infrastructure at the company. The development of a new IT infrastructure must enable convenient and easy collection of data required to measure the performance dimensions presented in this section. Step three of the framework is to use the performance measures and assess the success of implementing the defined strategy as well as validating it. The process owner group plays an important part of that work. It should work with following up on measures and act if targets are not achieved. A visualization of the proposed performance measurement system can be seen in Figure 5.7.

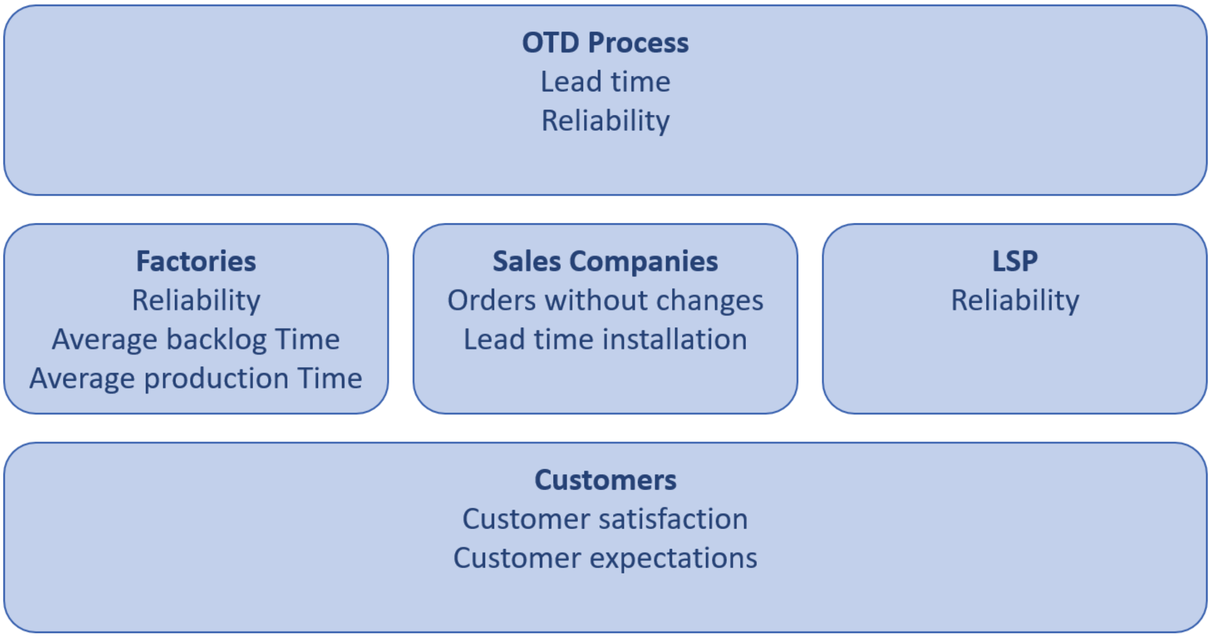

Figure 5.7. A visualization of the proposed performance measurement system for the company.

6. Redesign the planning concept

The planning concept was identified as a cause for low delivery performance by the authors and the focus group. However, it has not been assessed as the most urgent cause to solve since many other improvements would have to be made first. The theoretical lead time of the planning concept is approximately five weeks. However, other issues, which should be solved first, result in a forecasted lead time of 7.8 weeks. The previous improvement proposals presented in this section aim to solve many of those issues and thus reduce lead time to get close to the theoretical five weeks. When that has been done, the assessment is that there is potential for further lead time reduction by modifying the planning concept, achieving an actual lead time of even less than five weeks. The previously presented improvements are mainly supposed to enable information sharing and visibility required to improve the current planning concept and enhance coordination, see Figure 5.8.

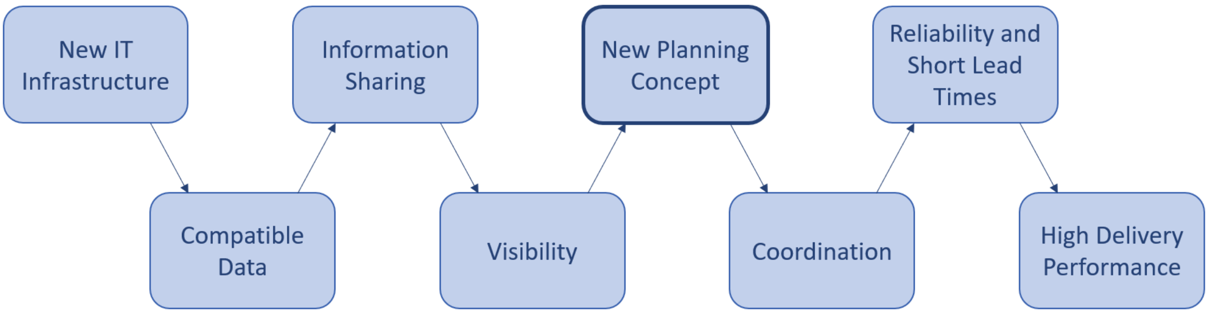

Figure 5.8. Showing the requirements before being able to implement a new planning concept and the desired results of it.

Based on identified issues related to the current planning concept, the new concept should have more than one deadline per week, use data and not only physical inventory position for last-mile delivery planning, and be more flexible. Furthermore, no suboptimizing exceptions from the concept should be made by individual factories. The concept should aim to enhance coordination of material, have sufficient but not unnecessarily large buffers, and thereby decrease lead times and increase reliability.

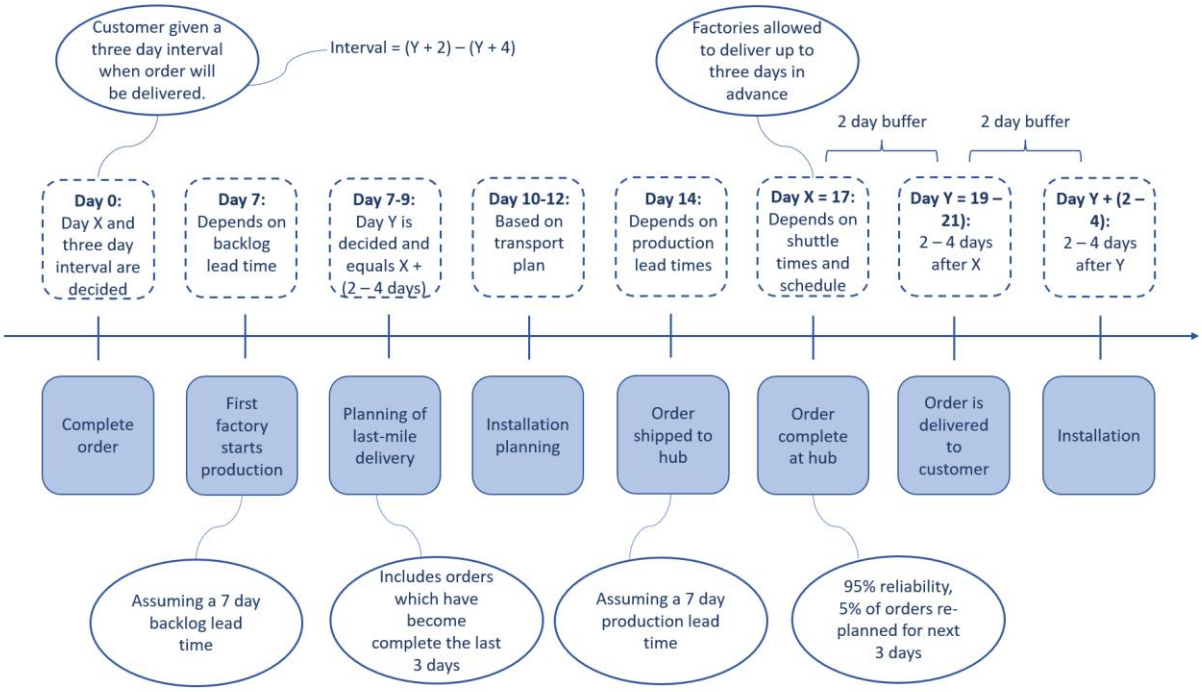

Figure 5.9. A visualization of the new proposed planning concept.

The new proposed planning concept is presented in Figure 5.9. Note that it is an example with the assumption of seven days backlog and production times respectively. A difference in backlog and production lead time with x days compared to the example above will change Day Y with x days. The main features and a comparison to the old planning concept are shown in Table 5.1 below.

Table 5.1. A comparison of main features of the new versus the old planning concept.

New concept	Old concept
Use days as unit	Use weeks as unit
Plan in three-day intervals	Plan in five-day intervals
Use data of future complete orders at hub	Use physical inventory only
Give customer exact delivery date 12 – 14 days in advance	Give customer exact delivery date 3 – 8 days in advance
Installation occurs 2 – 4 days after delivery	Installation occurs 7 – 12 days after delivery
Plan ahead in time from complete order to installation	Plan backward in time from delivery week to today
Theoretical lead time of approximately 25 days (assuming 7 days backlog and production lead time respectively)	Theoretical lead time of approximately 35 days

Below are descriptions of the different deadlines:

1. Complete order

The planning concept plans from the point an order becomes a complete order (Day 0). Then, the customer is given a five-day interval (only counting weekdays) when the order will be delivered. Based on that five-day interval, factories are given a day (Day X) when they must have delivered to the hub. The five-day interval depends on backlog and production lead times and could be described by the formula: $Day\ X = Backlog\ lead\ time + Production\ lead\ time + Shuttle\ lead\ time$, where the shuttle lead time is estimated to be approximately three days.

2. First factory starts production

Day X is decided by the factory with the longest $Backlog\ lead\ time + Production\ lead\ time + Shuttle\ time$. The factory which starts production first is the one with the longest $Production\ lead\ time + Shuttle\ lead\ time$.

3. Planning of last-mile delivery

Planning of last-mile delivery is done every three days (weekdays) and includes all orders which have had production started in the last three days (since last last-mile delivery plan). When the plan is made, the customer is given an exact delivery date, within the three days initially promised. Deliveries are planned to be done 2 – 4 days after the order is supposed to be complete at the hub, to have some margin.

4. Installation planning

Installation planning is also done in three-day intervals and follows right after transportation planning. Every three days, an installation plan is made for all orders that were included in the transport plan. The objective should be to plan the installation to be made 2 – 4 days after planned delivery, day Y.

5. Order shipped to hub

Depends on the shuttle lead time but must be performed so that components are complete at the hub at day X the latest.

6. Order complete at hub

The order must be complete at the hub at day X the latest, which is decided by backlog, production, and shuttle lead times. Factories will be allowed to deliver to the hub up to three days before X.

7. Order is delivered to customer

Should be performed 2 – 4 days after day X, when the order is complete at the hub. Thus, there is a two-day buffer to allow for minor delays.

8. Installation

Should be performed 2 – 4 days after day Y, when the order is delivered. Thus, there is a two-day buffer to allow for minor delivery delays.

The idea of the new planning concept is to plan ahead from when an order becomes a complete order to installation. Last-mile delivery planning should be done in three-day intervals, for all orders that have become complete since the last transport plan (three days ago). This will improve information quality by using more recent information. The frequency of the planning will therefore be higher than before, and weeks will not be considered as a unit. Everything will be planned in three-day intervals (with weekends excepted), sometimes ranging across two different weeks. For instance, Monday – Wednesday, Thursday – Monday, Tuesday – Thursday, and so on. Thus, small delays will not punish as much as before, and lead times will be shortened. The concept will consider data about orders that will be complete, rather than just orders that are physically complete at the hub. This will be enabled by the new IT-setup and improved visibility. A requirement for that to be possible is enhanced reliability, so that orders with approximately 95% certainty will be complete at the hub on day X. The concept, together with the other improvements, will shorten the lead time at the hub significantly which is more in accordance with the theory of CODP that no stock should be held in the downstream material flow. Furthermore, the new concept will allow for delivery date to be determined and communicated to customer earlier than today.

The improved information sharing and visibility that earlier proposals aim to achieve are supposed to enable earlier detection and communication of delays in the OTD process. Most delays will happen before the first factory starts production, i.e. during the backlog lead time. Then, all factories can still postpone the start of production and therefore, the delay does not have such a large impact on the OTD process in the terms of tied-up capital and costs. Delays will be communicated through the ERP-system and notify all factories so that they do not start production and thus prolonging the lead time at the hub. Day X and Y will be postponed and with customer requirements and production schedule considered.

The different days and deadlines are estimations of what would be reasonable considering the effect of other improvement proposals and general aspects of the OTD process. However, the deadlines must be evaluated and tested to make sure that they are reasonable. The concept can easily be modified by adjusting length of intervals or buffers to suit the OTD process and the reliability at different factories. The theoretical lead time with the new concept would be approximately 25 days assuming seven days backlog and production lead time. The three-day interval proposed must be assessed by weighing volume versus frequencies and costs of last-mile delivery. Perhaps, consolidation of transports of other product groups must be made to make it financially feasible to switch to a three-day interval.

5.5 Summary and Desired State

The roadmap with improvements presented in Figure 5.3 shows the proposed route of improvements that the company is suggested to take to achieve improved delivery performance. All improvement proposals are aimed to individually contribute to improved delivery performance. However, the objective is that the proposals collectively improve the delivery performance more than the sum of all individual improvements through synergy effects. The improvements will together move the company from the as-is state, presented in the Empirical Study, to a desired to-be state with improved delivery performance. The desired to-be state can be summarized as follows:

Firstly, the to-be OTD process will have a strategy with clearly defined objectives. It will have a large focus on the customer and customer experience and recognize the distribution of the product as a vital part of the whole order fulfillment process. The OTD process will be managed by a process owner group of stakeholders from all participating entities of the process. The group will first implement the newly designed strategy and objectives, which includes explanation and motivation as to why all entities should strive towards fulfilling the strategy. The group will then continuously meet to follow up and find potential for improvements of the process. Further, it will follow up on performance measures and evaluate different entities in achieving objectives. The performance measures will incentivize all entities to achieve the common strategy and objectives and therefore act in the best interest of the whole OTD process rather than the entity of its own. That includes the sales companies in different countries, which have common principles and rules of working. Parallel to this, a reliability enhancement project will be launched at Factory 1 to achieve the newly defined reliability targets.

The OTD process will have a well-designed IT infrastructure with, if not the same, at least compatible systems at all different entities. The systems infrastructure will support the information flow through the whole process and enable coordination and measurement. The information flow will create an OTD process which can be seen as one integrated process rather than many fragmented ones. The well-integrated OTD process enables good coordination of components at the distribution hub with an average lead time of three days. The customer is well informed during the whole OTD process, mostly through automatic emails providing updates about the order and its status. That will result in a lower number of changes to delivery requirements from customers.

Further, the newly designed planning concept will have sufficient buffers to achieve high reliability in the OTD process. Last-mile deliveries will be planned every three weekdays enabling short lead times at the hub. The planning concept will result in a total lead time of the OTD process of maximum 25 days, satisfying expectations from customers. The transport planner will utilize the visibility of the OTD process to plan orders ahead of their arrival at the hub. Customer expectations will continuously be evaluated in each of the countries to detect potential changes enabling redesign of the OTD process. The improved visibility and integration will result in automatic information flow between different entities and therefore no need for manual sharing of information. All necessary information will be available in all systems and the installation planner will be able to access it without human intervention.

5.6 Applicability of Improvements

The improvement suggestions present a logical approach to improve performance in the OTD process. However, the applicability needs to be discussed in order to increase the trustworthiness of the study. Beginning with the proposed strategy improvements, the biggest threat revolves around the practical implementation of the strategy in various parts of the supply chain. This requires iterative communication over a longer period. Regarding the practical development of strategy initiatives however, the applicability remains high. From the focus group this cause of low performance was ranked the lowest on complexity, further confirming this. The suggestion regarding enhancing reliability is highly applicable as well, due to its exploratory nature.

The creation of a process owner group is a tangible and clear solution, which should be easy to implement. The main restriction regarding this proposal is finding time for the already busy employees at the company. The willingness for improvement must be high from top management along with supply chain participants in order to ensure that the process owner group receives priority over other activities. Similar is the activities regarding an improved performance measurement system. Lack of willingness to implement it is the biggest barrier. Improvements regarding IT infrastructure are, as outlined in the literature, oftentimes difficult and not always successful. The primary way to manage that in this thesis revolves around a gradual effort of consolidation and standardization. The next strategy to is to focus integration efforts on the specific parts of the OTD process which needs improvement, with regards to the strategy decisions and the CODP. However, as seen in the focus group, IT infrastructure changes are still regarded as highly complex operations at the company. The long-term success relies on continuous iteration of the needs and capabilities of the OTD process, and clear top management support for these activities.

Lastly, the redesigned planning concept presents the most uncertainty in regards to applicability since there are many prior improvements required. The proposed changes are all built on the findings in the empirical chapter. However, other limitations which were not identified could present issues since the redesign of the planning concept presents changes in the entire OTD process, and tasks and activities could have been missed or overlooked due to its complex nature. Therefore, details which should be added to the concept could be missing.

6 Conclusion

The purpose of this chapter is to conclude the report by outlining how the purpose was fulfilled and how research questions were answered. It also explains how the report contributes to existing literature in the field, as well as how it contributes practically to the company and to the authors. Lastly, the limitations of the study and suggestions for further research are discussed.

6.1 Fulfilling the Purpose and Answering the Research Questions

The purpose of this thesis was to *develop improvement proposals for how the company can achieve improved delivery performance in the OTD process.* A four-stage design, beginning with the problem description, was utilized to answer this question. Through an abductive approach, literature was iteratively reviewed to develop an understanding of performance measurement and delivery performance, general logistics and distribution theory, and supply chain integration and coordination. Data was collected through interviews, documentation, and observations to develop a mapping of the OTD process and its current performance. Through pattern matching, nine causes were identified to have a negative impact on delivery performance at the company. With a focus group these causes were discussed and ranked to aid in the development of six key improvement proposals. The improvements were created through the findings of the empirical study, the theoretical background, and the practitioners' view through a focus group. Theoretically, the improvements could result in a lead time reduction to approximately 25 days and enhanced reliability of the hub to 95%. However, it is difficult to quantify the effects of proposed improvements since there are many uncertainties in the success of implementation.

To aid in fulfilling the purpose, two research questions were posed. The first research question was focused on understanding the low performance: *What are the causes of low delivery performance in the order-to-delivery process?* From the empirical study, a mapping of the process and its performance was done, outlining several clear examples of issues in the OTD process. By utilizing the mapping, nine causes of low performance were identified with the help of pattern matching, ranging from specific issues such as the planning concept to high-level issues regarding the strategy.

The second research question was concerned with understanding how to address the low performance and identified causes of it: *How can delivery performance be improved?* This question was answered through understanding the literature regarding improvements of delivery performance and comparing it to the practitioners' views obtained through the focus group and impact-complexity matrix. Several similarities and differences were identified, and the insights were utilized for the improvement proposals. Through the development of six improvement proposals the empirical and theoretical foundations were applied to outline clear directions for how delivery performance can be improved at the company. The proposals present a logical approach for how the company can transform the OTD process from its current state to an improved process in terms of reliability and speed. It was found that improvements to the strategy were needed to formulate appropriate goals. Further, reliability was identified as a limiting factor in the process. By creating a process owner group, governance and incentives can be utilized to align entities and continually improve the process. It was also proposed to develop a rigorous system for performance measurement to be able to accurately assess performance. The proposals culminated in the presentation of an outline of an improved planning concept for the OTD process.

6.2 Contribution

The contribution of this thesis is primarily a practical contribution to the case company and a theoretical contribution to research, which are outlined in the sections below. The thesis has also been greatly formative in the author’s own development as supply chain practitioners, by enhancing their understanding of supply chain management, particularly in the context of distribution and delivery performance.

6.2.1 Contribution to the case company

Through the as-is mapping, the case company is provided with a comprehensive understanding of the entire OTD process, which was lacking before. The models and frameworks explaining the process can be used as internal descriptions. Further, the causes behind the low performance are explained, and improvements on how to address the low performance are proposed. The implementation of which can lead to substantial delivery performance improvements, which itself lead to shorter lead times, reduced costs, increased reliability, and improved customer satisfaction. In turn, this enables the company to strengthen its competitiveness in the market. Furthermore, the improvement proposals, models and frameworks provided can be generalized and implemented for other product groups at the company as well. As many of the causes of low performance are based on culture and past strategy at the company, it can be assumed that OTD processes for other product groups face similar issues.

6.2.2 Contribution to research

Firstly, this master thesis contributes to the existing body of research on supply chain management by offering insights into improving delivery performance within a global manufacturing company, specifically ASSA ABLOY Entrance Systems. Using a case study methodology, the thesis explores the complexities and challenges associated with working holistically to achieve delivery performance in a large industrial company. Furthermore, it contributes to the existing body of research in being made in a post-pandemic environment with new challenges compared to the pre-pandemic environment.

Secondly, the research proposes a set of actionable strategies for improving delivery performance at the company. These strategies are grounded in the application of supply chain theory which was compared to the view of supply chain professionals. This comparison provides unique insight into perceived similarities between theory and practice in the area of delivery performance improvement. Lastly, by demonstrating the practical application of the improvement proposals in a real-world context, the thesis bridges the gap between theory and practice, offering a valuable reference point for future research aiming to apply similar strategies in other multi-national, MTO supply chain environments.

6.3 Limitations and Further Research

The master thesis main limitation relies in the methodology of utilizing a single case study. To understand how to improve delivery performance, it would have been beneficial to look at multiple large industrial companies in order to be able to develop broad generalizations. However, utilizing a multiple case study approach was not possible, as it would have entailed a much larger empirical investigation which would have required more time and resources. It would have been interesting to understand whether other companies face similar issues, and the reasons behind them. A smaller extension than a multiple case study would be to do a survey for other similar companies based on the findings surrounding ASSA ABLOY Entrance Systems, such as other large industrial Swedish companies. Another form of this would be to survey the direct competition of the company in order to gain specific insights into the market for industrial doors. These surveys were discussed in the early stages of the thesis but were decided against in favor of conducting focus group discussions.

The research can also be further extended to encompass the implementation of the improvement proposals. This would bring further validation to the suggestions's effect on delivery performance, which still relies heavily on theoretical knowledge in the area. Per its exploratory nature, the study does not go into detail regarding the specific implementation requirements. However, it could be a source of inspiration for further research, such as a specific investigation into breaking the silos at the sales companies, a rigorous investigation into the production issues at Factory 1, as well as the coordination issues in the hub. Further, the physical setup of the OTD process itself would be interesting to evaluate and improve. This could also be extended beyond the OTD process. One interesting aspect that was not investigated in this thesis is the consolidation of flows between the different business segments at the company.

One aspect touched upon in the thesis was the impact the position of the CODP has on delivery performance. It was, along with cost, outlined as being the only performance dimension affected by the CODP (Harfeldt-Berg & Olhager, 2024). For further understanding of this it would be beneficial to investigate companies with different CODPs, to evaluate how this affects supply chain configuration and planning.

An aspect hindering the work on the thesis was the difficulty in obtaining data on the performance of the OTD process. The lack of measures regarding especially lead times led to assumptions and less reliable data. It also hindered some investigative efforts, such as obtaining data regarding lead time at the hub. More quantitative data, and better access to information systems at the company would have enabled deeper analysis and comprehension. With enough data it would also be possible to test certain solutions, such as the improved planning concept, to better evaluate their viability.

It was also difficult to evaluate the planning concept of the OTD process. Although its identified negative effects on performance, the method of planning in weekly buckets was not well documented in the literature. Consequently, the opportunities and weaknesses surrounding planning granularity were difficult to assess from a scientific point of view. Research regarding the impact of operational planning concepts and delivery performance is much needed to further understand this relationship. Further, descriptive studies investigating the appearance of different operational planning concepts in different environments would be interesting to evaluate to gain further insights. Lastly, studies investigating the transformation to a higher level of granularity are needed for an accurate assessment of implementation regarding these activities.

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Appendices

Appendix 1 – General interview guide

Interview Guide: X

Interview purpose:

Understand the overall strategy and objectives of the x factory, important activities, planning routines, as well as opportunities of improvement.

Background:

Project: Master Thesis project in Supply Chain Management at Lund University, by Isak Idoff and Johannes Petersson, to be finished in June.

Scope: The order-to-delivery process of Overhead Sectional Doors (OHSD), including the three factories in x, y and z, limited to the w hub and its customers.

Objective: To propose changes for improved delivery performance of OHSD at AAES resulting in:

1. Shorter lead times
2. Lower costs
3. Increased reliability

Questions:

Background and overall strategy
Q1: Can you tell us about your role and responsibilities?

Q2: Could you tell us what you know about the history of the x factory and its connection with ASSA?

Q3: What do you produce in the factory except for track rails for OHSD? How large part of the production does OHSD make up?

Q4: What would you say is your overall goal when producing the track rails for OHSD? Low cost, short lead times, reliability?

Q5: Would you say that you apply any specific production strategy such as lean, agile, or similar?

Processes, activities, and systems
Q6: Do you have inventory of all components to produce the track rails?

Q7: Could you walk us through the process from when you receive a production order from x to when the track rails are delivered to the w hub? We want to know about both the physical- and information flow.

Q8: How does the shuttle to w work? Frequencies, volumes, planning, and responsibility?

Q9: How are the different activities and steps coordinated/planned?

Q10: What systems and applications are used at different steps to support activities and

Improvement opportunities
Q11: What KPIs do you use to measure performance?

Q12: Are you satisfied with the reliability that you have had in production during the last years?

Q13: What are the most usual reasons for disruptions and delays in production at the x factory?

Q14: What weaknesses of the current processes related to OHSD have you identified?

Concluding question
Q15: Do you have anything to add that will help us in the work with this project? Any specific people we should talk to? Any documents to share?

Appendix 2 – Survey

Possible causes of low delivery performance

After outlining 10 possible causes of low delivery performance, we want to get the "practitioners view" of their respective impact on delivery performance, to be compared to literature. The form consists of 10 questions.

The problem areas is ranked on "Impact on Performance" - how much it affects supply chain performance negatively, along with "Difficulty to improve" - how much it would cost in time and money to improve.

You do not need to overthink your answers, simply use your knowledge of the supply chain and go with your instincts as a practictioner!

Complex physical setup

The physical setup of the OTD process has been identified as a reason of low delivery performance. The fulfillment of the products to customers is achieved through production of parts at three different facilities, which are consolidated and sent to customers through a hub. The complexity itself isn't necessarily problematic, but due to poor coordination and information sharing, it remains a significant hindrance to improved performance.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Strategy issues

The main issue identified related to strategy is that there seem to be no common supply chain strategy or clear goals and objectives of the OTD process for the product. When asking different stakeholders, different perceptions of the supply chain strategy were presented

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Low reliability in HHW Factory

A consequence of the physical setup with three different factories is that low reliability at just one of the factories, in this case Factory 1, results in low reliability for the whole OTD process. The low reliability makes it difficult to coordinate the material flows at the hub and results in low trust at other entities of the process towards Factory 1.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Local optimization (Silo-thinking)

There are several instances of silos in the supply chain. The sales companies have been identified as not having a standardized way of working, which creates local optimization for each unit. It has been seen that many offer extremely high levels of flexibility towards customers and allows changes without considering the entire supply chain.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Fragmented IT-setup

The IT-setup for the OTD process uses multiple systems for different purposes, which often is not compatible with each other.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Insufficient planning concept

The concept of only having one deadline per week for orders to be complete at the hub negatively affects the delivery performance in different ways. Firstly, it automatically leads to lead time and tied up capital. Another implication of having just one deadline per week is that all delays punish hard. A one-hour delay on the Wednesday can lead to one extra week at the hub.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Poor communication with customers

There are three main issues related to the company’s communication with customers:

1. Late communication of exact delivery day
2. Lack of order status updates and long period of no communication
3. No integrated system to communicate with customers

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Lack of information sharing

The quality of the data in the OTD process is often lacking. One example of this is unreliable and missing signals from the LSP to the company. Another is a lack of information towards installers, which sometimes are not notified of changes to delivery dates, and truck drivers face similar issues regarding drop-of point and locations

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○

Insufficient performance measurement

It has been identified that the company is not measuring the lead time of the OTD process and does not have relevant measures of reliability. The only measure related to lead time that has been collected is the average lead time at the hub, namely 22 days. Production lead times or lead time of the whole OTD process are not measured. Regarding reliability, the factories report the percentage of orders delivered to the hub the correct week on a monthly basis to the company.

	1	2	3	4	5	6	7
Impact on performance	○	○	○	○	○	○	○
Difficulty to improve	○	○	○	○	○	○	○