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DEVELOPMENT OF A PERFORMANCE MEASUREMENT SYSTEM FOR THE EVALUATION OF LOGISTICS SERVICE PROVIDERS

ABSTRACT

Jonni Vanhalakka: Development of a performance measurement system for the evaluation of logistics service providers
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Logistics is a key part for companies in the manufacturing industry because manufactured products must be efficiently transported to customers. The development of logistics should not be forgotten because logistics contributes the value creation for customers. Product transport must be carried out on the terms of a customer so the customer can optimise its processes in the best possible way, in which case the value chain created by the supplier and customer can compete against value chains created by other companies. The measurement and reporting of logistics operations contribute to logistics transparency, making it possible to develop logistics according to a company's strategy. The research aims to develop a unified performance measurement system for the case company, which can be used to develop the case company's logistics according to its strategic goals. The logistics performance measurement system needs to be able to guide the operational activities of logistics towards the case company's strategy.

This research can be divided into two parts, which are the literature and interview research. Pragmatism, which emphasises the practicality of knowledge, is used as a research philosophy in the research, to which abductive reasoning in the creation of theory is naturally connected. The research strategy is a case study, which aims to investigate the phenomenon in depth in a certain environment. Qualitative research material was collected through semi-structured interviews and workshops. As a result of the literature research and qualitative data analysis, the most important success factors of the case company were identified for the development of the performance measurement system.

The research begins with the literature research, which was used to thoroughly understand the operating environment of the case company. In addition, the literature research provided a performance measurement system implementation model, which was applied to the case company. With the help of literature research, interview structures were developed, which were used to recognise the needs of both internal and external stakeholders of the case company. Draft performance measurement dashboards were created, which were tested in workshops and presentations with the case company. The material obtained from the workshops and presentations was used to guide the development of the dashboards toward the strategic goals of the case company's logistics. The case company had an ongoing project, which purpose was to increase transparency in logistics processes. The project offered a new opportunity for research because the information provided by the project was not available before. Not all the measurement success factors identified in the research could be implemented so research is still needed in the future. The challenges of implementation were related to the manual work in the logistics processes, which would be required in collecting and using measurement data.

The research proves that it is important to use the available tools and frameworks when implementing a performance measurement system. An implementation framework can break down the implementation goals into smaller sub-goals so that nothing is left undone with the main goal. A company's measurement goals must always be dealt with on a case-by-case basis. The objective of a performance measurement system is to support the company's strategic goals, in which case implementation models and frameworks must be applied in the operating environment of the company. In addition, the research emphasises the importance of sharing information and knowledge so that logistics processes can be systematically developed.

The research developed a system for measuring the performance of the logistics service providers used by the case company. A total of four dashboards were created and these were uploaded to the case company's server where using the dashboards is agile.

Keywords: Logistics service providers, performance measurement, dashboard

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

TIIVISTELMÄ

Logistiikka on tärkeässä roolissa valmistavan teollisuuden yrityksissä, koska valmistetut tuotteet tulee kuljettaa asiakkaille mahdollisemman tehokkaasti. Logistiikan kehittämistä ei tule unohtaa, koska logistiikka osaltaan parantaa arvon luontia asiakkaita kohtaan. Tuotekuljetukset tulee toteuttaa asiakkaiden ehdoilla, jotta asiakas pystyy optimoimaan omaa toimintaansa parhaimmalla mahdollisemmalla tavalla, jolloin toimijoiden luoma arvoketju pystyy kilpailemaan muiden yrityksien luomia arvoketjuja vastaan. Logistiikkatoimintojen mittaaminen ja raportointi edesauttaa logistiikan läpinäkyvyyttä, jolloin logistiikan kehittäminen yrityksen strategian mukaan on mahdollista. Työn tavoite on kehittää ja luoda kohdeyritykselle yhtenäinen suorituskyvyn mittausjärjestelmä, jonka avulla kohdeyrityksen logistiikkaa voidaan kehittää yrityksen strategisten tavoitteiden mukaisesti. Logistisen suorituskyvyn mittausjärjestelmän on tärkeä pystyä ohjaamaan logistiikan operatiivista toimintaa kohti kohdeyrityksen strategiaa.

Tutkimus voidaan jakaa kahteen osaan, jotka ovat kirjallisuus- ja haastattelututkimusosa. Tutkimuksessa käytetään tutkimusfilosofiana tiedon käytännöllisyyttä korostavaa pragmatismia, johon abduktiivinen päättely teorian luomisessa luonnostaan liittyy. Työn tutkimusstrategiana on tapaustutkimus, joka pyrkii tutkimaan ilmiötä syvällisesti tietyssä toimintaympäristössä. Laadullinen tutkimusaineisto kerättiin puolistrukturoiduilla haastatteluilla ja työpajoilla. Kirjallisuuskatsauksen ja laadullisen aineiston analysoinnin tuloksena tunnistettiin tapausyrityksen tärkeimmät menestystekijät mittaamisen kehittämistä varten.

Tutkimus alkaa kirjallisuustutkimusosalla, jonka avulla pyrittiin ymmärtämään kohdeyrityksen toimintaympäristöä perusteellisesti. Lisäksi kirjallisuustutkimus tarjosi suorituskyvyn mittausjärjestelmän käyttöönottomallin, jota lähdettiin soveltamaan kohdeyrityksessä. Kirjallisuustutkimuksen avulla laadittiin haastattelupohjat, joita käytettiin kohdeyrityksen sekä sisäisten että ulkoisten sidosryhmien tarpeiden kartoittamisessa. Saadun aineiston pohjalta luotiin luonnosmittaristot, joita testattiin kohdeyrityksen kanssa käydyissä työpajoissa ja esittelyissä. Työpajoista ja esittelyistä saatua aineistoa käytettiin ohjaamaan mittaristojen kehittämistä kohti kohdeyrityksen logistiikan strategisia tavoitteita. Kohdeyrityksellä oli käynnissä projekti, jonka tarkoituksena oli lisätä läpinäkyvyyttä kuljetusprosesseihin. Projekti tarjosi tutkimukselle uudenlaisen mahdollisuuden, koska projektin tarjoamaa tietoa ei ollut ennen saatavilla. Kaikkia tutkimuksessa tunnistettuja mittaamisen menestystekijöitä ei voitu toteuttaa, jolloin tutkimusta tarvitaan vielä tulevaisuudessa. Haasteet liittyivät pääsääntöisesti prosesseissa olevaan manuaalisen työhön, jota vaadittaisiin mittaustiedon keräämisessä ja hyödyntämisessä.

Tutkimus osoittaa, että suorituskyvyn mittaamisen käyttöönotossa on tärkeä hyödyntää tarjolla olevia työkaluja. Käyttöönottomalli pystyy pilkkomaan käyttöönoton tavoitteet pienempiin paloihin, jolloin tavoiteltavasta kokonaisuudesta ei jää mitään tekemättä. Yrityksen mittaamisen tavoitteita pitää käsitellä aina tapauskohtaisesti. Suorituskyvyn mittaamisen tavoitteena on tukea yrityksen strategisia tavoitteita, jolloin käyttöönottomalleja on sovellettava kohdeyrityksen toimintaympäristössä. Lisäksi tutkimus korostaa tiedon jakamisen tärkeyttä, jotta logistiikan prosesseja voidaan kehittää systemaattisesti.

Tutkimuksessa saatiin kehitettyä kohdeyrityksen käyttämien logistiikkapalvelutuottajien suorituskyvyn mittaamiseen tarkoitettu järjestelmä. Yhteensä neljä mittaristoa syntyi ja nämä ladattiin kohdeyrityksen palvelimelle, jossa mittaristojen käyttäminen on ketterää.

Avainsanat: logistiikan palvelutuottajat, suorituskyvyn mittaaminen, mittaristo

PREFACE

This research aimed to create something concrete that would help the case company on a practical level. The goal was achieved. This research was done for SSAB and its logistics organisation. The research started in February 2022 and lasted until July 2022. This has been a long and educational journey during which I have learned a lot. Logistics can offer many interesting opportunities.

I would like to express my gratitude to everyone who participated in this research process. Thanks to SSAB, which was able to provide me with this research topic. Thank you to all participants in the interviews, without you this research would not have been completed. Special thanks to Heikki and Petteri, it was nice and easy to work with you. I was able to tell you things very easily, which helped in conducting the research. You also provided logistics knowledge that is not taught in school. In addition, I want to thank my thesis instructors Heikki Liimatainen and Erika Kallionpää for their advice and instructions for the research.

Finally, I would like to thank my family and friends for their support and interest in my research. You listened and encouraged me to continue when challenges were faced. The research is over, but the learning is not.

Tampere, 31 July 2022

Jonni Vanhalakka

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ABBREVIATIONS

BI	Business Intelligence. An organisation that seeks competitive advantage from data, information, and knowledge
BU	Business Unit. An organisational structure that produces revenues and is responsible for the costs
CSF	Critical Success Factor. An aspect that is meaningful for a company's efficiency and performance
EDI	Electronic Data Interchange. A standardised format that is used to interchange business information
ERP	Enterprise Resource Planning. A type of software that organisations use to manage daily business activities
ETA	Estimated Time of Arrival
IS	Information Systems
IT	Information Technology
KPI	Key Performance Indicator. A measure of performance for a specific object that is essential to a company's business
LSP	Logistics Service Provider
PMS	Performance Measurement System
ROI	Return on Investment. A measure that is used to evaluate the profitability of an investment
SCM	Supply Chain Management
TMS	Transportation Management System. A type of software that organisations use to manage logistics activities
XML	eXtensible Markup Language. A markup language that is used for storing, transmitting, and reconstructing data

1. INTRODUCTION

1.1 Research background and motivation

Technology is used to gain a competitive advantage in the manufacturing industry by improving the quality of products and services. However, the manufacturing industry often has an urge that the produced products need to be transported to customers. Logistics development can be easily neglected because the value of logistics is indirect and thus more difficult to be aware of. The results of logistics developments are lowering costs, faster delivery times, and an overall better customer experience. According to Rajahonka and Bask (2016, p. 729), LSPs (logistics service providers) can offer innovative ideas to contribute to the development of logistics chains. Thus, collaboration is an important aspect when end customers' experienced value is wanted to be increased.

Li (2011, p. 65) proved that collaborative communication will enhance commitment and understanding between supply chain partners. Li continues how collaborative communication is essential to make all supply chain members strive for the same goal. Thus, a manufacturer (who is buying logistics services from LSPs) must acknowledge the performance of supply and logistics chains. Logistics chains' performance can be monitored with data, which is provided by the used LSPs. Also, manufacturers have their own supply chain IS (information systems), which collect data from logistics operations (Olson, 2014). Each member of a supply chain has its own IS, but the real question is how the supply chain's produced data can be directed to the development of the supply chain. Olson (2014, p. 16) describes two main benefits of IS in a supply chain. The first is data sharing among supply chain members, which creates opportunities to develop the efficiency of the supply chain. The second is real-time information, which can help in supply chain decision-making.

The case company of this research has established a centralised data cube, which collects data from different processes (e.g., sales and logistics). The centralised data cube enabled the possibility to build a PMS (performance measurement system), which would aid the case company's logistics development and decision making. The developed PMS also would assist to align LSPs' processes toward the case company's vision. The PMS would be used as a monitoring tool that ensures the wanted outcomes from the logistics processes of the case company. The dashboard would also benefit the LSPs because it will make the logistics relationships more transparent. According to Kilibarda et al.

(2016), LSPs' customers are more satisfied when they have developed relationships or partnerships with them.

According to Papakiriakopoulos and Pramatari (2010), the literature provides frameworks for implementing a PMS but the literature is often lacking practical guidelines for the implementation. For example, Kennerley and Neely (2003) recognised trends that positively affect the implementation of a PMS and these trends in the literature provide the foundation for this research. In addition, Parmenter (2015) and Lönnqvist et al. (2006) provide wide frameworks to establish the background for an efficient PMS. The framework created by Lönnqvist et al. (2006) is used in this research to find out the wanted CSFs (critical success factors) that are essential in the background for the working PMS. This research will narrow the gap between literature and practice in the aspect of implementing a PMS.

The research's case company is SSAB Europe. SSAB Europe is a global steel company, which produces plate, coil, and pipe products. The research is made for the case company's logistics department, whose responsibilities include maintaining the operations of logistics chains at a strategic level. The logistics department is responsible for concluding the logistics agreements, and the development of the used logistics chains. The case company has multiple manufacturing plants in the Nordic countries, and this research will use their data to create a PMS.

1.2 Objectives of the research

The case company expects to get a tool, which can provide objective results from LSPs' performance. Currently, the case company doesn't have an agile way to monitor the logistics performance. Thus, different styles of calculations and visualisations are made by hand in the current situation, which is not a resource-efficient way. The case company wants to have a way to check the logistics operations' big picture. Logistics activities in the big picture can help the case company to investigate how well different development projects have an impact on the overall logistics performance.

The target of this research is to make a PMS that will be uploaded to the case company's server. The server enables the usage of the PMS via a web browser. The dashboard should be interactive so users can investigate dependency relationships on their own. Visualisation is important because plain data is already available, but the visualisations of the data are lacking. The case company acknowledges that they have a lot of data available, and not all the possibilities created by the data are known. This research also

tries to discover the possibilities that the available data can offer to the case company's logistics operations.

This research is limited to the case company's external logistics operations. The external logistics are handled with a wide scope (e.g., truck and ocean transportation). However, there is a limitation that data which is available now is used in the development of the dashboard. If needed data is not available, the plans to get this data are opened in this research's discussion chapter. There was no time to plan and create integrations to get the needed data for the visualisations.

In this research, there are one main research question and four supporting sub-questions. The sub-questions support answering the main question. All the questions will be answered during the research. The main research question is answered mainly during the analysis part of the research. The sub-questions are dealt with in both the literature review and empirical analysis. Based on the research problem, the **main research question** is:

How can a performance measurement system be developed and used efficiently to evaluate logistics service providers operationally?

The main research question captures the fundamentals of establishing a PMS. The word "efficiently" is added there so the PMS operating logic would be simple enough so that users know how to use it. The PMS should address those aspects that are recognised to develop the case company's logistics processes. The PMS will handle historical operational data from the logistics activities. Thus, the PMS will not try to predict processes' outcomes but analyse the actual happened logistics activities. The **research sub-questions** to back up the main research question are:

1. What is being measured in the case company's logistics now, and how is this data used?

2. How logistics service providers can be evaluated?

3. How to develop a logistics-related performance measurement system for a company operating in a steel manufacturing business?

4. What is the current logistics situation of the case company and how does it affect the creation of a performance measurement system?

The sub-questions split the main research question into smaller pieces, which are easier to approach. Because of this, a comprehensive answer to the research problem is obtained, and nothing important is forgotten. Selected research methods to answer the research problem and questions are opened more deeply in Chapter 4.

1.3 Structure of the research

The research has two main sections, which support each other. The first section is the theoretical study and the second is the empirical study. The theoretical study aims to establish the foundation for the empirical study so the answer to the main research question can be developed. The empirical study will mainly answer the main research question, and the PMS for the case company is developed in that section.

The second and third chapters are focused on the theoretical study of this research. The second chapter deals with performance measurement and how a PMS can be developed so it supports an organisation's strategy and vision. The third chapter covers a supply chain and its management. This chapter tries to find aspects of the literature that could be used in a PMS to gain a logistics advantage.

The fourth chapter opens the research methodology and reveals the background choices made by the research author. The chapter will cover the research design (e.g., philosophy, methodological choice, research strategy, and data collection and analysis) and how the overall research process was done from start to finish.

The fifth chapter expands the case company's current state. It will cover the current logistics-related processes, so the development need is understood. Firstly, the research question's impact on the case company's vision is introduced. Then, the logistics chains and the data collected from them are covered. The internal and external stakeholders are described so the ongoing developments can be understood. Finally, the evaluation of LSPs is addressed, and how it is conducted now.

The sixth chapter is the analysis and results of the empirical research, and it aims to the development of a logistics performance system. The development process is opened, and the developed PMS is introduced in this chapter. This chapter follows the framework from the literature, so the selected choices are justified.

The seventh chapter is the discussion of the research. This chapter reveals CSFs that were not able to be implemented in the PMS. The chapter opens with how the PMS should be used as a management tool and what kind of development projects are coming and how they will affect the usage of the PMS. The eighth chapter reveals the key findings from the research and all the research questions are answered clearly. Also, the research process' criticism and limitations are open and how the research's results can be used in future research.

2. PERFORMANCE MEASUREMENT

2.1 Performance measurement in general

Measurement enables learning from the past and this can be used to improve performance and achieve better predictability in the future (González et al., 2010, p. 115). In the context of logistics, managers need options to monitor progress, and this can be achieved with reliable performance measures (Waters, 2003, p. 16). Measuring also reduces operational costs and drives revenue growth, hence fortifying shareholders' value (Keebler and Plank, 2009, p. 786).

Measuring helps to understand logistics activities and risks, predict outcomes, manage risks, enable more reliable deliveries, and gain proactive management in crises avoidance (González et al., 2010, p. 115). Waters (2003, p. 16) adds that when organisations are improving logistics, appropriate measures are needed to judge the changes in the logistic processes. Waters continues that finding proper measures is challenging, and therefore often neglected.

Organisations need to start developing their capabilities to assess, manage, and control environmentally friendly performance in response to external demands, such as stricter regulations and increased customer pressure (Björklund et al., 2012, p. 29). Managing and controlling will have a positive effect on the delivery of the products and customer satisfaction, both of which are at the core of the business (González et al., 2010, p. 115). According to Anand et al. (2015, p. 136), measurement can be used to benchmark organisations' current levels of daily activities against the best-in-class performers.

As stated above, the benefits of a PMS are great for overall business and development. The case company acknowledges this, and the benefits of the PMS are the reason why this research was wanted in the first place. The case company have already established methods to measure and collect data. Still, the case company recognises that there are possibilities where the collected data could be used to gain a competitive advantage.

2.2 Key performance indicators in general

People often use the terms "KPIs (key performance indicators)" and "metrics" to mean the same thing, but unfortunately, they indicate different entities (Kerzner, 2017, p. 121). KPIs strive to progress toward the company's strategic goals and metrics are measurements of the company's overall business (Perez, 2021). According to Anderson (2015, chap. 6), KPIs are the highest-level measures that are linked to the company's strategy,

and therefore to the vision. Anderson continues, how KPIs help to keep the business going in the planned direction. KPIs can be also used in an informative way. KPIs are the main indicators that managers use to enlighten their decisions in the context of business (Bishop, 2018, p. 21). KPIs can be used at the individual level, within teams or departments, or at the overall business level ("The Difference Between Measures, Metrics and KPIs," n.d.).

Parmenter (2015, p. xv) argues that there are three major benefits in the usage of KPIs, which are the alignment of daily actions and the CSFs of the organisation, the improvement of the organisation's performance and the creation of wider ownership. Studies have indicated that organisations have too many KPIs and the number of those in an organisation needs to be reduced (Elzinga et al., 2009, p. 509; Shahin and Mahbod, 2007).

KPIs guide daily activities so the strategic objectives can be met. KPIs produce information about how operational-level procedures are executed. (Parmenter, 2015, p. xvii) As visualised in Figure 1, KPIs can be used to guide daily activities towards strategic objectives. Using KPIs is not straightforward because organisations may struggle to use performance information efficiently to improve their actions (Elzinga et al., 2009, p. 510). Franco and Bourne (2003 and 2005, according to Elzinga et al., 2009, p. 510) have named this phenomenon as "knowing-doing gap" and it describes the gap between organisations that manage through performance measures and organisations that do not.
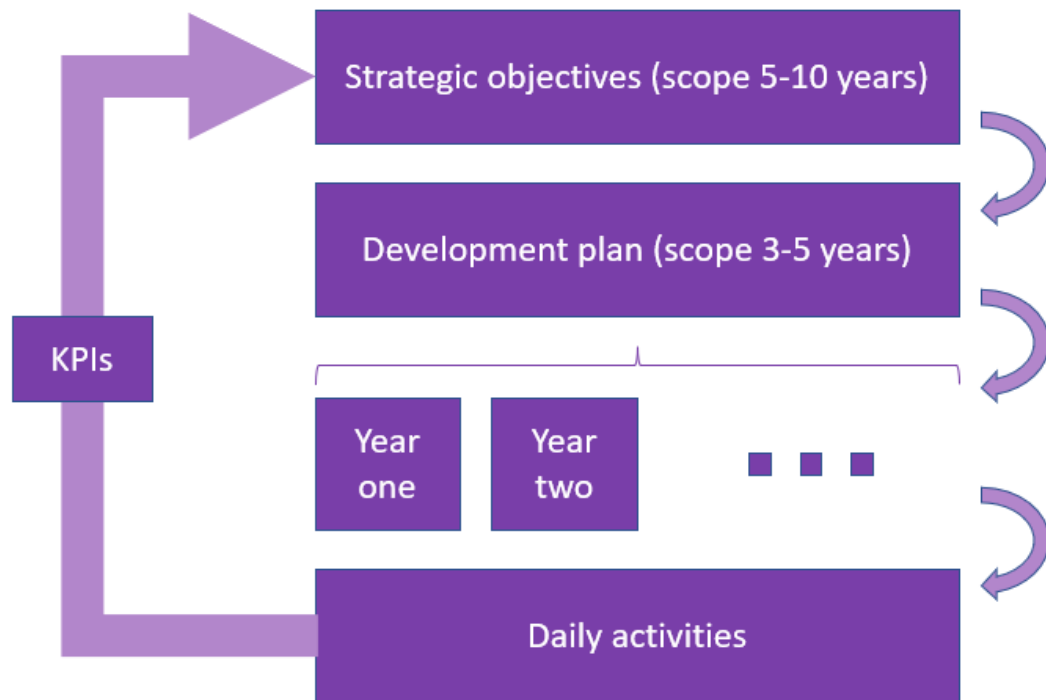
Figure 1. KPIs in the context of strategic objectives (Adapted from Parmenter, 2015, p. xvii)

The case company wants to have KPIs that will guide the daily activities towards strategic objectives, as demonstrated in Figure 1. Thus, the wanted PMS would provide an easy way to monitor the current direction within logistics operations. A more detailed analysis of the case company's logistics would be conducted differently, but with the help of a PMS, the workload of the detailed analysis could be reduced.

Increasing information overload creates complexity for finding essential KPIs (Podgorski, 2015, p. 148). Parmenter (2015, p. 101) points out that many organisations that have used KPIs have found out that the KPIs make little or no difference to overall performance. He continues that it is often since organisations start immediately implementing KPIs without preparation or planning.

2.3 Critical success factors

Boynton and Zmud (1984) point out that CSFs are objects that must be successful to ensure a favourable outcome for an organisation (according to Jalonen and Lönnqvist, 2011, p. 211). According to Ram and Corkindale (2014, p. 152), CSFs provide a systemic way of thinking that helps to identify the key areas, which require the attention of management to achieve business goals. CSFs can be economic, physical, or immaterial factors (Lönnqvist et al., 2006, p. 109).

Every organisation has its definition of CSFs because every company has different customers, different requirements for making business, and different stakeholders to do a collaboration with (Kerzner, 2017, p. 107). CSFs can vary in different situations (Ram et al., 2013, p. 169; Ram and Corkindale, 2014, p. 166). For example, the implementation of a project and the project's output performance are separate operations and should be measured as such. Therefore, there is a need to identify and separate different goals for different stages of doing. (Ram et al., 2013, p. 169)

CSFs are used to monitor the result of the processes. Metrics and KPIs measure the quality of the processes used to achieve the CSFs. CSFs are generally wider objects that consider the whole organisation or company, and therefore, they are difficult to track. Metrics and KPIs tend to be more specific, and therefore, more suitable for measurement. (Kerzner, 2017, p. 108) Ram and Corkindale (2014, p. 153) add that it is important to empirically establish CSFs as critical, rather than just acknowledging them. When the CSFs are established, all personnel of the company know how to align their daily activities with them.

One of the main goals of this research is to recognise the case company's CSFs in the logistics processes. The case company's logistics CSFs are very important so a developed PMS would answer those goals that the case company is striving for.

2.4 Implementation of performance measurement in general

The main idea of developing a PMS is divided into three entities, which are the planning phase, deployment of the PMS and using the PMS as a part of management operations (Hannula, 2002, p. 14; Lönnqvist et al., 2010, p. 120). There should be an urge at the organisational level for a PMS, and therefore the PMS project should not be conducted if there is no need for it (Lönnqvist et al., 2006, p. 105).

According to Lönnqvist et al. (2006, p. 100), the workload of developing a PMS is divided differently, and this is visualised in Figure 2. The first step in a planning phase and its purpose is to determine why PMS is needed and what are the project's goals (Hannula, 2002, p. 15; Jääskeläinen et al., 2013, p. 26). The planning phase can be seen as a learning process that includes meetings addressing personnel points of view about measuring needs (Lönnqvist et al., 2006, p. 100). The need for PMS can be, for example, a problem within business processes that need measured information to be solved (Jääskeläinen et al., 2013, p. 26). A deployment phase demands a lot of resources since there is a critical need for a thorough and practical plan for the implementation and execution of this plan. Resource utilisation will become steady in the usage phase when

personnel get used to PMS and the processes around it will become routine. (Lönnqvist et al., 2006, p. 100)
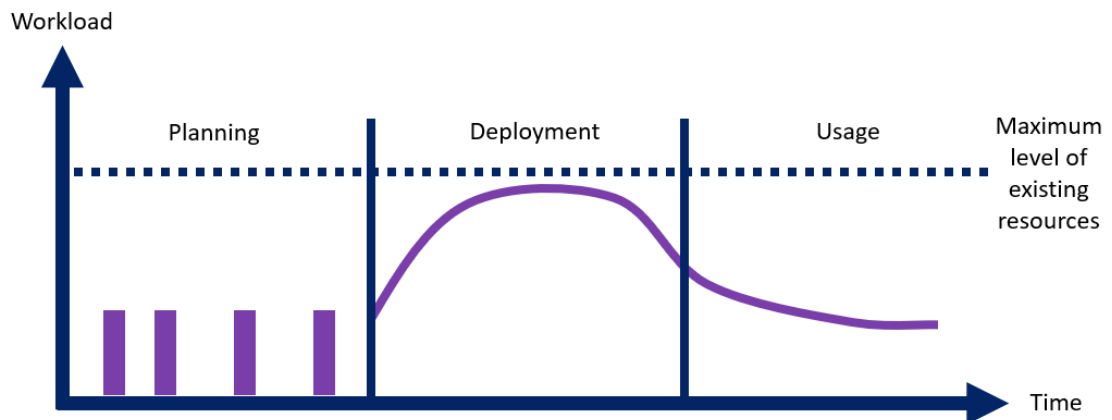
Figure 2. The workload of developing a performance measurement system (Adopted from Bourne 2003, according to Lönnqvist et al., 2006, p. 100)

Commitment is an important aspect of PMS implementation (Hannula, 2002, p. 15; Lönnqvist et al., 2006, p. 105). When personnel understand the need for a PMS, they usually are more committed to executing the project (Lönnqvist et al., 2006, p. 105). PMS implementation needs to be connected to the organisation's big picture because according to Lönnqvist et al. (2010, p. 120), the planning phase's foundation is based on the organisation's strategy and vision.

When developing and implementing a PMS, it is profitable to participate in different personnel from different organisational sectors (Jääskeläinen et al., 2013, p. 28). This research aims to interview different stakeholders to understand the whole environment around the research's theme in the case company. According to Jääskeläinen and Sillanpää (2013, p. 450), a PMS implementation should be done organisationally bottom-up. They continue, how this enables the familiarisation of the personnel with the issue and the measurement culture, which helps to grow commitment towards the project.

2.5 Framework for performance measurement system implementation

2.5.1 Starting the project

A framework for implementation is a useful tool to manage the PMS's successful implementation. The framework helps to cover all aspects of implementation and it smoothens the processes. There are multiple frameworks for implementation (e.g., see Lönnqvist et al., 2006; Parmenter, 2015) but the framework created by Lönnqvist et al. (2006) will be

the main framework to be used in the development of this research because the framework was discovered to be the most suitable.

According to (Lönnqvist et al., 2006, p. 103), five main steps are needed for a PMS implementation project. These steps are:

1. Starting the project

2. Determination of the project's objectives and measurement perspectives

3. Determination of CSFs

4. Determination of metrics

5. Determination of operating principles

In addition to these steps, two steps are conducted at the same time with the project. These two additional steps are the involvement of personnel and communication of the project, and the development of IS. (Lönnqvist et al., 2006, p. 103) All mentioned steps are visualised in Figure 3.
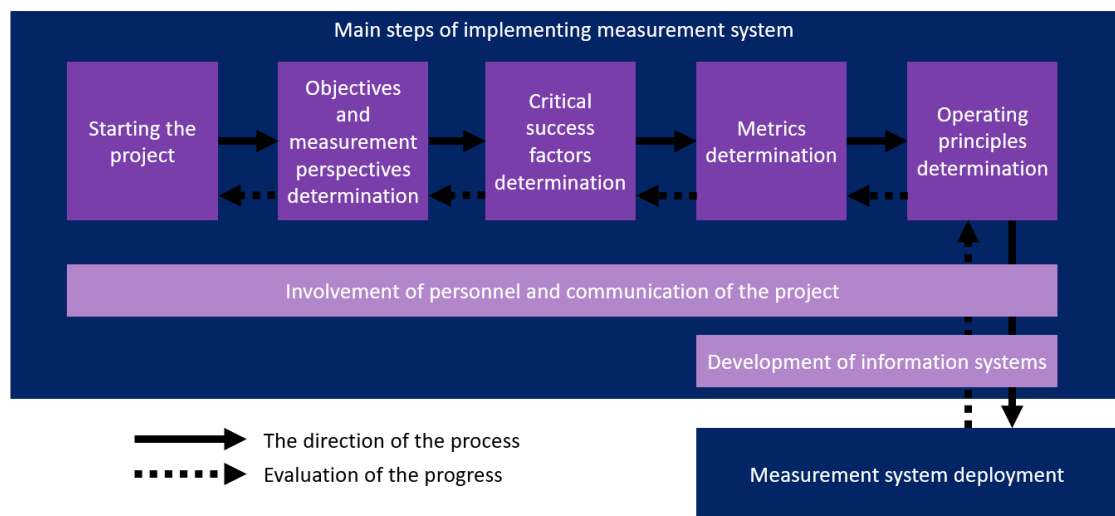
Figure 3. Main steps of implementing measurement system (Adapted from Lönnqvist et al., 2006, p. 104)

In the beginning, there must be commitment, resources, and the need for the PMS (Hannula, 2002, p. 15). Parmenter (2015, p. 106) continues how a partnership with the staff and third parties must be ensured because the organisation needs to understand the purpose of the measurement. In addition, the processes that do not deliver the wanted results need to be abandoned. Parties' desires within the implementation need to be understood because according to Bourne et al. (2000, p. 767), the idea of a PMS is translating the views of customers and stakeholders into business objectives. It helps to

understand the implementation process when the steps of the implementation are visu-
alised as in Figure 3.

2.5.2 Objectives and measurement perspectives

It is acknowledged that if an organisation's strategy is clear, it is easier to create a PMS
because CSFs are easy to lead from an understandable strategy (Lönnqvist et al., 2006,
p. 106). According to Allio (2012, p. 25), many organisations do not suffer from poor
indicators in the PMS, but the poor linkage between the organisation's strategy and
measurement objectives.

Another tactic despite the company's strategy is discovering CSFs by interviewing top
and middle-level management who are taking responsibility for different processes. The
target of the interviews is to understand strategic goals, which affect the short and long
term. (Lönnqvist et al., 2006, p. 106) Moura et al. (2021, chap. 4) add that in these inter-
views, it is beneficial to ask about the company's business objectives, is the company
achieving those objectives, is the company using the right measures at the moment, and
how measures are used to manage the business. According to Lönnqvist et al. (2006, p.
107), CSFs can be also approached by stakeholders. The main idea of this is to recog-
nise the most important stakeholders and use their goals and needs to discover CSFs.

Still, the most important thing is that the main principles of different organisations are
recognised (Lönnqvist et al., 2006, p. 108). Agasisti et al. (2020, p. 1121) highlight that
even if different companies start an implementation process because of the same kind
of external pressure, the process should follow different implementation patterns. This
creates the reason for defining objectives and measurement perspectives individually for
each company, and not the same framework can be used for all companies. When the
measurement strategy has been established, measurement perspectives are selected
to endorse the company's strategy (Lönnqvist et al., 2006, p. 108).

2.5.3 Critical success factors

After the objectives and measurement perspectives have been identified, they are used
to determine CSFs (Lönnqvist et al., 2006, p. 109). Kulatunga et al. (2011, p. 294) also
used literature to help identify CSFs in addition to interviews. Each objective and meas-
urement perspective should be fulfilled with the most important CSFs within that per-
spective. There should be about the same amount of CSFs within each measurement
perspective. (Lönnqvist et al., 2006, p. 110) Again, it must be remembered that CSFs
vary within different organisations because every organisation or company has different
entities to be emphasised (Lönnqvist et al., 2006, p. 109).

According to Power et al. (2001), the most important CSFs in agile supply chains are participative management style, computer-based technologies, resource management, continuous improvement enablers, supplier relations, and technology utilisation. Gunasekaran and Ngai (2003, p. 833) highlight five CSFs that are IT (information technology), transportation, strategic planning, capacity planning, and inventory management. Razzaque and Sheng (1998, according to Pettit and Beresford, 2009, pp. 452–453) found the following CSFs within a supply chain: communication of ideas, relationships, the importance of the human factor, and the setting of standards and monitoring performance against those standards. It is good to remember that determining CSFs is often full of compromises because not everything can be measured (Lönnqvist et al., 2006, p. 109).

The big picture of measurement perspectives and CSFs should be visualised, for example, with the help of a strategic map. A strategic map helps to understand how different measurement perspectives influence each other. (Lönnqvist et al., 2006, p. 110) It may be challenging to successfully determine all CSFs at once because measuring some CSFs may be impossible and this is noticed not until when the process goes further (Lönnqvist et al., 2006, p. 111).

2.5.4 Metrics

For each CSF, there should be determined at least one metric (Lönnqvist et al., 2006, p. 112). The use of metrics defines how the metric should be created (Lönnqvist et al., 2006, p. 112). For example, if the purpose of a metric is to show the performance of a LSP, it should be simple enough to be understandable and not have too much information on it. This helps the metric to fulfil its purpose, which is to be agile. Metrics may be challenging to determine at once and there will likely be many iterations during the developing process (Lönnqvist et al., 2006, p. 115).

Hugos (2018, p. 181) states that there are three levels of metrics. The first level is strategic, which helps top management to decide what to do. The second level is tactical, which helps middle management decide how we will do it. The final level is operational, which helps people with doing daily activities as strategically planned. According to Lönnqvist et al. (2006, pp. 112–113), a metric should be added to the dashboard if the use of the metric is easy and affordable. He continues that if implementing a metric demand too much work and big investments, there might be an urge to reconsider the selection of the metric. Lönnqvist et al. continue that still, the most important thing to keep in mind is that relevant metrics are those that are essential to the business processes and not only the cheapest and easiest to conduct (Lönnqvist et al., 2006, pp. 112–113).

According to Lönnqvist et al. (2006, p. 113), there should not be too many metrics in one PMS. He adds how the most important thing is that metrics are relevant to an organisation's strategy and the number of metrics varies on the context of usage. Allio (2012, p. 26) contributes how quantity does not cover quality and decision makers need insight instead of just data and information. A company's personnel need access to a one-page display of the key measures and metrics, and these displays are called dashboards. The dashboards give a person a glance at the data that is the most important and useful. (Hugos, 2018, p. 184)

Despite the number of metrics, a PMS should be well-balanced wholeness. There should be a good balance between metrics that are economical versus non-economical, focused on longer versus shorter strategic goals, representing internal versus external efficiency, and proactive versus reactive. (Lönnqvist et al., 2006, p. 113). Therefore, it is hard to decide beforehand how many metrics are the right amount for the specific purpose.

2.5.5 Operating principles

A PMS is made for use and tooltips would help people know how to use it. In addition, the background of the PMS should be communicated to the users, so they know what kind of data the PMS is dealing with. According to Lönnqvist et al. (2010, pp. 120–121), the following operating principles are a good example to communicate to the users:

1. Where is data taken from for the metric?

2. How often the measurement is conducted and reported?

3. Who is responsible for the metric?

4. What is the metric's target value?

5. To whom and how the measurement results are reported?

Operating principles should be documented, and for analysing measurement results, the documentation should be available with the results. This helps to understand the results thoroughly because the documentation provides transparency. (Lönnqvist et al., 2006, p. 117) The documentation makes the use of the PMS more efficient because it helps to answer the most common questions that may arise when using the PMS. The documentation also helps with errors and problems because due to the document the data source can be found. Documented operating principles are important for this research's PMS because it is wanted that everybody from the case company would be able to use the developed PMS.

2.6 Challenges of implementing performance measurement

According to Bourne et al. (2000, p. 767), implementing a PMS will raise several problems, which are problems with IT infrastructure, personnel resistance to measurement, and management being distracted by other events. Sterck and Bouckaert (2008, according to Poister, 2015, pp. 416–417) underlay the major challenges of collecting data and making metrics from this collected data. Firstly, objectives may not be specific enough to make metrics. Also, there might not be an established causal relationship between input and outcomes. Finally, data collecting procedures may be too expensive. These challenges can be addressed by making quality standards, monitoring data quality, and making processes to correct data problems.

Bititci et al. (2012, p. 320) found out in their study that understanding the PMS as a social system may be challenging but also beneficial. In this perspective, the PMS should be seen as affecting everything within the company. It is easier to develop a PMS for only one purpose but this way of doing may increase organisational silos, which would slow down the development. Bourne et al. (2000, p. 760) found out that although a PMS is often developed in four to five months, it takes seven to thirteen months before the company's personnel starts using the PMS in their daily activities. Understanding the benefits and social system idea of a PMS is important so personnel start to use it.

Phusavat et al. (2009, p. 659) endorse knowledge from external sources when creating and using a PMS. If there is no motivation to use the PMS, the motivation can be achieved by finding possibilities from other organisations (value chain concept). Information from the PMS leads to a willingness to seek information outside an organisation. Lönnqvist et al. (2010, p. 126) refine this idea of external knowledge by stating that end customers' input is important in the company's processes. A company's productivity may increase when, for example, end customers' self-service level is increased. This leads to a challenging situation that whether this self-service level should be considered in the PMS and how it would be conducted.

According to Lönnqvist et al. (2010, p. 128), there might be too many metrics in the PMS deployment phase. This is often because the process of prioritising the company's objectives and selecting metrics for supporting the objectives has failed in the planning phase. Lönnqvist et al. continue how too many metrics often lead to a situation where the PMS is not used actively by the company's personnel because too much information is available. Umashev and Willett (2008, p. 387) found in their research that the size and complexity of an organisation can cause conflicts in implementing the PMS to the different levels, for example, for top and middle management. A big and complex organisation

may cause a problem that there are too many metrics in the final product. In their study, there were priority conflicts, when top management tried to pursue corporate goals and middle management endorsed operational goals.

Communication in the implementation process plays an important role in tackling all these mentioned challenges. Still, it is easy to neglect the communication of the PMS development process. The neglection often leads to misunderstandings that occur at the end of the development process. Lohman et al. (2004, p. 283) suggest that different styles of tools should be used in the implementation process of the PMS so the communication of the implementation can be increased.

2.7 Performance measurement system's output

2.7.1 Dashboards

According to Kerzner (2017, p. 121), KPIs and metrics can be used in reports, scorecards, and dashboards. The case company desires an interactive platform to use the information provided by the PMS, so this chapter will mainly focus on dashboards. Eckerson (2011, p. 22) defines a dashboard so that it is an information delivery system that composes information for users so the users can measure, monitor, and manage processes. Person (2013, pp. 103–104) lists factors that must be taken into consideration so that dashboards succeed in improving the company's efficiency and performance:

1. Dashboards need to be based on the casual links that drive success

2. Dashboards need to increase the speed, ease, and accuracy of decision-making

3. Dashboards need to drive discussion on what is causing the results and outputs

4. Dashboards cause decision-makers to act based on the results

5. Dashboards need to use right-time data that enables fast decisions to keep business objectives on track

According to Allio (2012, p. 26), the most optimised number of metrics or indicators in a dashboard is about 15. He continues how ratios are often useful, for example, quality errors per unit shipped because they provide insight into the trade-offs within the business. Sarikaya et al. (2019, p. 683) add that the dashboard concept has turned from static single-view reporting to more interactive interfaces with multiple views. This new era of dashboards enables communication, learning and motivation. Multiple views in a dashboard make it harder to set a specific number of metrics advanced, and the number of metrics will depend on the case.

Metrics should not too complex. This goal does not just mean that choosing the most simplistic indicators is the best play, but the indicators should address critical entities across the value chain. (Allio, 2012, p. 26) To create the indicators that address the whole value chain, there must be knowledge and information about the organisation's value chain. Person (2013, p. 107) suggests that the company needs to lead the dashboard project, and IT is just an enabler. IT may not know all the aspects that must be taken into consideration in the implementation, and IT as the main developer of a dashboard can lead to misunderstandings within the business.

Allio (2012, p. 27) argues that dashboards often lack context, which leads to weakening dashboards' impact and side-tracking decision-makers. Therefore, metrics should be represented in a context. For example, if the metric indicates units shipped in different periods, there should be last year's results presented as well. This immediately helps the dashboard's user to understand the contextual matter behind the metric. Sarikaya et al. (2019, p. 683) identified two major different design perspectives when creating reporting dashboards. The first one is the visual side of dashboards, which includes the way how data is presented. The second perspective is the functional side, which focuses on the usability of the dashboard.

2.7.2 Visualisations

Heer et al. (2010, p. 1) state that the goal of visualisation is to help our understanding of the data by exploiting the human visual system for seeing patterns, spot trends, and found outliers. The human visual system helps us to see differences in line, shape, and colour without much thinking effort, and data visualisations are taking advantage of this to create graphs to help understand the data more easily and precisely (Hui, 2018, chap. 5).

Hui (2018, chap. 5) lists graphs that are examples for data visualisation: the plotting of a bar, scatterplot, histogram, boxplot, time series, line chart, and scatterplot matrix chart. These examples help to analyse and reason the data and understand the relationship between different variables. Jääskeläinen and Roitto (2016, p. 23) studied different graphs' benefits in their study. A bar chart or column chart supports the comparison of measurement results. A line chart supports an understanding of trends over the periods. A traffic light graph helps to understand the achievement of key objectives. An objective matrix shows an overall view and combines the organisation's goals and trends.

A good visualisation is not just a static picture but an interactive entity that allows the user to drill down and find more insights from the data. For example, the view can be changed by zooming and filtering and mixing up the values of some scale of the display,

and the result can be displayed incrementally. (Vo T. H. et al., 2017) Well-designed visualisations can improve a company's comprehension, memory, and decision-making (Heer et al., 2010, p. 1). The main idea behind an effective visualisation is to identify the main points that the visualisation wants to make. In addition, effective visualisation helps to understand the background of the visualisation's audience and accurately present the data to that audience. (Vo T. H. et al., 2017)

Abela (2013, p. 100) created a chart selector guide, which is presented in Figure 4. The use of this selector guide starts from the middle: what task the user wants the chart to accomplish. Then there are four possible choices for the purpose of the visualisation, which are:

1. Chart makes a comparison (e.g., last year's sales were higher than this year's)

2. Chart makes a relationship (e.g., when marketing goes up, sales go up too)

3. Chart displays a distribution of the data (e.g., there is a broad range of prices that people are willing to pay for delivery prices)

4. Chart can show a composition of the data (e.g., the final cost of the product is made up of manufacturing and transportation costs)
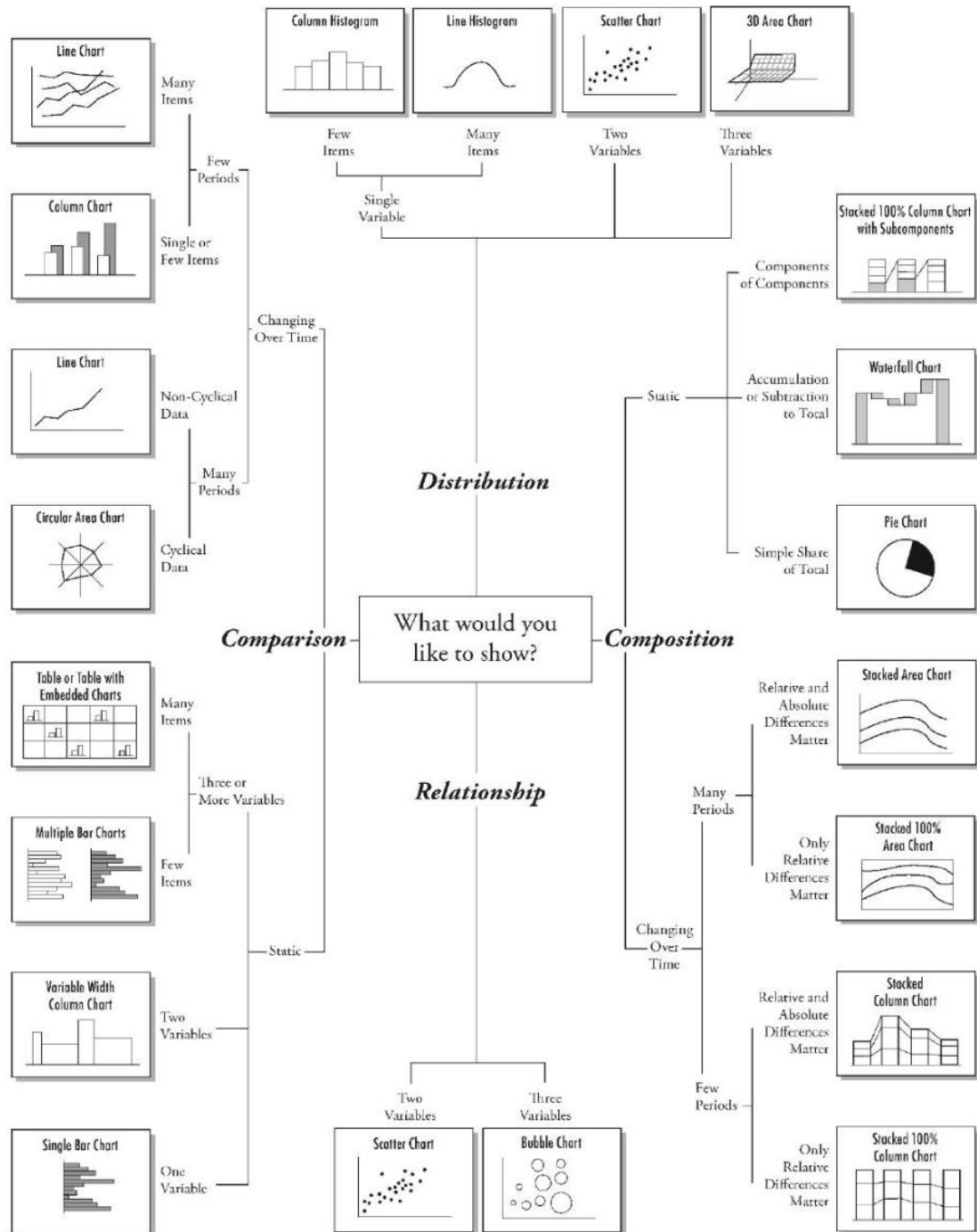
Figure 4. Chart selector guide (Abela, 2013, p. 101)

The chart selector guide is helpful when there is a need to quickly find out the right graph for the specific goal for visualisation. This type of chart selector guide has human psychology in its background, and the user of a chart selector does not have to think about the cognitive side of charts. Jääskeläinen and Roitto (2016, p. 22) also emphasise visualisations' importance in the implementation process of a PMS, not only in the use phase. For example, a strategy map can be useful for clarifying and prioritising the objects of

measurement and communicating the logic of a PMS to the company's personnel and challenging strategies during the usage of the PMS.

2.8 Evaluation and maintenance of performance measurement

Nowadays organisations are operating in a dynamic environment so business goals can change quickly. If a company's strategies are changed but performance measurement metrics are not updated, the metrics become useless and in the worst case, the metrics will lead the organisation's daily activities and resources in the wrong direction. (Lönnqvist et al., 2006, p. 142) According to Bourne et al. (2000, p. 761), regular meetings are required for evaluating and maintaining a PMS. The directors and managers who are responsible for the PMS must attend these meetings. Metrics from the PMS should be reviewed whether they are outdated or not. Other technical problems or possibilities should be also discussed.

Lohman et al. (2004, p. 277) state that a PMS cannot be considered a static entity, but it must be maintained to remain relevant. Lohman et al. continue that there are events that can be used to trigger changes in PMSs. The first event is that the PMS doesn't cover all the company's activities anymore. This can occur, for example, when new business areas are discovered. The second event is that the organisation updates its business objectives and goals. According to Lönnqvist et al. (2006, p. 143), new metrics are often just added to the PMS and old irrelevant ones are not removed. This makes the PMS too complex, and the use of the PMS becomes impractical.

The metrics of a PMS should be observed frequently. There should be a forum (e.g., monthly or yearly) that discusses the PMS's metrics and does these metrics answer the purpose anymore, for which they were created in the first place. (Lohman et al., 2004, p. 277) According to Kamble et al. (2020, p. 12), three situations can occur in the maintenance process. The first is that there is no need for any changes to the PMS. In this case, all is good, and the PMS is delivering what it should. The second scenario is that something needs to be removed from the PMS. The removal is usually due that a metric from the PMS has become irrelevant or insignificant with no contribution to the organisation's goal. The final scenario is revision. This occurs when something is not measurable due to the unavailability of relevant data or business processes are changed.

3. SUPPLY CHAIN MANAGEMENT

3.1 Supply chain and its management

3.1.1 Supply chain

There are many definitions for the term supply chain, and the basic idea of a supply chain is visualised in Figure 5. Sople (2012) describes a supply chain as a link that connects a set of facilities, companies, service providers, and demand points. A supply chain links upstream suppliers and downstream customers with different flows from a source to an end customer. (Sople, 2012, chap. 1) Bandyopadhyay (2015, chap. 1) deepens this description by adding that material and information flow both up and down in the supply chain as visualised in Figure 5. According to Zijm et al. (2019, p. 33), a supply chain captures all operations that begin from transforming raw materials into final products which includes sourcing, manufacturing, assembling, distribution to end-markets, and handling and storing materials. Zijm et al. continue, how a supply chain may also include the handling of returned products and the re-usage of components and materials. McKeller (2014, chap. 1) approaches the definition of the supply chain with a metaphor: supply chain is used to represent all the infrastructure, individual companies, and their personnel to create, store, and transport products to customers. Blanchard (2021, chap. 1) raises the product lifecycle point of view: when the supply chain as a definition is broken down to its basics, it is the sequence of events and processes that covers the whole lifecycle of a product.
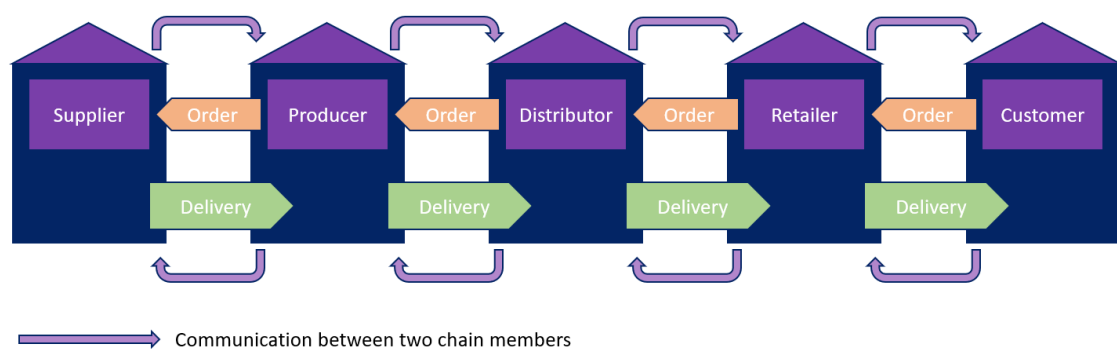
Figure 5. Simplified graphical model of a supply chain (Adapted from Bandyo-padhyay, 2015, chap. 1; Karrus, 2001, p. 14)

According to Lehtonen (2004), the number of supply chain members (see Figure 5) varies and often the chain includes many members that do not own products. These kinds

of members are, for example, LSPs (transportation and warehousing) and port operators. Supply chains also have members that specialise in communication and sharing information, and members that integrate logistics services. (Lehtonen, 2004, pp. 102–103) The case company can be seen as a supplier. The case company manufactures steel materials that producers buy to produce their own products. The case company buys the logistics services from different LPSs to ensure the supply chain's functionality. Thus, it is important that there would be a tool that could be used to analyse the performance of the LSPs. At each stage of the supply chain, the customer pays their suppliers for the goods received and therefore funds flow upstream from the end customer to the original supplier (Crandall, 2014, p. 6).

Wang et al. (2007, p. 2) point out that IT has been used in searching for ways to improve efficiency within supply chains, and therefore to gain a competitive advantage. This is backed up by Crandall's book because IT is used to aid in identifying the characteristics of the demand for the product and its delivery (Crandall, 2014, p. 6).

3.1.2 Supply chain management

The core of SCM (supply chain management) is planning and coordinating all elements of a supply chain, which are people, processes, and technology (Stanton, 2018, chap. 1). APICS Supply Chain Council (according to Blanchard, 2021, chap. 1) have come up with a definition that summarises the concept of SCM into six words, which are plan, source, make, deliver, return, and enable. Blanchard continues, how this summarisation captures the core functions of a supply chain. McKeller (2014, chap. 1) states that all definitions of a supply chain have four common elements, which are customer focus, value-adding processes, planning and management, and integration and collaboration.

LeMay et al. (2017, p. 1446) studied the definition of SCM and their conclusion was the following: "SCM is the design and coordination of a network through which organisations and individuals get, use, deliver, and dispose of material goods; acquire and distribute services; and make their offerings available to markets, customers, and clients". Mentzer et al. (2001, p. 18) also studied the definition and they stated different aspects of SCM: "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole". According to Zijm et al. (2019, p. 33), the definition of SCM can be shortly captured as it integrates supply and demand management across and within supply chain companies. Hugos (2018, p. 4) emphasises

responsiveness in his book: SCM is the coordination of the whole supply chain's participants to achieve the best level of responsiveness and efficiency for the customers.

According to Ivanov (2010, p. xi), the main goals of SCM can be centralised into three main goals, which are minimising costs, maximising the service level, and maintaining these previously mentioned two goals. SCM includes a quest for alliance and cooperation within the supply chain, so the rewards and risks are shared between a supply chain's members (Morana, 2013, p. 2). SCM is at the core of this research. As mentioned, SCM aims to ensure the supply chain's processes run smoothly. For the processes to work efficiently, monitoring is needed.

It is acknowledged nowadays that competition is not anymore only between products or services, but between supply chains (Sople, 2012, chap. 1). Therefore, it is recommendable to look at business as a single link in a long supply chain that delivers value to end customers (Stanton, 2018, chap. 1). According to Weele (2018, p. 252), IS are used to seek advantage in SCM. Weele continues, how advanced IS have become available, which are used to track and trace material flows in a supply chain.

3.2 Value chain

The concept of value chain origin is from Michael Porter's book, and it was intended for understanding how organisations can create value, and therefore, competitive advantage by looking at the discrete activities that an organisation performs (Kannegiesser, 2008, p. 11; Presutti, 2013, p. 1). A value chain can be described as a chain made of different members, and the materials for products or services will be processed into finished products during this chain. A value chain is visualised in Figure 6. All the chain members have their own value chains in their business, which steps are, for example, purchasing, manufacturing, distribution, and marketing. Each of mentioned steps will produce value itself but on the other hand, the costs will raise simultaneously. Each chain member's value chain is part of a larger value chain, which is used to create value for an end customer. (Sakki, 2014, p. 5)
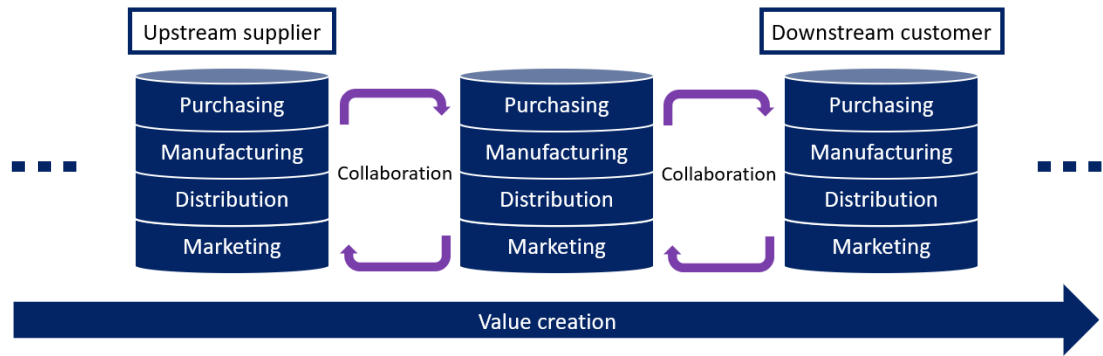
Figure 6. Visualised value-chain and its members (Adapted from Karrus, 2001, p. 15)

A value chain also has the concept of upstream and downstream (Figure 6). A value chain's upstream members are suppliers and downstream members are customers. Collaboration is an important part of a value chain because if it is neglected, it has a negative impact on costs and service levels. (Karrus, 2001, pp. 14–15). According to Hakemulder (2016, p. 3), the activities among a value chain are often divided into different organisations, though the activities may sometimes be located within a single larger business. Hakemulder continues, how these value-chain activities may take place within a single country or be more internationally spread. The globalisation of value chains has become a trend, and this globalisation is used to get a competitive advantage (Organisation for Economic Co-operation and Development, 2007, p. 31).

Hakemulder (2016, p. 3) states that in reality, value chains are not as linear as visualised in Figure 6. For example, producers may sell goods to both export and domestic markets, and there may be several distribution channels to help reach these markets. In addition, some products may be sold non-processed. (Hakemulder, 2016, p. 3) According to Kannegiesser (2008, p. 15), this leads to a situation where there must be a cross-organisation coordination and information exchange platform so transparency and accurate information for decision-making can be communicated.

If a supply chain refers to bringing products or services to markets, then a value chain refers to more of a developmental connotation, addressing growth, productivity, and job creation. A value chain does not take a particular member into scope but considers the process of delivering products or services to markets as a complex entity, in which all value chain members have a role to play. (Hakemulder, 2016, p. 4)

3.3 Logistics and its management

It can be said that the term logistics has evolved more and less towards the term supply chain and its management. Logistics can be seen as one part of SCM, and therefore,

logistics management is linked to the management of a supply chain. The hierarchy of SCM, logistics management, and logistics operations are visualised in Figure 7. According to Zijm et al. (2019, pp. 33–34), logistics management is that part of SCM that plans, implements, and monitors the forward and reverse flow of goods and information between the point of origin and the point of usage of these goods, while meeting customers' demands and requirements. Logistics management is responsible for logistics operations and processes, which are typically warehousing, fleet management, transportation, materials and orders handling, designing of logistics networks, and management of third-party LSPs (Grant, 2017, p. 9; Zijm et al., 2019, pp. 33–34).
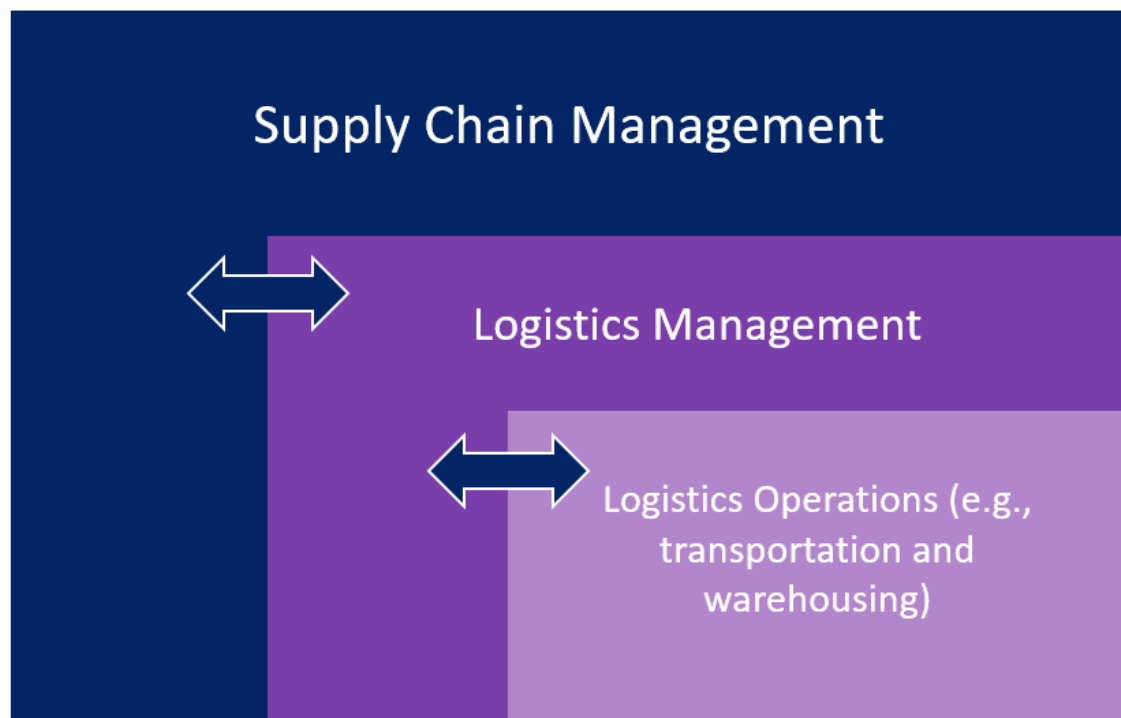
Figure 7. Hierarchy of supply chain management, logistics, and logistics operations (Adapted from Zijm et al., 2019, p. 34)

Logistics is a planning framework that seeks to make a single plan for the flow of information and product through a business. As visualised in Figure 7, SCM seeks linkages and coordination between the processes of other entities in the supply chain. (Christopher, 2016, chap. 1) According to Grant (2017, p. 9), logistics is that part of SCM that controls, implements, and plans the effective production and information flow through the supply chain.

Logistics can be seen as the transportation and storage of materials, parts, and end-products in a supply chain. Logistics includes internal and external materials handling operations, as well as inbound and outbound activities in the context of warehousing. Information sharing is a core function between the various stages of a logistics chain.

(Zijm et al., 2019, p. 33) Christopher (2016, chap. 1) describes logistics as the process of managing the procurement, movement, warehousing (e.g., materials, parts and finished products), and enabling the related information flows.

Sakki (2014, chap. 1) comes up with the idea in his book that logistics is not a single function but a series of functions that are conducted separately. The logistics functions are in and between companies within the supply chain (Morana, 2018). Sakki (2014, chap. 1) continues how these logistics functions merge the products' or services' production steps into a single entity. Sakki uses the following metaphor: logistics is like a blood circulation mechanism, which allows the living body to function. Logistics management considers all material flows, starting from the purchased materials, through the manufacturing processes, and ending with the customer receiving the goods (Weele, 2018, p. 253). According to Christopher (2016, chap. 1), the mission of logistics management is to serve customers as best as possible in the most cost-effective way.

3.4 Evaluation of logistics service providers

There are different factors that companies appreciate when they evaluate LSPs' performance. In the case company, the evaluation is used in the logistics services tender, and within the contract period. A logistics-related PMS would give insights into how the logistics processes have worked with each LSP. The result of the evaluation may be affecting both the number of product shipments that are given to a LPS and the decision of even making future collaboration with the LSP.

According to Juga et al. (2010, p. 496), logistics is one thing among others that companies tend to outsource to strengthen their focus on core competencies and improve operational efficiency. Therefore, companies must monitor and evaluate LSPs, so the logistics-related value experienced by the customers can be maintained at a specific level. It has been said that the LSP delivering products or services is the last thing that customers experience in the buying process.

Logistics service quality is positively associated with logistics service buyer's satisfaction, which again positively strengthens the buyer's loyalty to the LSP (Juga et al., 2010, p. 500). According to Gil Saura et al. (2008, p. 662), information and communication technology improves the quality of the logistics service offered to the final customers. Information and communication technologies create transparency, which will help customers to plan their processes with the knowledge of when the products and services will arrive.

There are different factors that companies use to evaluate logistics service quality. Juga et al. (2010, p. 501) identify three main factors from the literature, which are operational service quality, personal service quality, and technical service quality. Operational service quality contains the following measures: ability to keep schedules, offer service promptly, and provide sufficient capacity. Personal service quality contains service-mindedness of personnel, the expertise of personnel, and accessibility of personnel. Technical service quality includes the technical quality of both physical resources and IS, and problem-free electronic communication. (Juga et al., 2010, p. 501) Gil Saura et al. (2008, p. 662) made the same kind of findings on logistics service quality: timeliness is the most significant dimension together with order and personnel quality.

When technology is improving logistics' information flow through the supply chain, it influences customer satisfaction, and therefore, the customer's loyalty towards the product manufacturing or retailing company gets stronger (Gil Saura et al., 2008, p. 663). Gupta et al. (2021, chap. 5) identified in their paper that the LSPs are under continuous pressure to deliver sustainable services nowadays. This has an impact on the customer's loyalty in the future. Gupta et al. (2021, chap. 5) list examples of how LSP should be able to provide sustainable practices such as green warehousing, trained personnel for implementing green operations, sustainable capacity optimisation, eco-friendly fleet, and cost optimisation. Gupta et al. continue that to reach and maintain sustainable practices, the LSP should seek help from advanced IT tools such as artificial intelligence, machine learning, and big data analytics.

3.5 Supply chain and logistics flows

According to Morana (2018, chap. I), logistics often refer to two main flows, which are product and information flows. Morana expands the definition of a product flow that this term is sometimes replaced by material flow, goods flow, physical flow, or service flow. When addressing a supply chain with flows, there are three flows, which are mentioned logistics flows (product flow and information flow) and cash flow (Morana, 2018, chap. 1; Stanton, 2018, chap. 2). It is important to understand supply chain flows as the core functions of logistics PMSs. The flows give the idea of what is even possible to measure and visualise in PMSs. This chapter will give an idea of what data the case company is collecting for their databases within the logistics processes.

Supply chain flows are simplified in Figure 8, which has three main flows: information, product, and cash. According to Stanton (2018, chap. 2), product flow heads downstream in the supply chain adding value step by step until it reaches the customer. Sakki (2014, chap. 1) adds that products may also flow upstream on a smaller scale and product flow

means physically delivering and warehousing goods during the steps of a supply chain. Products flowing upstream are often due to one of the following: commercial reasons (technical problems), legal reasons (recycling), or economic reasons (recovery and re-use) (Morana, 2018, chap. 1). According to Sakki (2014, chap. 1), information flow can be simplified as information about customers and purchasing processes but also there is a need for information about prediction and planning. Stanton (2018, chap. 2) expands the nature of information flow that suppliers and customers provide information about products, and when these products will be delivered. Information flow is a two-way process, but the main direction is still from the customer to the company and further to the supplier (Sakki, 2014, chap. 1; Stanton, 2018, chap. 2). Morana (2018, chap. 1) defines that the cash flow mainly flows from downstream to upstream, but it can also flow in reversed direction. Sakki (2014, chap. 1) opens that cash flow is a bigger entirety than just a payment of the transported goods. If information flow is working, it speeds up the payment process. The speed has an impact on profitability because if the payment from the customer can be received faster than what is the supplier's materials term of payment, the business needs smaller capital to run. (Sakki, 2014, chap. 1)
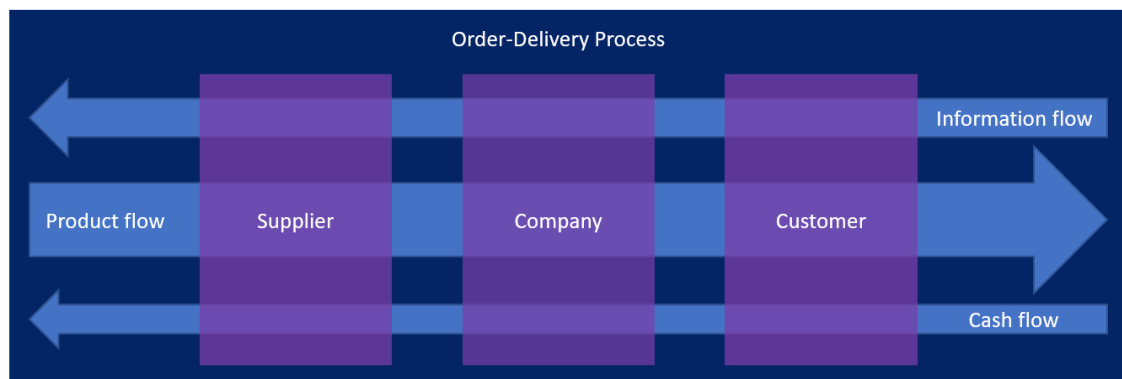
Figure 8. Flows in an order-delivery process (Adapted from Sakki, 2014, chap. 1)

These three main flows need to be managed simultaneously to gain the best performance within the supply chain. There is a need for determining how long a company can wait between the time when sending the product to the customer, and the time when the payment is received. There is also a need for planning what information is sent and in what direction, to keep the supply chain working as efficiently as possible. (Stanton, 2018, chap. 2) It is important to understand the value chain and flows inside of a supply chain. When every member of the supply chain acknowledges the importance of collaboration, the supply chain turns according to Sakki (2014, chap. 1) into an efficient large chain of companies that competes against other similar chains.

The following subchapters will address mentioned flows in a supply chain with the help of literature. The final subchapter will introduce flows that the literature has recognised to gain a more modern approach to supply chain and logistics flows.

3.5.1 Product flow

Logistics activities can be named after the starting point of the logistics processes. For example, supply logistics consists of the management of raw materials, components, and parts before the main operations in the manufacturing plant. Internal logistics is carried out in manufacturing plants, and it includes operations like receiving and storing materials, carrying the materials to the production lines, and storing and loading the finished products to transport vehicles. Distribution logistics is an activity that is conducted from the manufacturing plants before the market, for example, to distribution centres. Finally, external logistics is carried out when sending finished products to customers or sales points. Distribution logistics goes often under the external logistics term. (Ghiani, 2013, p. 5) On the other hand, Stanton (2018, chap. 2) makes a narrower naming with the terms inbound and outbound logistics. Inbound logistics refers to the products or materials that are shipped to a company before the manufacturing activities. Outbound logistics refers to the products that are shipped to the customers after the manufacturing.

Products or materials can be transported, for example, on ships, trucks, trains, and aeroplanes. The goals of logistics activities are to move the materials or products as fast as possible, reduce transportation costs, and decrease inventory because products and materials are an asset that ties up working capital and depreciates quickly. (Stanton, 2018, chap. 2) According to Dolgui et al. (2005, p. 223) when a company takes care of collecting and analysing demand and supply information, activities related to product flow are often excluded from the company's main functionalities. In other words, logistics processes are often outsourced to a different style of LSPs. This leads to the that many processes in logistics require a synchronous real-time flow of product and information (Clausen et al., 2014, p. 80), so the LSPs can operate as best as possible.

Direct quantification of the quantity, volume and costs within product flows can be used to find out possible new cost-cutting options. This will lead to business input-output optimisation. (Wagner and Enzler, 2006, pp. 7–8) To gain these mentioned benefits, the synchronisation of product flows must be achieved. According to Klug (2013, pp. 1–2), synchronisation also helps to prevent build-ups of inventories in a supply chain, and therefore, the products flow without interruptions in a process between different members (nodes) of the supply chain. Klug continues how each member of a supply chain is fed materials from the previous member of the supply chain at the right time. This has

led to a just-in-time supply ideology, where all elements of the delivery activities are synchronised.

To achieve synchronous product flow, the flow must be stable. For example, product flow can be disturbed by mistaken estimates, bad or defective components, equipment failure, or misspelling. Production must be planned so, that it can answer different kinds of interruptions so the product flow can be continued in these situations. (Klug, 2013, p. 2)

The case company's product flows can be seen flowing in both directions. The case company is receiving materials and components so they can produce steel products, and finished products are sent to customers. This research will mainly focus on product flow that is flowing to customers (downstream).

3.5.2 Information flow

Information flow can be defined as the driver for material flow, which starts from the end customer and influences the whole supply chain (Sadler, 2007, p. 138). Information flow enables the synchronisation of material flow. Sakki (2014, chap. 1) describes that a supply chain can be optimised with the help of the right kind of information: unnecessary purchasing can be avoided, which prevents unnecessary warehousing, workload, and transporting. Sakki summarises that many problems could be avoided if a company transporting the products would know their customer's plans and overall business. Information shared in a supply chain allows the supply chain members to gain an advantage in terms of financial performance (e.g., asset management, operating costs, and productivity), and in terms of improving operating processes (e.g., process flexibility, production planning, and resource control) (Klein and Rai, 2009, p. 754).

Bailey and Francis (2008, p. 10) found out that information sharing in a supply chain is an enabler rather than a driver of the supply chain's performance. Bailey and Francis discovered that although the level of information sharing and transparency was good, it still led to inefficiency in information flow. They raised the concept that there is a need for taking other factors concerned in information flows. These factors are listed in Table 1. This idea is backed up by Gavirneni (2002, p. 651), who states that information flow in supply chains can be better organised by changing the operating policies in the supply chains. This will reduce the total costs and improve efficiency in the supply chain.

Table 1. Factors to establish well-performing information flow in a supply chain (Adapted from Bailey and Francis, 2008, p. 5)

Factor	Description
Collaborative foundation	Trust, mutuality, openness, frequent communication, and interaction between personnel
Vision and strategy	Shared vision and its objectives, common value definition
Coordination	Aligned performance measures, joint decision making, forecast
Transparency	Cost and performance data, markets demand
Control	Standard practices, defined ordering parameters
Incentives	Shared benefits
Supply chain design and improvement	Lead-time compression, process simplification and improvement, supply chain design, cross-functional projects

Sadler (2007, p. 138) captures the idea of gathering logistics information with the following: "it is the involvement of people, equipment and procedures to gather, sort, analyse, evaluate and then distribute information to the appropriate decision-makers in a timely and accurate manner so that they can make quality logistics decisions". Klein and Rai (2009, p. 754) point out that asset-specific IT investments may become topical to establish the digital mechanisms for the exchange of strategic information. All parties must understand the benefits of optimised information flow so that the investments can be discussed.

According to Sadler (2007, p. 138), the data-information-knowledge concept can be recognised in information flow of logistics: data is the collection of facts about a company's orders and logistics actions. Information is a valid summary of the data, for example, how a specific transportation company has performed, which can be used in decision-making. Knowledge can be seen as the ability of companies to remember the procedures for dealing with complex and surprising situations. Kaipia (2009, p. 153) continues with the

information concept: there should be a suitable relation between the volume of logistics information shared and logistics activities execution flexibility. If the volume of logistics information shared is high and execution flexibility is low, it leads to a waste of planning resources. There is a lot of information for usage, but logistics processes cannot adapt that quickly, leaving the information unused. On the other hand, if the execution flexibility is high and the volume of information shared is low, it leads to too high process costs. In this scenario, processes can adapt quickly but the lack of information makes the adapting opportunity impossible. (Kaipia, 2009, p. 153)

3.5.3 Cash flow

Lee (2000) describes that cash flow includes repayment schedules, credit terms, freight payments, and consignment ownership arrangements (according to Zhang et al., 2015, p. 1146). Demand and cash flow influence each other. There are more risks with the cash flow when forecasting a longer period due to the accumulation of risks. Increasing the safety stock levels can increase the service level in the big picture, which reduces the cash flow risks but it will raise inventory costs. When there is a suitable amount of information available, the members of a supply chain can reduce risks in cash flow. (Zhao et al., 2015, p. 3688) The information helps to plan operations in a way that committed capital can be reduced from the logistics processes.

Leng and Zailani (2012, p. 305) found out in their research that cash flow has a positive impact on the overall performance of a supply chain and its management. Still, cash flow should not be prioritised too much from the other flows. According to Frankel (2013, chap. 6), a company's top management often measures performance in terms of sales volume, market share, cash flow, and ROI (return on investment). Operational management often values different kind of metrics, which focuses more on operational performance because daily activities drive financial results. This misalignment is often due to a company's strategy that is not fully understood. (Frankel, 2013, chap. 6) Cash flow should not be seen as the main flow to be concerned but as one dimension in supply chain flows.

Crandall (2014, chap. 15) identifies three main cash flow cycles. The first one is when a company sells or buys with debit, which is repaid quickly. The second cycle takes longer because a company invests their cash in the inventory and the products from the inventory are sold on credit. The third cycle takes the most time. This cycle happens when a company invest their cash in long-term projects, for example, equipment or IS. Cash flow cycles are important because they reflect the current financial state of organisations and

this information can be used to judge whether or not to continue with current plans (Leng and Zailani, 2012, p. 295).

A company's manufacturing or operating strategy influences cash flow. For example, if a company maintains a high inventory level of goods to serve its customers, the cash flow cycle is longer than if the company would manufacture goods based only on the customers' orders (make-to-order principle). (Crandall, 2014, chap. 15) The commitment to share rewards and risks will be implemented with the cash flow integration processes. Integration processes also involve financial help for long-term business partners, price negotiation process, and implementation of strategic investments. (Zhang et al., 2015, p. 1146)

3.5.4 Other flows

Product, information, and cash flows are the fundamental flows in the context of supply chain and logistics. Some authors have recognised more flows, which are enabling the fluency of the fundamental flows. Tixier (1983, according to Morana, 2018, chap. I) determines the flow called people flow. People flow contains the operations that are needed for the fulfilment of an order. Collaborative learning between a company and its supplier can increase the local knowledge, which will decrease the need for people flow (Gebauer et al., 2013, p. 39) because the operations of orders will become familiar. However, this creates a dilemma for a company because the company needs to determine how committed it will be to the supplier. If the commitment is high, it can be a slow and problematic process to change the supplier to another one.

Mesnard and Dupont (1999, according to Morana, 2018, chap. I) bring up the flow called intelligence flow. Intelligence flow's main purpose is to maximise the usage of all information. When information is used in the most optimised way, it can lead to the following benefits:

1. Responsiveness - Identifying and satisfying unseen scenarios and demands

2. Agility - Ability to rapidly reconfigure the usage of the resources

3. Efficiency - Ability to systematically remove all waste in the supply chain

Intelligence flow is mainly based on technology-based solutions and the flow allows to process data more precisely and frequently. Intelligence flow also eliminates the need for manual work processes (e.g., manual documentation), and this will reduce errors made by humans. (Choudhury et al., 2021, p. 2082)

3.6 Supply chain technologies and information systems

3.6.1 Information systems

The main idea with supply chain IS is that they manipulate and display data with the technology required to "capture, communicate, store, and retrieve that data" (Hugos, 2018, p. 121). It is also noticed that IS are the key to success in SCM (Christopher, 2016, chap. 8). There are many IS available in the market for each step of a supply chain. It is also worth noting that when technology is evolving, there will be new software available to serve specific needs. (Olson, 2014, p. 4) Chopra and Meindl (2015, according to Hugos, 2018, p. 122) have defined IS (Table 2) that are often used to operate different supply chain operations.

Table 2. Typical supply chain information systems (Adapted from Hugos, 2018, pp. 122–126)

System	Description
ERP (Enterprise resource planning)	Gathers data from across multiple processes in a company. Supports a process-oriented view of business that affects all functional departments.
Procurement system	Focuses on the procurement activities between a company and its suppliers. Streamlines the procurement processes and makes them more efficient.
TMS (Transportation management system)	Enables daily operational planning of transportation with different transport modes. Is used to plan loads and can be used to send shipping orders.
Demand planning	Takes historical sales data and helps a company to forecast its demand. Data is used to create models that can help to predict future sales.
CMR (Customer relation management)	Helps to serve current customers and find new customers. System tracks buying patterns and histories of customers.

WMS (Warehouse management system)	Supports daily warehouse operations. Keeps track of inventory levels and stocking locations in a warehouse.
MES (Manufacturing execution system)	Provides short-term production schedules and helps to allocate raw materials and production resources.

A modern supply chain and logistics need efficient IS (as listed above) to serve end customers. These solutions provide transparency, efficiency to processes, and reactivity. Mentioned benefits help to retain competitivity in today's market. (Christopher, 2016, chap. 8; Wang and Pettit, 2016, p. 32) Supply chain software provides LSPs with a view from the manufacturing company's point of view. The view includes, for example, forecasts, logistics timeframes, current inventory, and shipping information. By giving this access to LSPs, the company can better meet its customers' demands and wishes. For example, a LSP can select those products that are needed as soon as possible by the end customer. LSPs can also monitor if there are unexpected problems within the supply chain and therefore use different routing to transport the products. (Olson, 2014, p. 4)

According to Olson (2014, pp. 4–5), there are two main types of SCM software. The first type is planning applications, which are used to generate improved plans using technology and mathematical algorithms. The second type is execution applications, which are focusing more on the operational side (e.g., tracing goods, managing logistics and materials, and sharing financial information). Stefansson (2002, according to Wang and Pettit, 2016, p. 33) defines that a supply chain is dependent on IS because there is a huge amount of data available from the business, and this big data flow can be used to establish efficient product flow in the supply chain. According to Christopher (2016, chap. 8), this data is more and more used to improve responsiveness with the help of information and IT.

According to Christopher (2016, chap. 8), multiple functions use supply chain and logistics-related information, and these functions are listed in Figure 9. A database is at the core of these functions, providing the organisation's external and internal data. The planning function uses the database's information to make decisions based on historical data. The customer service communication function is making the use of information by providing status information to end customers. The control function monitors the performance of different external business members. The coordination function uses the information to plan activities with a supply chain's upstream and downstream members.
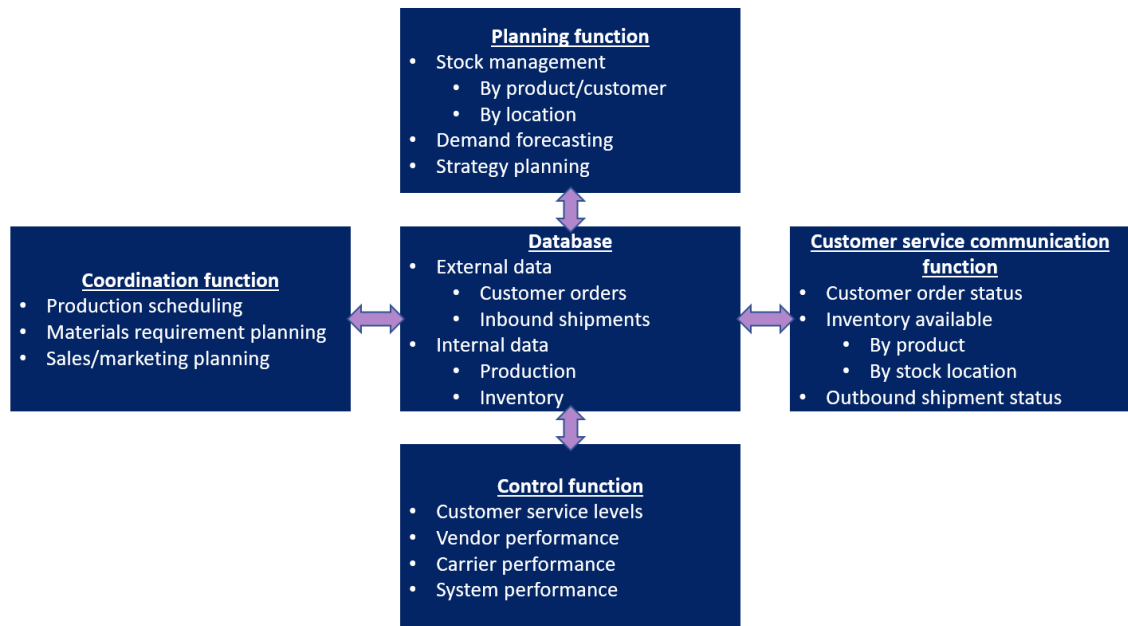
Figure 9. Functions of a supply chain related information system (Adapted from Christopher, 2016, chap. 8)

The use of IS enables a supply chain to transfer more into a demand chain, which helps the logistics system to respond the actual demand rather than estimated demand based on forecasts (Christopher, 2016, chap. 8). This is illustrated in Figure 9 and when all functions are working together and data flow is synchronised, it helps to answers the market's demand.

The case company is collecting logistics-related data to databases from execution applications (as Olson 2014 stated), which are the ERP and TMS. There is the control function (Christopher 2016) that is collecting data from incoming and outgoing transports from the case company's manufacturing plants. In addition, there is a new kind of project ongoing that will add more possibilities to control functions to monitor logistics performance. The project is called logistics transparency or track and trace project, and it will be introduced in more detail in Chapter 5.6.3.

3.6.2 Supply chain technologies

Sakki (2014) highlights the importance of digitalisation and the usage of the internet, and how these factors can be used to gain an advantage in the business. Organisations need to find partners whom activities and processes can be developed with. The main goal is to establish a network, which will be used to support business, create solutions, and serve end customers. (Sakki, 2014, p. 119) According to (Hugos, 2018, pp. 116–117), the key technology components are cloud computing, data transmission, databases, and business analytics.

A combination of different kinds of technologies creates cloud computing. These technologies are, for example, the internet, web browsers, server virtualisation, and open-source software. Cloud computing is based on the desire that a company wants to outsource all or some of its traditional IT operations (e.g., running data centres and IS). (Hugos, 2018, p. 117) Cloud computing enables access to resources over multiple device types, which are e.g., laptops, workstations, and mobile phones (Williams, 2012, chap. 1). According to Pagano (2020, chap. 2), there are three main choices when selecting cloud computing service. The choices are SaaS (Software as a Service), PaaS (Platform as a Service), and IaaS (Infrastructure as a Service). SaaS is based on a provider's application, and it can be used by multiple devices. All the underlying infrastructure for SaaS is invisible to the user. PaaS expands the ownership of cloud computing towards the payment for memory, storage environments and tools. IaaS is the whole entity that includes cloud resources as virtualised resource pools. In addition, the underlying computing and infrastructure are masked. (Pagano, 2020, chap. 2)

Cloud computing makes data available when there are multiple members of a supply chain included. The members can share their data directly to the cloud computing environment without any middleman. (Williams, 2012, chap. 1) According to Pagano (2020, chap. 2), the benefits of cloud computing are lower implementation costs, cost-effective upgrades to the system, and a faster time-to-value ratio.

Data transmission technologies were developed to transmit data between companies that are in contact (Hugos, 2018, p. 119). EDI (Electronic Data Interchange) is an industry-standard for sending and receiving electronic messages (Sehgal, 2009, p. 106). EDI is more based on standard structured datasets and companies must agree on which datasets they are going to use to transfer business transactions (Hugos, 2018, p. 119). XML (eXtensible Markup Language) is a meta-language that can be used to define a custom markup language or document type and this markup language describes the appearance or structure of the data contained in a document (Chatfield et al., 2009, p. 653). Therefore, XML is more based on the flexibility that allows sending data in a freer form (Hugos, 2018, p. 119).

A database is an organised and standardised grouping of data that is stored electronically. A database can be seen as a model of the business processes, for which it gathers and stores data. (Hugos, 2018, p. 120) Databases are parallelised with analytics and reporting, which are used by personnel for different kinds of purposes. Personnel doing different kinds of jobs will want different combinations of data for analytics purposes. (Hugos, 2018, p. 121) Analytics refers to discovering and communicating meaningful patterns in data. Analytics is based on applications of statistics, computer programming,

analysis tools, and mathematics. However, analytics also includes the presentability of the information and this means the usage of graphics, dashboards, and other data visualisation. (Plenert, 2014, p. 51) Companies are applying and using analytics to make their supply chains more responsive to end customers, rather than letting the availability of raw materials and other components drive the supply chain's operations (Mendes, 2011, p. 3). Zhu et al. (2018) found in their research that analytics can be used to increase a supply chain's transparency.

3.6.3 Enterprise resource planning

ERP is focusing gathering, manipulating, and displaying data. For example, ERP can view the whole process from order fulfilment through tracking orders from raw materials to delivery of the finished product to customers. (Hugos, 2018, p. 122) ERP is used to integrate and optimise the usage of data (Bradford, 2015, p. 1). Olson has determined common ERP features, which can be identified among all ERP systems available in the market. These ERP features are presented in Table 3.

Table 3. Common ERP features that can be identified among ERP systems (Adapted from Olson, 2014, p. 14)

Feature	Description
Best business practices	"Incorporation of processes evaluated as the best in the world"
Comprehensive	"Integrating as many business computing functions as possible, with a single database"
Modular	"An open system architecture allowing incorporation of those modules needed for the organisation"
Flexible	"Capable of response to changing enterprise needs"
External linkage	"Capable of linking external organisations, especially within supply chains"

ERP establishes data usage for the whole organisation, for example, cross usage between different BUs (business units). Also, necessary stakeholders are covered. ERP's foundations are databases, which are based on the organisation's needs. (Bradford,

2015, pp. 1–2) According to Lehtonen (2004, p. 132), an organisation's most important databases focus on customers, suppliers, and products.

ERP systems are based on the usage of modules. These modules are installed on their own or in combination with other styles of modules. There are modules available, for example, for finance, procurement, logistics, order fulfilment, manufacturing, and human resource. (Hugos, 2018, p. 123) According to Bradford (2015, pp. 1–2), the main modules of ERP are financial, human resource, and logistics modules. There are many sub-modules available under the main modules.

According to Hugos (2018, p. 123), ERP systems often lack the analytical side that is needed to investigate deeper problems within a supply chain. ERP is more optimised to operate daily activities, which are the base of the organisation's business. Real-time shared data leads to more complete and accurate data (Olson, 2014, p. 13).

The benefits of ERP are due to the real-time synchronising of data. This leads to reliability because all users have the same data and information available, reducing errors, and making processes more efficient. It is also easier to correct errors within the data because one correction corrects the error in the whole system. Real-time data across the business speed up an answer time to customers' inquiries. (Bradford, 2015, p. 6) According to Olson (2014, p. 12), "the main benefit of ERP is the elimination of sub-organisational silos that focus on their problems rather than serving the interests of the overall organisation".

4. RESEARCH METHODOLOGY

4.1 Research design

The following sub-chapters are based on the research onion model by Saunders et al. (2019). The research onion model helps to structure the research so the reader can understand the big picture behind the selected research choices. The research onion model is visualised in Figure 10. The research onion model is read from the outer ring and from there inward until the inner ring is reached.
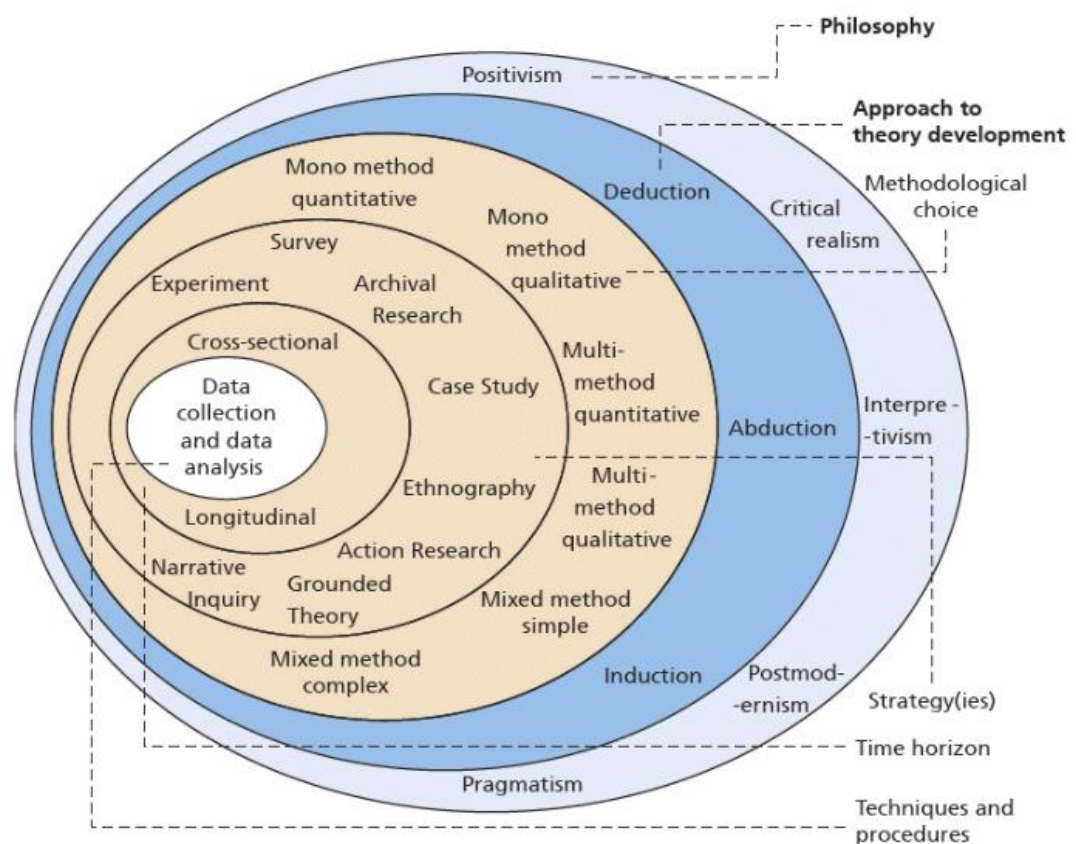
Figure 10. The research onion model (Saunders et al., 2019)

The sub-chapters are dealing with the onion layers one layer at a time. First, the research philosophy is described to the reader and then the approach to theory development. Then the methodological choice is covered, from where the research strategy is opened. Lastly, the time horizon of the research is introduced and finally, the data collection and analysis are justified.

4.1.1 Philosophy

A research philosophy refers to a set of beliefs and assumptions, which are used to develop knowledge from research (Saunders et al., 2019, p. 130). Burrell and Morgan (2016, according to Saunders et al., 2019, p. 130) noticed that a research author often makes assumptions unconsciously and these assumptions affect the research's outcome. Johnson and Clark (2016, according to Saunders et al., 2019) determined that it is important to be aware of research philosophies because they have an impact on the understanding of what is done in the research and how the phenomenon under the research is understood.

The main philosophy of this research is pragmatism. According to Florczak (2014), pragmatism as a research philosophy tends to consider the goal of research to be the developed solution to the research problem. Florczak continues, how the goal of research must not be influenced by the author's prior knowledge or assumptions and beliefs. Pragmatism emphasises theories, concepts, ideas, hypotheses, and discoveries as practical tools that guide thinking and doing in each context. Reality is the most important thing for pragmatism because the impact of ideas is measured and valued in practice through the successes they enable. (Saunders et al., 2019, p. 151.)

The role of pragmatism is to find the solutions that work best at a given moment, but at the same time, pragmatism is ready to change if the solutions prove to be ineffective (Lowe et al., 2020, p. 1739). The result of this research is an artefact that allows the case company's logistics performance to be evaluated. Pragmatism is suitable for this as a research philosophy because it is important to find the most suitable things from the research material (the theoretical and empirical) for measuring the case company's logistics activities. The case company's logistics performance and its measurement are largely context and case related, which guides the research problem's solving. Thus, theories should be seen as tools for planning and implementation.

4.1.2 Approach to theory development

The logic of scientific reasoning refers to different approaches to testing theory or building theory on research (Anttila, 2014; Saunders et al., 2019, p. 152). The logic of reasoning also determines how conclusions are created from the starting point of the research (Cramer-Petersen et al., 2019, p. 40).

This research has features of both deductive and inductive reasoning. Kaushik and Walsh (2019) determine how pragmatism typically involves abductive reasoning, which mixes the features of deductive and inductive reasoning by moving back and forth between them. Anttila (2014) has stated that the idea of abductive reasoning lies in the fact

that research starts with the concrete trying to structure it with the help of theories and models, and then returning to the concrete. In addition, he continues how with abductive reasoning, the research's interest is focused on assumed important facts. Saunders et al. (2019, p. 156) continue how abductive reasoning is flexible and only a few research-ers can conduct their research completely deductively or inductively. Flexibility enables the researcher to start using a well-observed phenomenon in the middle of the research and examine its effect in terms of the result (Anttila, 2014).

Deductive reasoning starts with theory and understanding it. The purpose of the theory is to bring elements and doctrines into the research, which are meant to be tested either by confirming or refuting. If the testing fails, the theory must either be rejected or modified and the process must be started again. (Saunders et al., 2019, p. 154) The process of inductive reasoning is the opposite: it starts with empirical data, which is used to create a new theory on top of it (Saunders et al., 2019, pp. 154–155). In inductive reasoning, conceptualising the research material is important because the purpose is to create a new theory from the concepts (Anttila, 2014).

In this research, the idea is to understand both the theory behind the phenomenon and secondary sources obtained from the case company, and based on them, an initial un-derstanding of the logistics measurement is created. The theoretical research will help to form an interview framework. The results obtained from the interviews are used in the design of the PMS together with the theory. The available data is investigated from the case company for the PMS together with the empirical data and theory. The next step is to create metrics for the PMS. Finally, the functionality and appropriateness of the PMS will be tested in workshops and presentations.

4.1.3 Methodological choice

This research is qualitative. Saunders et al. (2019, p. 179) describe the nature of quali-tative research in such a way that it aims to understand the phenomenon of the research object in a certain environment. Hirsjärvi (2008, p. 27) argues that qualitative research helps to clarify the meaning of behaviour in its context. Hirsjärvi continues that qualitative research enables historical observations of the researched phenomenon to be used in the research. The material of qualitative research is usually verbal, and it remains in this form during the research (Hirsjärvi, 2008, p. 136).

The process of qualitative research progresses from empiricism to theory, that is, from observations to a general level (Anttila, 2014). Abductive reasoning is used in this re-search, where the process varies from theory to empiricism and vice versa. Thus, the characteristic movement of qualitative research from empiricism to theory is grounded

with the help of theory. Saunders et al. (2019, p. 179) have stated how, in terms of the success of qualitative research, it is important for the researcher to be able to create a good and reliable relationship with the research subjects to gain access to the cognitive information of the research subjects. However, the researcher must work in a task-oriented state of mind i.e., acquiring knowledge is the priority, not curiosity (Hirsjärvi, 2008, p. 98).

4.1.4 Research strategy

There are different research strategies and their applicability to specific research must be examined on a case-by-case basis. The chosen strategy partly determines how the researcher tries to answer the research question (Saunders et al., 2019, p. 189). A research strategy is also linked to the utilisation of existing knowledge, the time, and resources used for research, and the available empirical data of the subject being researched (Saunders et al., 2019, p. 190).

The strategy of this research is a case study, but the research also contains features of design research. Yin (2018, according to Saunders et al., 2019, p. 196) claims that a case study aims to thoroughly investigate a specific real-world topic in a limited environment. According to Anttila (2014), a case study aims to intensively study a specific object, which is usually social. Anttila adds that the object under study usually consists of several influencing factors, in which case the aim is to get a comprehensive and accurate description of this entity. On the other hand, a single source or factor alone is not sufficient to answer the research question thoroughly, in which case it is appropriate to consider a larger group of sources or factors (Gillham, 2000, p. 2).

In a case study, the researcher and the subjects are seen to interact with each other, in which case the research is the researcher's interpretation of the case (Anttila, 2014). Interaction is important because it can be used to identify and find in-depth information about the phenomenon being studied (Saunders et al., 2019, p. 198). Interaction plays a central role in this research, as it helps the interviewees to find information about suitable metrics in the research's context. With the help of interaction, it is possible to discuss arguments in-depth in the interviews, which can be valuable from the point of view of the research. According to Anttila (2014), a case study can be seen as successful if the basic elements of the study can be repeated, even if two completely identical cases cannot be created. This forces the researcher to think about the structure of the research, in which case planning work plays an important role.

Design research is a research paradigm that allows the researcher to try to answer the problem by creating an innovative artefact, which is applied and evaluated (Hevner and

Chatterjee, 2010). Erlhoff et al. (2007, p. 27) state that artefact means an object that is created as a result of human skill and ingenuity. Erlhoff et al. continue, how the common definition of design at the organisational level is an interaction between people and artefacts. An artefact is generally seen as material, but an artefact can also refer to designed spaces, images, software, and environments in which software is used (Erlhoff et al., 2007, p. 28).

This research will create an artefact (PMS) that is used to monitor the performance of LSPs, and the artefact's performance will be assessed through workshops and presentations. The workshops are used for the agile evaluation of the artefact, so the artefact's development is aligned with the case company's views. Also, the case company's personnel involved in this research get the status information (e.g., what has been done and what is left to do) during the research process. The workshops also provide an opportunity to iterate during the research process. The iteration aids to find the dashboard's strengths and weaknesses. Also, the workshops enable that the outcome of this research was not only the research author's point of view but also the case company's unified point of view.

4.1.5 Time horizon

This research's time horizon is cross-sectional. The nature of a cross-sectional study includes studying the research's object at a certain point in time or during a short period (Anttila, 2014). Saunders et al. (2019, p. 212) point out that cross-sectional research is matched by longitudinal research, which has a longer time horizon than cross-sectional research.

The period of conducting this research is six months and the research's phenomenon under investigation is dealt with in a relatively short time. The research interviews are also conducted within a short period, which according to Saunders et al. (2019, p. 212) traditionally belongs to the nature of cross-sectional research.

4.1.6 Data collection and analysis

A semi-structured interview was chosen to collect material for this research. According to Saunders et al. (2019, p. 437), semi-structured interviews focus on a predetermined list of themes and key questions related to these themes. This was a suitable choice because the research author wanted to investigate insights within specific themes to learn the foundation for the PMS development. Anttila (2014) states that a semi-structured interview helps to cover necessary aspects of the subject of research because the important and essential themes have been considered in advance. A semi-structured interview enables the comparison of answers within themes. Themes and predetermined

questions enable conversation and discussion with interviewees. Thus, interviewees can explain their points of view in their answers so it will build more depth to the received data. (Saunders et al., 2019, p. 437).

Purposive sampling was used to select the interviewees for this research. A purposive sampling method requires that the researcher selects the best interviewees to solve the research problem. The impact of interviewees on the research must be considered in advance. (Saunders et al., 2019, p. 321) Selected interviewees for this study were discussed together with the case company to obtain the most comprehensive empirical data for answering the research questions. According to Saunders et al. (2019, p. 321), a purposive sampling method is suitable when working with a small sample, which is often in a case study's nature.

Thirteen people were interviewed during this research. Interviewees' positions varied from Sales Director to Head of SCM. Also, the most important external stakeholders were interviewed. There were two main interview structures, which were the structure focusing on the CSFs (Appendix A: The interview framework for CSFs) and the structure focusing on the technical possibilities of the logistics measurement (Appendix B: The interview framework for the technological foundation). The interviews lasted about one hour each and the interviews were conducted via a business communication platform called Teams. All interviews were recorded, and these recordings were used in the analysis phase of the interviews. Table 4 shows a summary of the positions, roles, and used interview structure of the interviewees.

Table 4. Interviewees of this research

Id	Position	Company represented	Interview structure	Responsibilities
BI1	BI Development Manager	Case company	Technology	Reporting capabilities, supply chain analytics
SCM1	Head of SCM	Case company	CSFs	Leading customer care, supply planning and logistics
SCM2	Head of SCM Digitalisation	Case company	Technology	Supporting supply chain processes through digitalisation
LSP1	IT and Process Developer	Logistics service provider 2	Technology	Use of data for operational and management purposes

LSP2	IT Project Manager	Logistics service provider 1	Technology	Software, processes
LSP3	Key Account Manager	Logistics service provider 2	Technology	Agreements and ensuring functionality
LOG1	Logistics Manager	Case company (Finnish BU)	CSFs	Truck agreements, strategic planning, overall responsibility for logistics
LOG2	Logistics Manager	Case company (Swedish BU)	CSFs	Truck agreements, strategic planning, overall responsibility for logistics
DEV1	Operation Control and Developing Manager	Case company	Technology	Quality and development, administrator, reporting capabilities
SALES1	Sales Director	Case company	CSFs	Setting prices, budgeting, customer satisfaction
SHIP1	Shipping Manager	Case company	CSFs	Ocean transport and harbour agreements, tendering, negotiations, providers' performance
LOG3	Transport and Logistics Analyst	Case company	CSFs	Statistics, reports, and costs information
LOG4	Transport Planning Manager	Case company	CSFs	Operational product transportation

The goal of these interviews was to determine the business objectives and CSFs for the development of the PMS. Also, the interviews aimed to find technology-based opportunities, which allow the measurement to be done correctly. Each interviewee has their own identification code (e.g., DEV1) and these codes are used for reference purposes in this research.

The analysis of the empirical material began by transcribing the interview material. The result of the transcribing process was that the materials of all interviewees were listed under each interview question. After this, the answers of the interviewees were themed into sub-units, where the answers were related to the same issues. According to Eskola and Suoranta (1998, p. 176), thematization tries to find out the key topics, which are repeated in the material in one form or another. These sub-units were then analysed in more detail and conclusions were made about them. The theming proceeded systematically and consistently because the transcribed material was large.

4.2 Research process

This chapter aims to declare the whole process of this research. The chapter will introduce the timeline for all the research parts. Firstly, the research started with theoretical research, which aimed to establish the knowledge for conducting the interviews. At the same time during the theoretical research, perspectives were sought for the creation of a PMS. The theoretical research provided aspects that were used in the development of the research framework for this study. Then interviews were conducted, and the received material was analysed. The analysed interview material (the empirical material) and the theoretical material together were utilised in the framework of implementing the PMS. After the development of the PMS, it was presented and improved based on the results of the workshops. Finally, the PMS was uploaded to the case company's server. Iteration played an important role in the research because it helped refine the research and PMS forward based on feedback. The research process is demonstrated in Figure 11.
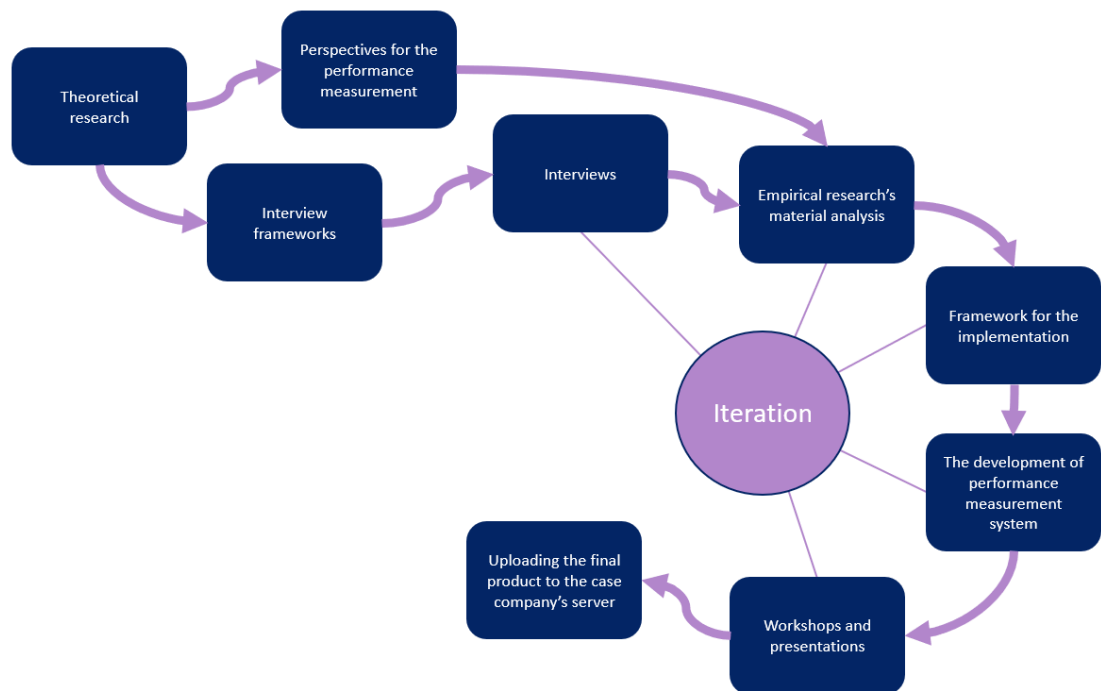
Figure 11. Research process

It is important to understand the research process and the meaning of its stages. Figure 11 aims to summarise the entirety of the research. The research progresses in such a way that each step supports the next one and this justifies the research. The planning of the research process helped the research and implementation of the PMS because any of the necessary steps were not left out.

5. DESCRIPTION OF THE CURRENT STATE OF THE CASE COMPANY

5.1 The research and its impact on the case company's logistics

The research objective was to develop a PMS that would evaluate the performance of LSPs that the case company is using. This is linked straight to the case company's vision, which is "a stronger, lighter and more sustainable world" ("Vision and Values," n.d.). The performance measurement will provide indicators that can be used in the development of the logistics chains. Therefore, the transportations of the products can be done most effectively, for example, utilising transport equipment so the weight capacity is all used.

The case company's vision is backed up with values, which are shortly driven, true, and ahead. Driven stands for that all stakeholders should work together to create value and all the activities aim to be result-oriented. True captives that all that is being done is right, for example, treating each other respectfully and acting with integrity. Ahead stands for that the future is in mind, which includes continuously improving and bringing innovations to life. ("Vision and Values," n.d.)

The case company's vision and values guide all processes, starting from the daily activities. It is the logistics department's responsibility to ensure that the vision and values are affecting the supply chain processes when comes to delivering products to customers. However, the case company is not transporting itself, but the transporting activities have been outsourced to LSPs. Therefore, the logistics department must supervise all the LSPs who are operating on behalf of the case company. The logistics department's responsibility is shown in Figure 12.

The Case Company

Vision

"A stronger, lighter and more sustainable world"

Values

Driven: "Together we create value"
True: "Do what is right"
Ahead: "Future in mind"

Logistics

Logistics Service Providers
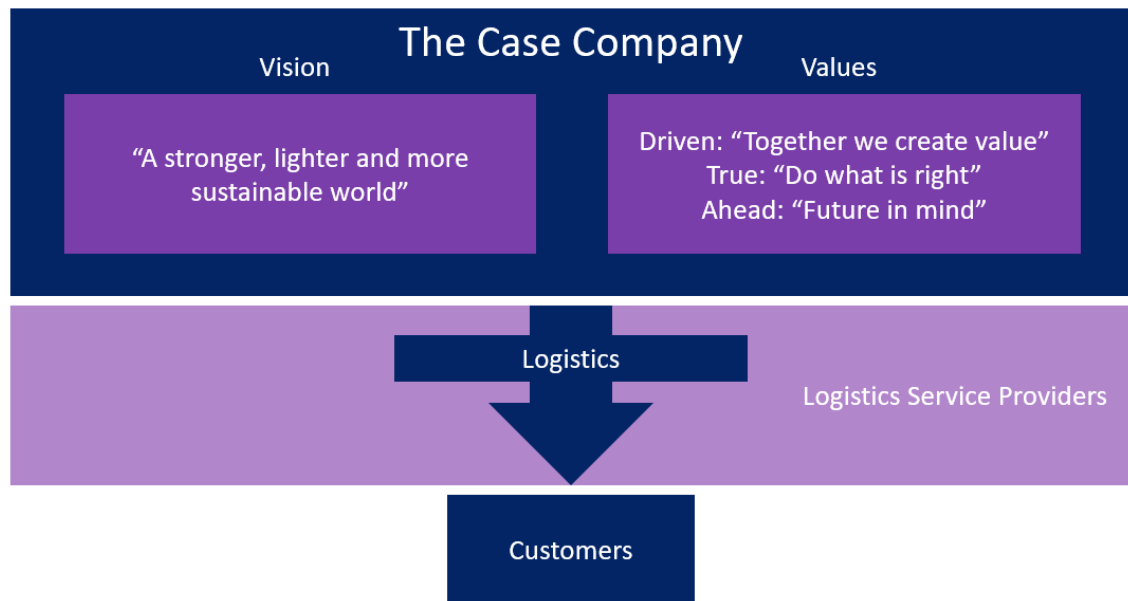
Customers

Figure 12. The case company's logistics, vision, and values

The case company's logistics cannot be forgotten even if the main business is manufacturing products. Products must be transported to customers. If the case company's logistics is not done in the most efficient way, the performance of the manufacturing will suffer in the wider spectrum. The case company's logistics is a visible process to the customers when the products arrive along the logistics chains. Therefore, it is important that the transportation is conducted respectfully. This will help the customers see the case company more positively.

5.2 Descriptions of the case company's supply and logistics chains

The case company's supply chain is a broad concept but, in this research, we will focus more on the downstream of this supply chain. The case company can be seen as a producer as visualised in Figure 5. The upstream members are the suppliers who deliver the raw materials for the case company that is refining the raw materials into steel products (e.g., steel coils, plates, pipes, or sheets). Also, the downstream members of the supply chain can be seen as producers. The downstream members, producers, use the case company's products as a material to manufacture refined steel products for the market.

The distribution (product flow) of the steel products to the downstream producers is handled by LSPs contracted by the case company. The LSPs work in different logistics fields. There are different subcontractors to handle truck transports, sea transports (container

and conventional), train transports, and harbour operators. Conventional sea transportation means in this case that the products are loaded on the vessel without being in containers. Even multiple subcontractors can be used in one logistics chain, for example, a train is used to carry products from the manufacturing plant to a harbour. In the harbour, the products are loaded on a sea vessel that carries the products to the end harbour. In the end harbour, the products are transported via trucks to the end customers. Also, air transportation is used in unusual situations, but air transport is based on spot pricing and not on contract. Air transportation is excluded from this research.

Information and cash flows are attached to the case company's product flows (as interpreted in Chapter 3.5). Information is shared during the supply chain both ways, between the upstream and downstream members. For instance, the case company sends information regarding the products' manufacturing statuses and end customers' delivery details to the LSPs. Also, information about the delivery is shared with the end customer so they can prepare their activities for receiving the products. On the other hand, LSPs share information about the progress of the delivery with the case company. After the deliveries are made, data about transportation is shared with the case company so the case company can analyse the performance of the LSPs.

Cash flows from the end customers (who buy the case company's products) to the case company. The case company directs some of this flow to the LSPs, in which case this flow is used to pay for the logistics services provided by the LSPs. There is a delay in this billing process so before the actual costs of transportation can be used, estimated freight prices are used to analyse the costs of the case company's logistics.

The case company delivers the products worldwide as visualised in Figure 13. The arrows' width symbolises the volume level of the product flow. Nordic countries and Central Europe's volumes are the highest and these product flows are handled by truck, train, and sea transports. Other product flows are mostly handled by container transports. The case company's product flows in Figure 13 are based on older average data and do not reflect the current state of product flows. Still, Figure 13 gives the main idea of the case company's product flows.
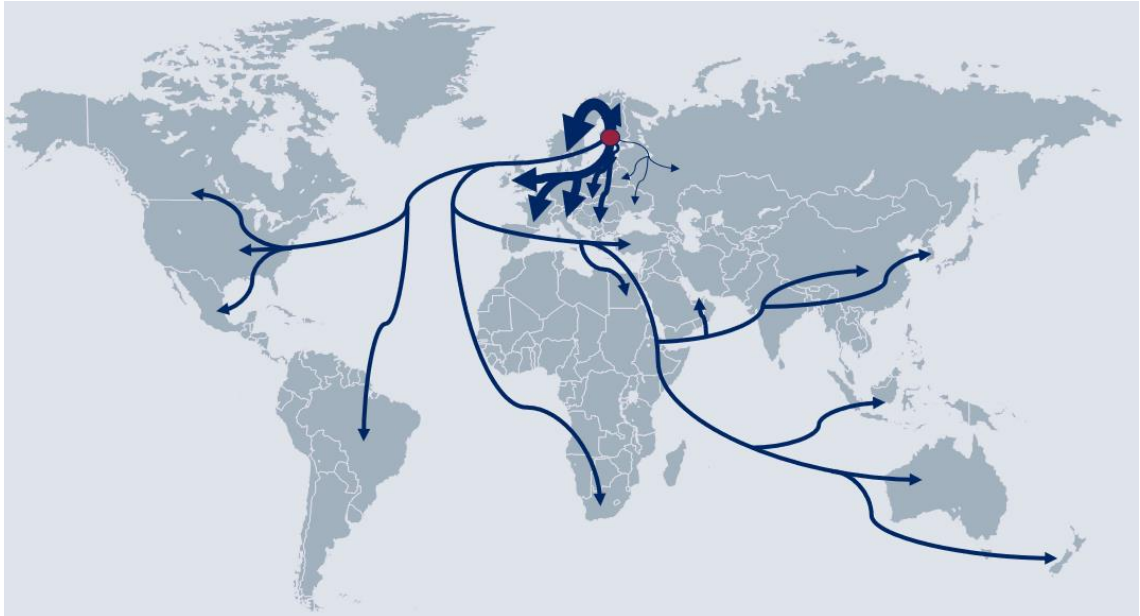
Figure 13. The case company's worldwide product flows

As seen in Figure 13, the volumes in Europe are the highest. Figure 14 visualises these European product flows. Sweden and Finland are the countries where the case company sells their products most and these countries are operated by truck transportation. Poland is the third biggest country by volume and this volume is also mostly handled by trucks. Deliveries to the further countries are handled by multimodal transportation, and the main principle is that there are sea transports done to Western Europe from the case company's manufacturing plants. The distribution from Western Europe to the customers is done with trucks.

Figure 14. The case company's European product flows

European product flows are dynamic. Tendering is used to find the main LSP for the different logistics legs, but high manufacturing levels may interrupt these logistics legs and spot pricing-based tendering (finding once time LSP for a specific delivery patch) may be needed. Also, if the used LSP encounters a problem that withholds their services, a compensatory LSP is searched. This may lead to a change in product flows.

5.3 Logistics data collection and use

A lot of data is collected but it is not used efficiently to develop the case company's logistics processes. According to Schoenherr and Speier-Pero (2015), SCM profession-als often deal with a massive amount of data and the real question is how to leverage it. They continue, how modern technology has made it easy to collect a large amount of data. Different LSPs have their own platforms and portals that can be used to monitor

their logistic legs and the products on them. It is also common that LSPs to send statistics of their performance to the case company's personnel via email. These statistics are often in a table format and these tables are attached to emails. When the case company's logistics chains consist of many different LSPs, and therefore different modes of transport, it is complicated to evaluate complete transportation legs and the LSPs' performance in them. It is also noticed that when the quality of data is high, the case company's supply chains are efficient (LSP1). Poor quality data can lead to distorted conclusions:

"The data must be reliable. If the data is incomplete, it must be highlighted so that incorrect conclusions are not drawn from the incomplete data." – Operation Control and Developing Manager (DEV1)

It is acknowledged that there is no straight knowledge about how to use all the collected logistics-related data. Also, the location of some data is uncertain, and therefore it is challenging to get hands on it:

"Information should be produced more in a structured way. There should be one place where you can see how the logistics chains are performing." – Head of SCM (SCM1)

It has also been noticed that when the collected data is not straight visualised, it is hard to understand how the data could provide information that could be used in the development of the logistics chains. This is backed up by Döbler (2020, chap. 1) because humans understand best through the visualisation of information, and when data is presented visually, the understanding of complex things increases greatly.

The case company's logistics agreements specify the most important things to be measured (SHIP1). Data is being used to compare different LSPs' performances. This leads to the selection of which LSPs and logistics chains are used to transport the products to end customers. Data is also used when determining new logistics chain concepts (SCM1, LOG3). New concepts are compared to older ones in the aspects of delivery times, volumes, and costs (LOG3). Still, costs are hard to monitor in real-time because there is a delay before actual costs are reported into the case company's systems. Before the invoices from logistics activities have been paid, the costs are represented as estimates in the ERP.

External stakeholders use the case company's data to reserve transport equipment so the arriving products can be transported to end customers in the most optimised way (LSP2). The case company sends data and information, regarding coming vessels and the products on them, to port operators and this information is used to plan onward transports. Wang et al. (2021, p. 1965) state that supply chains' upstream members often

have an information advantage about manufactured product quantity, so it is essential to share this information in a supply chain. Data shared with LSPs are not always the highest level of quality. This is often since the logistics processes still have manual work steps within them (LSP1). Some LSPs are using intelligent solutions to complete the data. For example, product group inferencing using the given dimensions. (LSP2)

The case company has been monitoring pickup accuracy in the past. Pickup accuracy in this context means that when delivery for the case company's products is ordered, the case company include a wanted pickup day in the order. This wanted pickup day is then compared to the actual day when the LSP arrives for the pickup. Pickup accuracy is still monitored to this day, but it doesn't anymore affect the activities so much as in the past (LOG4). The idea of monitoring pickup accuracy comes from the limitation of getting delivery accuracy in the past. Information related to timestamps of delivery was not accessible, so the pickup accuracy was adopted to be monitored. Just monitoring the pickup accuracy is not efficient because LSPs can transfer their transport equipment near the case company's manufacturing plants and make them wait for products. When a delivery order arrives, the truck quickly loads it.

The measured pickup accuracy is not serving all internal stakeholders. For example, the case company's sales department does not have data about how the products have been delivered to the end customers in time because only estimates can be calculated from the pickup times. The case company's end customers are most interested in if the products arrive in time (SALES1). The company needs a tool that could be used to monitor the delivery times to end customers so the logistics processes can be developed further (SALES1). There is an ongoing project (the logistics transparency project, more later) that will produce data about the actual transports and this project enables delivery time reporting.

5.4 Internal and external stakeholders

Overall collaboration with external and internal stakeholders is functional (LOG2, SALES1, SHIP1), but there is also room for improvement. There are frequent meetings between internal and external stakeholders in which overall activities and performances are addressed (SHIP1). Single meetings, which often occur due to problems in the supply chains, are organised as necessary. Also, innovations, supply chain waste removal, and process reengineering are handled in these meetings (LSP3). Reports are shared through these collaboration chains, but they are hard to use because they come in different forms. This makes it difficult to understand the big picture. Manthou et al. (2004, according to Cao and Zhang, 2013, pp. 59–60) state that the ideal situation would be for

stakeholders to have real-time access to information wherever and whenever. Data and information shared by the case company are not always perfect. For example, the port operator is harmonising data flow with different rules because the case company has multiple manufacturing plants that are using their own kind of processes and IT systems.

The case company's logistics management values that there would be a method to show logistics performance to the other organisations and departments of the case company. The logistics management has the information about the logistics performance, but it is challenging to introduce it to an outsider who does not have their core competence in logistics:

"It is important to be able to share information with someone who has no experience with logistics. The most important thing is to be able to get the facts presented in a believable form." – Transport and Logistics Analyst (LOG3)

The sharing of logistics information has led to an ad hoc query policy where visualisations and analyses of the performance are tailored for each meeting with LSPs. Ad hoc analyses and visualisations are not the most efficient way. Also, these ad hoc materials for the meetings often focus on problems in the supply chain. Thus, the overall picture of transportation will be unclear when the material does not cover all aspects of transportation.

Internal collaboration in the case company should be improved because currently there are few signs of silo thinking to be noticed. According to Waal et al. (2019, pp. 3–4), silo thinking leads to focusing only on the interests of one's own organisation and not seeing the interests of the company. Waal et al. continue how this leads also to a lack of understanding of the benefits of sharing resources and knowledge. Silo thinking appears in the case company in such a way that the departments and organisations do not share information at the most beneficial level. For example, some crucial information (e.g., a huge delivery amount has been sold and the delivery patch will be needed to transport with extra capacity from LSPs) has been found from unofficial sources. Information is shared with the closest organisations, but the information does not reach everyone that needs it.

The case company's logistics and sales department do a lot of collaboration. For example, the customers contact the sales if they want to know their orders' ETA (estimated time of arrival). The process then continues, and the sales department contacts the logistics department to consult the ETA. Logistics may estimate the products' arrival time or inquire about the LSP for a more specific time. The same process as mentioned above will be realised when there is a problem with products or the quality of the transportation.

The sales department does not have a clear picture, for instance, of which LSPs are the most reliable in delivery accuracy and delivering speed. This information could be provided with the average results from the PMS, which considers delivery time data.

The case company's logistics department belongs under the case company's SCM. Therefore, the case company's SCM is interested in logistics performance. The SCM's main interest focuses on the transported amount and its costs. A monthly report is provided for the SCM, and this report shows transported amount and costs within different modes of transport. Otherwise of monthly reporting, the communication of logistics performance is mainly made verbally. The end customers usually provide feedback to the case company's sales department and the feedback mainly occurs when there are problems. This feedback is treated and analysed with the collaboration of the case company's logistics and SCM. A more agile way of analysing logistics performance would suit the SCM better to develop processes toward the company's vision.

Data that is shared in these stakeholder collaboration chains is important and its exchange needs to be increased. It is necessary to be aware of the effects of the data on different stakeholders:

"It is important to be able to combine and validate data so that it is reliable. The case company needs to be aware of things that benefit it, and which benefit both the company and the LSPs." – Operation Control and Developing Manager (DEV1)

Information (e.g., delivery times) needs to be shared with the end customers because the end customers want to optimise their processes with this information (SCM1). Also, the case company's production predictions are shared with the LSPs. The LSPs operating with vessels are strict with the predictions. They sell ship space to different customers depending on the volume prediction. There is a little room for change but if the prediction is not met there will be penalty costs. (LOG1) Additionally, data can help to prevent problems if they are spotted from the data in advantage (SCM1). It is acknowledged that all internal stakeholders do not understand to share their data fully, and this might be the result of silo thinking.

5.5 Weaknesses and strengths of existing logistics metrics

The case company's organisational hierarchies have been changed in the recent past, and therefore organisations' common performance goals are still under development process. The logistics reporting system is still looking for its place because wanted reporting aspects need to be created or asked. There are no tools that could be used in an

agile way to find wanted results within logistics data. Additionally, data from other the case company's internal stakeholders is hard to process for logistics purposes (LOG3).

The case company's central data warehouse has a lot of logistics-related data but all of it may not be relevant for logistics development purposes. Therefore, it may be challenging to find wanted data because there are a lot of possibilities to choose from. (LOG3) The internal stakeholders are needed when planning and establishing reporting because, for example, the case company's BI (Business intelligence) team does not always fully understand the logistics processes. The logistics organisation and BI team must increase integration so the reporting process can be developed to the need. According to Parmenter (2015, p. 106), all parties must understand the object of measuring something and if the measurement does not deliver the wanted, the measurement logic must be rejected.

The case company's logistics-related contracts may be hard to find and use because the contract archiving process is unclear. Also, if contractual matters want to be clarified, for example, for measurement purposes, the contracts must be manually gone through. Contracts' metadata is quite incomplete so it cannot be used to find out the wanted things. There is a plan that all contractual matters (e.g., promised delivery times) could be reported in the case company's central data warehouse in the future (BI1).

The case company's manufacturing plants' warehouse levels should be able to be monitored in more detail. The same considers the delivery amount that has been sent to end customers. (SCM1) In sea transports, reporting from full logistics chains is inaccurate. Freight costs from one leg (e.g., shipment from Finland to Central Europe) are more reliable. Full leg, in this case, can be that the shipment continues from Central Europe to North America with an ocean vessel. So, when the full sea logistics chain includes many operators, the reliability of reporting decreases a lot. (SHIP1) Container deliveries are also lacking data, which makes it hard to conduct reporting.

It is important that data could be connected to other data sources, and the data's validation process could be complete so that it is always coherent. Now there is data in different data models, which must be used separately. This can also be seen in this research because separate PMS dashboards must be created for different data models because they cannot be combined.

5.6 Development of logistics processes

5.6.1 Ongoing and planned developments

The logistics management benchmarks LSPs from time to time, and costs are the main factor in these benchmarks. It is acknowledged that costs should not be the only factor now nor in the future because the importance of sustainability will be increased in the case company's logistics processes. The logistics management supports the benchmarking with the experience of the case company's logistics personnel, which work directly with the LSPs. The problem with experience is that biases may affect it, and therefore objectivity may be challenging to achieve.

Logistics-related data should be produced in a more structured way. There should be standards on how data is saved. According to Sebastian-Coleman (2013), data quality standards define the expected condition of the data so its usage can be continued without interruptions. In the case company, there are now many different systems that are used in operating the case company's logistics. If there would be one single system that could be used to handle all logistics daily activities, it would boost the usage of data because all the data possibilities would be in one place (SCM1).

Measurement of the logistics is needed to evaluate the LSPs. Delivering as promised increases the value that the customers are receiving, and it must be pursued. Delivering time window is provided for customers, and the customers plan their processes according to this information. Therefore, the delivery time window should be achieved, which allows the customers to proceed with their manufacturing processes. The case company's LSPs are the ones to whom this delivery process has been outsourced. The case company must have tools to monitor and develop these processes where the LSPs handle the case company's products.

LSPs usually serve multiple companies with their logistics services. Therefore, LSPs tend to optimise their own logistics processes in the name of utilising logistics equipment in the most profitable way possible. Companies who buy logistics services must monitor the logistics processes, at least in the start phase of a logistics agreement, so all aspects that have been agreed upon are met.

The LSP comments that the estimation of products to be delivered should be improved. For example, there might be a sudden situation where there is an urge to deliver a huge number of products to the customers. According to the LSP, it is challenging to respond to unexpected volume spikes (LSP3). This is a recognised problem in the case company and plans to improve predictability have been made. According to Pagano (2020, p. 57),

accurate predictions improve the allocation of resources, such as labour, equipment and material.

The case company sees that it must take care of its LSPs. If something is agreed with a customer, the case company strives to communicate these agreed matters to the LSPs. It is beneficial for all supply chain parties when customers are acknowledged as the most important, and all activities aim to serve the customers in the best way possible. The development of logistics chains is seen to serve the customers. Developing the case company's logistics chains is based on experience and collaboration with the LSPs operating in them. Short-term strategic development goals are delivery accuracy improvement, the logistics processes' digitalisation (e.g., automation and transparency), and sustainable development (e.g., considering emissions) (LOG1, SALES1, LOG3).

The case company's biggest (the level of cooperation) LSPs are the main group that logistics development is made with. Digitalisation and sustainability are the main subjects of development now, but still, the costs of logistics should not be forgotten. (LOG1) The biggest LSPs have a wide range of measurement data for the case company to use, which they want to share in the name of developing the logistics processes because both parties benefit from it.

5.6.2 Factors influencing the development of logistics processes

Digitalisation and sustainable development (e.g., fossil-free transportation) are the main themes that are affecting the development of the case company's logistics processes now (SCM1, LOG1). The mentioned themes originate from the case company's vision and values (LOG1). There are many logistics processes and methods that the case company's personnel are just used to do, and this style does not fully favour the case company's strategic goals. Regarding these processes, they must be unified by the case company's vision and strategy.

The steel market should also affect the development of the case company's logistics. There should be more time to concentrate on upcoming trends. Today's way of doing is more like problem-solving and the actions are aimed backwards and not looking into the future. The development of the logistics processes should also aim at predictability and resilience. For example, if fuel costs rise suddenly, there would be still functional logistics chains that can deliver products to the end customers within reasonable costs. According to Gupta et al. (2022, p. 11), today's logistics systems are not resilient, and this was exposed by the outbreak of the covid pandemic. Gupta et al. continue how innovative

technology plays an important role so that logistics systems can adapt quickly to the prevailing situation in the future.

The case company's logistics future should be more discussed. A roadmap has been made, which purpose is to guide the future of the case company's logistics (LOG2). The logistics road map starts from fixing the basics and establishing a common logistics platform (TMS) that all the case company's manufacturing plants would use. The next steps are to create transparency in the logistics processes (the logistics transparency project, more later) and to establish a logistics-related ecosystem.

The end customers' impact on the development of the case company's logistics processes is noteworthy. All the logistics activities aim to serve customers as best as possible. (LSP3) The case company wants to be a flexible player in the steel market, and this affects the optimisation of the logistics processes (LOG4). It is acknowledged that it is near impossible to demand digitalisation and sustainable development from LSPs if the collaboration is short in time. It is important to establish long collaboration chains so the logistics processes can be developed together with LSPs in a more efficient way. (LOG1) According to Wang et al. (2016), LSPs support the value chain and act as builders of a logistics network. In addition, LSPs are becoming increasingly active integrators within and between supply chains.

The development pressure of logistics processes is often made by end customers. Transportation quality should be top-level, but still, the end customers do not want to pay any extra for the transportation. The development of the logistics processes should be done cost-efficiency. The goal is to ensure adequate and timely transportation equipment, which can serve the needs of end customers.

5.6.3 Logistics transparency project

The logistics transparency project (also known as the track and trace project) aims to create a visibility platform for transportation track and trace. The visibility platform provides the end customers with harmonised real-time information about their deliveries (e.g., where the shipments are and when they will arrive). Also, the project will aid the case company because it will improve reporting and therefore analysing of the product deliveries. The project will eliminate the need for manual work of reporting because it will automatically gather harmonically the wanted data. The case company will be able to gain a comprehensive view of deliveries. This establishes the comparison between different logistics chains. Also, the project increases the proactivity in logistics chains, so activities can be changed before problems will occur. ("Next-level customer service with real-time transportation visibility," 2022)

The logistics transparency project's concept is visualised in Figure 15. The idea is to gather transportation data from source systems, harmonise the data collection and saving, receive tracking information from LSPs, and provide the data to the case company and its customers. ("Next-level customer service with real-time transportation visibility," 2022) The logistics transparency project is established on an integration platform, which takes data from the case company's different manufacturing plants' systems. Data is saved on the integration platform harmonically and the data from the integration platform can be used for different purposes. This data is then transferred to the case company's central data warehouse and needed formulas and calculations are made in the central data warehouse. In addition, another data source is used to complete the integration platform data so transportation can be investigated in complete logistics chains (BI1). It was acknowledged that the most important and challenging part of the project was to get LSPs to provide the location updates ("Next-level customer service with real-time transportation visibility," 2022). There are three main possibilities to get the location data and these possibilities are LSPs' telematics systems, mobile devices (applications), and LPSs' TMS. The biggest LSPs (defined by turnover) were the easiest to connect in the visibility platform because they are already using reporting and analytics to gain a competitive advantage. Smaller LSP companies were harder to get involved with the project because they were often lacking necessary IT systems.
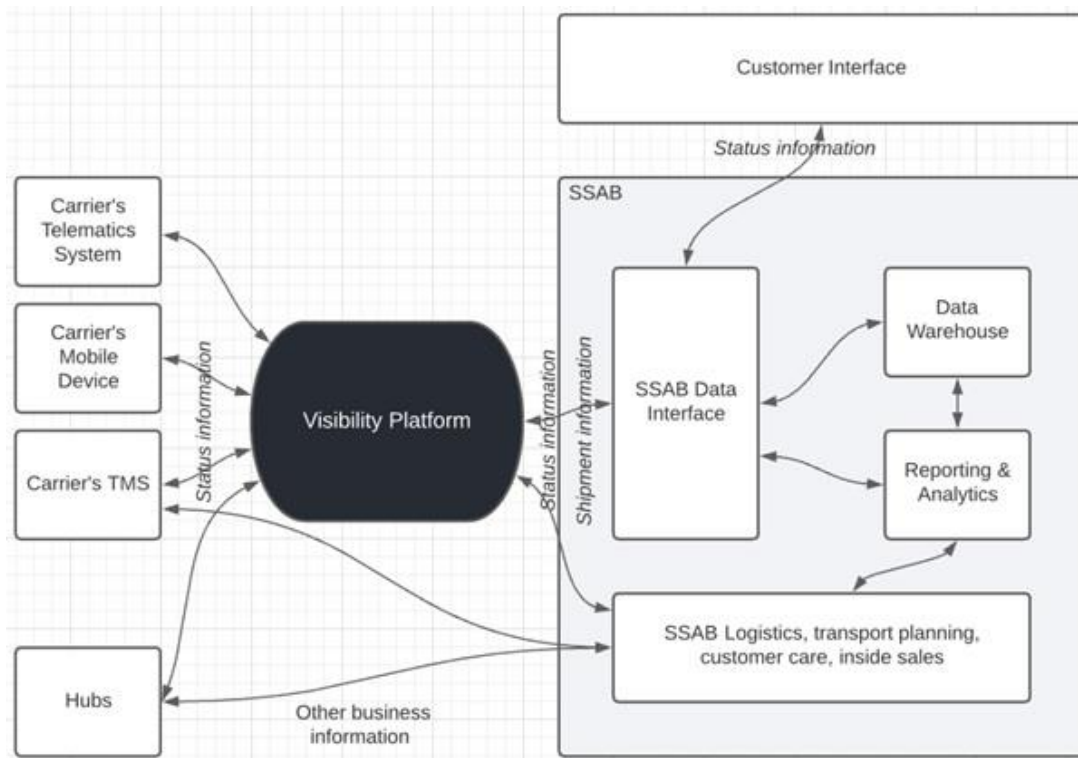
Figure 15. The logistics transparency project's concept ("Next-level customer service with real-time transportation visibility," 2022)

As visualised in Figure 15, the logistics transparency project's data will be used in the case company's data warehouse. This integration platform data creates new kinds of opportunities for evaluation of the LSPs. For example, location information has not been available before the project. It is also noteworthy that the logistics transparency project is still ongoing when this research was conducted, and therefore not all LSPs used by the case company are involved yet. Still, the PMS is developed in a way that when new LSPs are connected to the visibility platform, their data can be used immediately by the PMS's dashboards.

5.7 Evaluation of logistics service providers by the case company

Experience in logistics helps to evaluate LSPs during a contract period or in a logistics tendering (SHIP1), but monitoring is also needed. The main aspects to be appreciated in logistics tendering are performance history, costs, transport equipment requirements, and the company's financial background. A PMS would be appreciated as an aid that would provide an agile way to check LSPs' performance before more detailed analyses. According to Chen (2008), LSPs evaluation can assist in selecting the most suitable LSPs and integrating LSPs' capabilities to develop the customer experience using objective-oriented requirements.

Many discussions are done with the case company's operational transport planning team during a logistics tendering. The main goal of these discussions is to find out how the LSPs have performed and what are the expectations towards the LSPs. Is also worth noting, that LSPs' experience with the case company is appreciated during the evaluation process. There is always a set time when a completely new LSP starts operating the case company's product deliveries. When a company already knows the case company's loading procedures (e.g., what information a driver needs and knowing loading processes), the loading activities stay efficient at the start of the contract period.

There are frequent meetings with the LSPs during the logistics contract periods (LOG1). In these meetings, different KPIs are discussed, which are also used in evaluating the LSPs. Both parties (the case company and the LSPs) bring their materials to the meeting. The case company's material usually deals with pickup accuracy, transported volumes, sustainable development, and whether the matters specified in the logistics contracts have been fulfilled (LOG2).

In the future, there will be new issues (e.g., digital capability) on which LSPs will be evaluated. In this context, digital capability means two things, firstly a LSP must be ready to exchange delivery orders and invoicing digitally and secondly, the possibility to connect to the case company's visibility platform.

6. ANALYSIS AND RESULTS OF EMPIRICAL RE-SEARCH

6.1 Objectives and measurement perspectives determination

Objectives and measurement perspectives for the PMS were determined with the help of both literature and empirical material. It was quickly recognised that the case company's vision and values were not enough to be used as the foundation of the PMS. As Lönnqvist et al. (2006, p. 106) mentioned in their book, the strategy toward a company's vision can be narrowed down by conducting interviews in the company. The interviews revealed that there is often a desire for a PMS, but its content cannot be described:

"Usually, a company wants a PMS, but it is not known what all it should contain. The creator of the PMS must develop questions and help the company answer them." – IT Project Manager (LSP2)

The case company's logistics organisation's most important thing to do is establish and enable logistics chains, which are used to transport products to the end customers. Products must be in the right place at the right time with reasonable costs. This can be achieved by making good logistics agreements with LSPs and doing a collaboration with them. And the customers must not be forgotten either because the customers' feedback should listen to for development purposes.

It is acknowledged that data can be used to develop logistics processes further and it helps to develop quality and efficiency (Prajogo and Olhager, 2012). When data quality and real timing are high, it provides an opportunity to improve daily activities towards business goals. The case company's warehousing capacity is limited so the product flow must be regular. Data and information are used to prevent warehouses from exceeding their capacities.

LSPs used by the case company are often operating dynamic product flows. This means that there are no in-advance planned routes to be used but the logistics chains are planned according to different customers' orders. According to Vicentiy (2020, p. 2), to effectively manage dynamic logistics flows, data visualisations based on the needs of the user and task must be available. To serve the case company's end customers as best as possible, high-quality data need to be shared with the LSPs.

Collaboration among the case company's internal stakeholders is essential to serve the end customers. When there are problems within logistics processes, the case company's

sales organisation is often the first party to get this information. Problems in the supply chain are often the main reason why logistics processes are developed further, and similar finding has been made in the literature by Chen et al. (2017). The sales organisation also consults the case company's logistics organisation about the delivery of different product batches. This often occurs when there are a lot of orders coming from end customers and the sales organisation needs to find how big a product batch can be sent to the end customers with current logistics chains. The case company's sales are planned with logistics terms and restrictions to ensure the delivery of the products.

It is important to monitor LSPs' performance on those aspects that have been decided in the logistics contracts because the case company is paying what has been agreed (SHIP1). For example, in the case company's logistics contracts, there are determined maximum delivery and preload times in ocean transportation (LOG3). It is difficult to measure something that is not agreed upon in the contract. There is a misconception that logistics-related inefficiency is affecting only LSPs, but the truth is that the costs of this inefficiency will be paid at the value chain level:

"A misconception is that a LSP is good if it can pick up products on a fast schedule. However, this does not always indicate efficiency, as the equipment may be waiting nearby the loading place, causing waste in logistics chains." – Logistics Manager (LOG1)

Monitoring also helps in other matters than the contractual. According to Piecyk and Björklund (2015), analysing and evaluating the performance of LSPs improves the sustainability of logistics operators' activities. This way it is possible to ensure that the LSPs' activities are in line with the company using their services.

The PMS needs an overview view that delivers all the most important performance indicators at once (SCM1). This managerial view in the dashboard will signal the big picture of logistics performance. On the managerial level, costs (euros per ton), delivery times (actual versus promised), transportation equipment's utilisation rate, and pickup accuracy are measurements that need to be frequently monitored (BI1, SCM1, SCM2, LOG1, LOG2).

In ocean transport, it is important to monitor if vessels arrive on harbours in the time that has been promised and if the actual delivery times are what has been promised by the ocean transport companies (LOG1, LOG2). Stuffing time, among container shipments, is important to be measured. Also, distribution transports from harbours are meaningful to monitor because the distribution transports affect the total duration of the logistics chains. (LOG2, LOG4) There is now a new process within the ocean transports that

operational personnel manually fill out Excel spreadsheets with the most important per-formance indicators, for example, vessel arrival accuracy, nomination accuracy, safety, and product damages (SHIP1).

IT capability is also an important aspect to be measured because product flows are im-portant, but information flow might be even more important in today's way of doing (DEV1). According to Christopher (2000), the ability of an organisation to respond to fast-changing logistical situations and environments requires IS and processes from the sup-ply chain. The case company must be ready to adapt, and IT capability contributes to increasing resilience. Also, IT capability is in alignment with the logistics transparency project because LSPs will need specific IT systems to be connected to the visibility plat-form.

LSPs' response time would be beneficial to measure because it would help to estimate LSPs' ability to answer volume spikes (DEV1). Transport's quality should be also meas-ured, and the quality includes the case company's instructions, safety, and emissions (LOG2, DEV1). Emissions will affect a lot of the case company's logistics in the future. Products are being developed to be coal-free, and therefore logistics needs also to be environmentally friendly. (SHIP1, LOG4) Lowering emissions is a part of the case com-pany's vision (SALES1). In the future, it will be probably mandatory for LSPs to provide their emissions levels from actual transportation. Emission levels will be used in tender-ing to find out what are the plans to reduce the emission levels.

The case company's end customers also demand plans of how the case company will reduce transport emissions (SALES1). The phenomenon where customers expect and demand sustainable logistics solutions have been observed and recognised in the liter-ature (García-Arca et al., 2014). Sustainable logistics was seen as a threat to the effi-ciency of logistics in history (according to García-Arca et al., 2014, p. 343), while today it is slowly starting to be more of competitive advantage. The emission levels are now based on theoretical average and the emission levels are uploaded to the case com-pany's central data warehouse. In the future, emissions will be based on actual logistics activities (BI1, LSP2) and there will be a clause in logistics contracts that obligates LSPs to report their actual emissions (LSP2, SHIP1).

It is acknowledged that emissions from transportation will be paid as taxes, sanctions, or higher prices in the future (LOG1, DEV1). Supply chains' sustainable development is always a cooperative process, and this development will help all supply chain members when inefficiency from the chains is removed (LOG1). The ideal state would be that if

someone asks about the emissions of transportation, there would be an actual and coherent answer to that (SCM2).

All identified objectives of the PMS are visualised in Figure 16. There are a total of seven main objectives identified, and additional information about these main objectives. These seven main objectives were identified to be the foundation for the PMS. The case company's vision and values can be seen affecting objectives, for example, sustainable development and value creation are also linked to the case company's vision.

1. Creating and enabling logistics chains to serve end customers
- Monitoring the performance of the logistics service providers
- The importance of manufacturing prediction
- The end customers would be able to see products' arrival

2. Creating value for the end customers
- Transporting products to the end customers fast enough
- Benchmarking current logistics processes and innovating new
- Solving logistics-related problems
- Predictive way of doing before problems actual occur

3. Logistics service providers should meet the matters agreed upon in the contracts
- Agile way to use performance measurement

4. Logistics service providers' performance
- Impact on tendering
- Decision-making based on costs
- Bonus policy

5. Internal and external stakeholders' need for logistics data
- Development of the collaboration
- Information sharing is open and transparent

6. Sustainable development
- Reducing transport emissions

7. Use of data
- A lot of data is available, but it is not used efficiently
- Which logistics service provider can be used in special situation

Figure 16. Objectives for the PMS

Objectives in Figure 16 can be transformed into measurement perspectives. A total of five measurement perspectives could be identified from the objectives. The measurement perspectives are the following:

1. End customers experienced value

2. LPSs and their efficiency

3. The case company's operational logistics efficiency

4. Personnel

5. The case company's vision

The measurement perspectives will be themes within which critical success factors will be considered. It is important to consider the measurement perspectives in a context, so it is possible to understand the impact of measurement on the entire process.

6.2 Critical success factors determination

CSFs are the aspects that are needed to be measured in a PMS (Lönnqvist et al., 2006, p. 109). The measurement objectives and perspectives were clarified previously, and they serve as a basis for defining the CSFs. Both the literature and empirical research helped in the development of CSFs. The interviews were used to find the CSFs that would support the logistics development of the case company towards strategic goals. The interviews helped to bring operational insight into the determination of CSFs:

"A PMS should be developed upside down, in which case operative management and personnel should be involved in the determination of CSFs and the CSFs found should be communicated upwards in the organisational hierarchy" – IT and Process Developer (LSP1)

The literature research supported the determination of the CSFs. The result was a comprehensive list of CSFs whose measurement would support the development of logistics performance. The CSFs were presented to the case company and the feedback confirmed that the research was on the right track. The CSFs to evaluate LSPs are:

1. Reducing transport emissions

2. Safety

3. Nomination accuracy

4. Service quality

5. Pickup accuracy

6. Costs by different logistics companies

7. Availability of transport equipment

8. Transport volumes

9. Responsiveness

10. Delivery time

11. Cost-effective use of transport equipment

12. IT capability

13. Compliance with the agreements

14. Actual delivery time vs. promised delivery time

15. Transportation quality

It is noteworthy, that the CSFs are created from both the case company's and LSPs' activities. Logistics is a collaboration, in which case only monitoring the performance of LSPs does not improve the overall activities. This should be remembered that the logistics processes of the case company can also disrupt the performance of LSPs, in which case the case company must be ready to modify its processes. According to Prajogo and Olhager (2012, p. 520), to improve a supply chain's product and information flows to increase efficiency, long-term cooperation relationships must be established. The determination of CSFs comes from the collaboration ideology. Logistics processes need to be developed together so the end customers can receive the maximum service level. If only the LSPs are demanded to have a top-level of performance, it will jeopardise the case company's vision to be a flexible and sustainable steel service provider in the market.

The next step is to examine the big picture of measurement perspectives and the CSFs within them. This is visualised in Figure 17. According to Lönnqvist et al. (2006, p. 110), the purpose of this is to understand the cause-and-effect relationships of the CSFs so that the whole is unified and not contradictory. Firstly, the case company's vision of reducing transport emissions is affecting the whole entity, and this is seen impacting the case company's and LSPs' daily activities. The personnel are the main function that boosts the efficiency of the case company's and LSPs' operational logistics. The operational logistics between the case company and LSPs are contributing to the experienced value that the end customers receive.
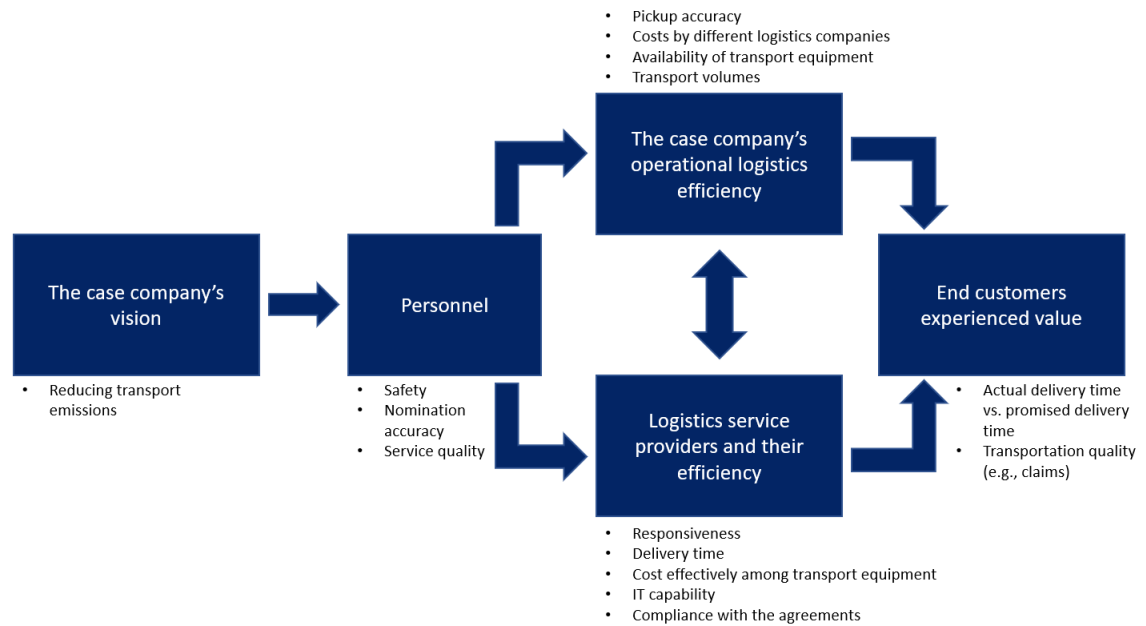
- Pickup accuracy
- Costs by different logistics companies
- Availability of transport equipment
- Transport volumes

The case company's operational logistics efficiency

The case company's vision

Personnel

Logistics service providers and their efficiency

End customers experienced value

- Reducing transport emissions

- Safety
- Nomination accuracy
- Service quality

- Actual delivery time vs. promised delivery time
- Transportation quality (e.g., claims)

- Responsiveness
- Delivery time
- Cost effectively among transport equipment
- IT capability
- Compliance with the agreements

Figure 17. Critical success factors to be measured (Adapted from Lönnqvist et al., 2006, p. 111)

The measurement perspectives visualised in Figure 17 create a theoretical model to monitor and therefore evaluate the case company's and LSPs' performance. The big picture must be understood so different results can be interpreted without the danger of these results being biased. For example, if the LSP's responsiveness is poor, the reason for this can be the lack of information shared with the LSP by the case company. It would be an easy way to accuse the LSP that their processes are not working and therefore the responsiveness is poor. However, this does not tell the whole truth and solve the problem.

6.3 Dashboards and their background

6.3.1 Technical background of the case company

Microsoft's Power BI data visualisation software is the case company's official choice for data visualisation (BI1). The case company has bought licenses for enterprise usage so Power BI will be used in this research for building the PMS's dashboards for evaluating the LSPs. The case company has a Power BI server that is used for uploading Power BI reports for usage. The server can be used in a web browser in which case the Power BI reports are easily accessible.

The case company have a database server that is used to host data sets in a tabular form. The server has different data models for different kinds of purposes. For example, the server has models concerning the company's logistics, sales, stock levels, and so

on. These models are used in this research to provide the wanted data for the PMS's dashboards' metrics.

The case company wanted the models to be linked with a live connection to the Power BI so data can be refreshed easily to gain the latest data. It was noticed early that Microsoft's Power BI does not support multiple live connections from different data models into one Power BI report so there was a need to create multiple Power BI reports. This enabled access to different data from the different data models. The data concerning the case company's sea transportation was retrieved from Microsoft's SharePoint, which is used to share files with stakeholders and organisations in the case company. The purpose for this was that the case company's sea transport planners manually fill the performance indicators of sea transports into an Excel spreadsheet file that is in this SharePoint. Not all sea transport data is available from systems because, for example, there is data concerning forecasts about the shipping volumes, and the forecasting is done by emails. In Table 5, the used data models and their purposes for this research are listed.

Table 5. Used data models and their purposes for the research

Data model	Purpose
The logistics transparency project's data	1. Delivery location data 2. Timestamps 3. Prediction of transportation
Logistics cost analysis	1. Costs 2. Volumes
Emissions	1. Emissions
Sea transport KPIs (SharePoint)	1. Delivery capacity nomination of vessels 2. Arrival and departure of vessels 3. Reclamations

Data models listed in Table 5 were used singly in different Power BI dashboards. So, a total of four Power BI dashboards were needed. Microsoft's Power BI is a suitable program for this research because it provides an interactive way of reporting. The user can select or click different parameters from the dashboard's page (e.g., clicking LSPs) and

the selection will filter the page's other graphs based on this selection. Thus, the user can investigate dependency relationships between different attributes.

6.3.2 User interface and visualisations

The dashboards should be interactive, not static. The dashboard's interactivity helps to investigate matters behind the results. (SHIP1) An interactive dashboard helps the user to interpret the big picture, after which the user can focus on the things that are necessary and important to them (Koponen et al., 2016, p. 73). The dashboards should not be too complicated to use (LOG3). The dashboards should have filters that help to use the report's interactivity. These filters, for example, could be the customers (SCM1, SALES1), transport modes, delivery countries, LSPs, and dates. (LOG1) Filtering helps the user to hide non-interesting parts of the data (Koponen et al., 2016, p. 74).

The dashboards should have a feature that allows to drill down to get a more detailed perspective because the feature would help to find root causes if there are problems (SCM1). In addition, a drill-through feature is needed because it would reveal the data behind performance indicators. Also, the drill-through feature helps to locate problems if needed. (SCM1, LSP1, LOG3)

The case company's brand should be visible on the dashboards. For example, the case company's brand colours, logos, slogans, vision, and values should be visible, so the users of the dashboards remember why they are using the dashboards. (LSP1) According to Piehler et al. (2016), bringing the company's brand visible enhances the personnel internalisation of the brand, which affects positively brand identification and commitment. This strengthens the commitment of the personnel to the company's strategic goals.

Visualisations are important to be included in the dashboards (SCM2, LOG1, LOG4). A dashboard that includes only digits leads easily to time waste because the users need time to fully understand the tables (SCM2). When presented in a visual form, the data often reveal features that would remain hidden in the text or table (Koponen et al., 2016, p. 18). The dashboards' visualisations should be simple enough that the dashboards can be used to represent results to personnel outside of the logistics field (LOG2, LOG3). Colours should be used in the dashboard, so it is easier to understand different entities (BI1). It would be beneficial that one critical success factor would be presented on one page of the dashboard (BI1). It can be said that the visualisation is successful when it forces the user to notice something that was not expected (Koponen et al., 2016, p. 18)

The chart selector guide in Figure 4 was used to develop visualisations for the dashboards. The chart selector guide in question helped in starting the visualisation process

because a chart can be selected according to the goal of visualisation. However, minor modifications were made despite the chart selector guide's recommendations.

6.3.3 Metrics determination

After the CSFs determination, metrics for each CSF were established. The main idea in this phase is to create suitable metrics to evaluate LSPs and represent that specific CSF (Lönnqvist et al., 2006, p. 112). This phase included an agile way of testing and finding possibilities from the data models for metrics. The testing was conducted with an Excel spreadsheet that was connected to the available data sources. Finding the right data also came up in the interviews:

"First, it is important to investigate whether the data even exists. If there is no needed data, it is important to study how it could be obtained. It is also necessary to investigate both what is the data's quality and how real timing it is." – IT and Process Developer (LSP1)

During the interviews was noted that costs and volumes should be the main values of the dashboards so a holistic view can be achieved (LOG2). Also, the dashboards should cover market areas (LOG1).

Determined metrics are listed in Table 6. In this table, there is first the CSF and the metric or metrics to endorse it. In the metrics column, there are brackets after the metric and inside the brackets are the identifiers that imply the nature of the result.

Table 6. Metrics for the dashboards (Adapted from Lönnqvist et al., 2006, p. 115)

CSF	Metric(s)
Reducing transport emissions	Emissions per transport (gram/tonne-kilo-metres)
Safety	Number of safety observations (count)
Nomination accuracy	Nominated delivery amount vs. delivery capacity (count or %)
Service quality	Personnel survey (%)
Pickup accuracy	Promised arrival time vs. actual arrival time (difference or %)
Costs by different logistics companies	Total costs (€) and deviation costs (€)
Availability of transport equipment	Loads picked up in time (count or %)

Transport volumes	Delivery weights (ton)
Responsiveness	Has a delivery order been cancelled and rebooked by the LSP (count)
Delivery time	Used time (hour)
Costs effectively among transport equipment	Utilisation rate (ton or %) and preload/unload time (hour)
IT capability	Companies included in the visibility platform (count)
Compliance with the agreements	How many aspects of the agreement have met (%)
Actual delivery time vs. promised delivery time	The actual time of arrival vs. ETA (hour, count or %)
Transportation quality (e.g., claims)	Number of reclamations (count)

The metrics listed in Table 6 were the foundation for the creation of the dashboards. It was acknowledged that not all metrics are possible straight away to conduct, and therefore there is a need for planning how some metrics can be achieved by the case company. Also, it is mentioned in the literature that metrics determining at once is almost impossible and multiple iteration rounds may be needed (Lönnqvist et al., 2006, p. 115).

6.4 Development of dashboards

The following sub-chapters will demonstrate the result of the development of the dashboards. The sub-chapters are handling the different data models used in this research. A total of four dashboards were developed because the data models were not possible to combine in a single report. Created dashboards are visualised in Figure 18. In that figure, there are four dashboards (on a dark blue background) and metrics within them. In addition, the CSFs that were not possible to include in the dashboards (on a light purple background) are shown in Figure 18. The dashboards in Figure 18 used the following data models:

1. Logistics costs and volumes - Data model: Logistics cost analysis

2. Logistics emissions - Data model: Emissions

3. Logistics service providers' performance - Data model: The logistics transparency project

4. Sea transport KPIs - Data model: Sea transport KPIs (SharePoint)
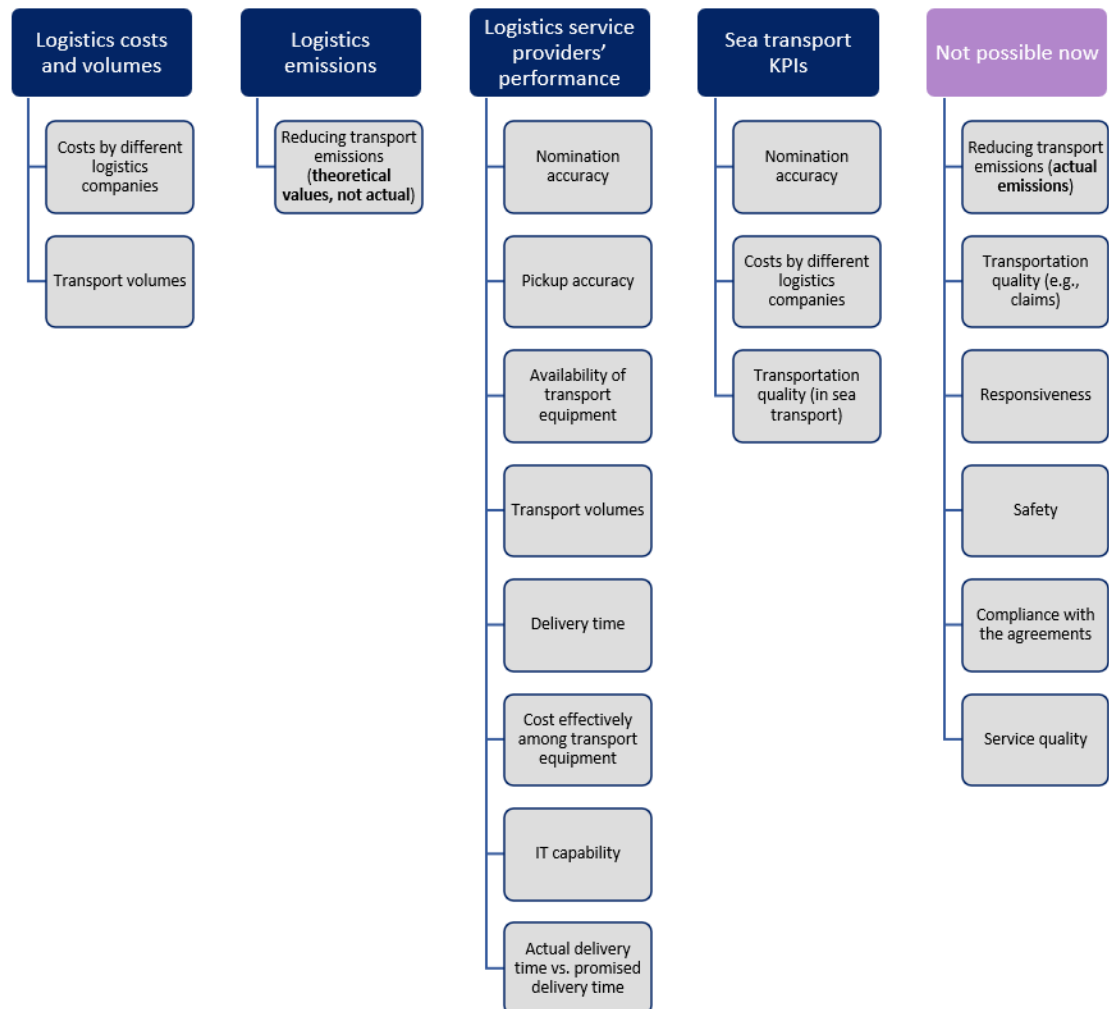

Figure 18. Dashboards and CSFs within them

In the following chapters, there are pictures included from the dashboards and the data in those pictures are censored. The reason behind this is that the dashboards use confidential data concerning customers and external stakeholders.

6.4.1 Logistics service providers' performance

The dashboards have all the same kind of theme that is aligned with the case company's brand. The idea of this was to create dashboards, which remind the user of the dashboards' purpose. The case company's logo, vision, colour, and values were included on the dashboards. This enables showing external stakeholders the dashboards' results because the case company's theme makes it professional for the context. Figure 19 has

the dashboard's (the one using the logistics transparency project's data) front page, which will demonstrate the used theme.

Figure 19. Logistics service providers' performance dashboard's front page

The dashboard's second page has filters that can be used to filter the whole dashboard. The filter page is visualised in Figure 20. There are different options to filter all the dashboard's pages. When a filtering selection is made, it will apply to the whole report. In all report views, there are "Filters" buttons that will lead the user to the filter page. In the left upper corner (Figure 20), there is an arrow button that will lead the user back to the page where the "Filter" button was pressed.
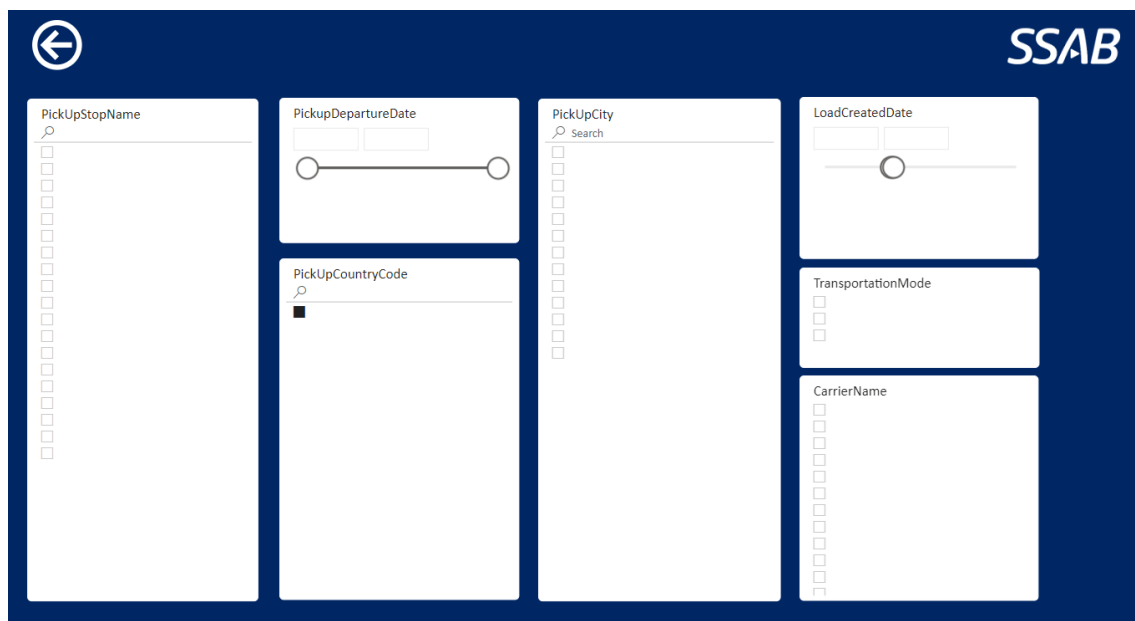
Figure 20. Logistics service providers' performance dashboard's filter page

Next is a page (Figure 21), which presents delivery times within the product transportation. There are a total of three graphs that visualise the delivery time in hours. The first graph tells the delivery times at a weekly level. The next graph represents the LSPs and their average transportation times. The final graph has a drill-through option that allows the user to visualise the data by the transportation mode, delivery country, delivery city and end customers. The drill-through feature allows the user, for example, to select a specific transportation mode (e.g., truck transport) and then the user can see delivery countries and the delivery times within them filtered by truck transport. Finally, there is a table that has all the visualised data in a table form, and a few data labels. The data labels, for example, transform hours into days and counts all the loads that are available in current filtering. Also, there are lines in the graphs that tell the delivery times in the same period month and year before. These lines help the user to see the development of the delivery times.

Figure 21. Delivery times

The next page is a sub-page for delivery times. This page (Figure 22) can be used to monitor in more detail the loads, that the LSP has operated. Also, the user can use the delivery city or country to list all the loads to the city or country. There is a graph that visualises the delivery times by the selected parameter (transport mode, delivery country, or delivery city). The loads are listed in chronological order within the selected date filter. The user can investigate, for example, deliveries by a specific transport company and see if there are any abnormal delivery times to the specific country.
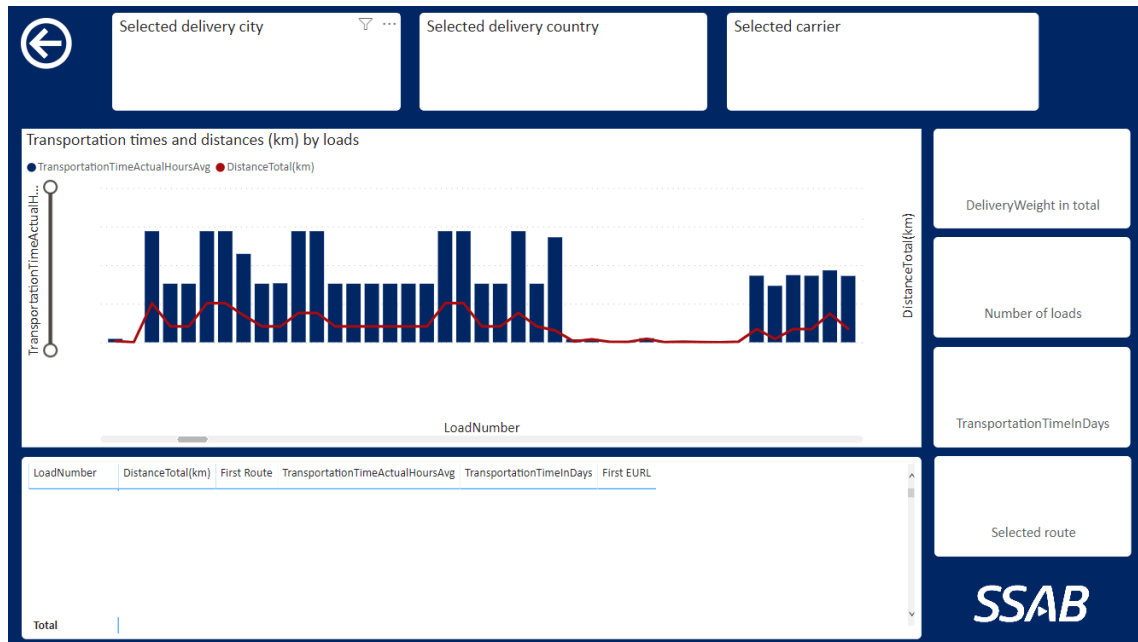
Figure 22. Delivery times in more detail

The second main page of the dashboard is about utilisation rates and the page is represented in Figure 23. Utilisation rate in this context means the average weight in product loads. The utilisation rates have been achieved by dividing the delivery weights by loads. This is the closest method to gaining information about the transport equipment's utilisation. The case company does not have data about the LSPs' equipment maximum capacity, which could be used to reflect the used capacity by deliveries. When previously mentioned is not possible, average weights by loads are the answer to this need. The user can see average delivery weights by different LSPs in one graph. The second graph uses the mentioned drill-through feature that allows the user to visualise data by the transportation mode, delivery country, delivery city, and end customers. The user can see from this page how well the transport equipment has been used in the matter of capacity. For example, if the utilisation rate in a specific country has been particularly low, it would be appropriate to think of different ways of transportation so low volumes can be combined to gain cost efficiency. This helps to reduce logistics costs because the case company can then offer full loads to LSPs. Finally, there is a table that offers data in more detail from every transportation and a few labels (e.g., the number of loads, cumulative delivery weight, and average utilisation rate).
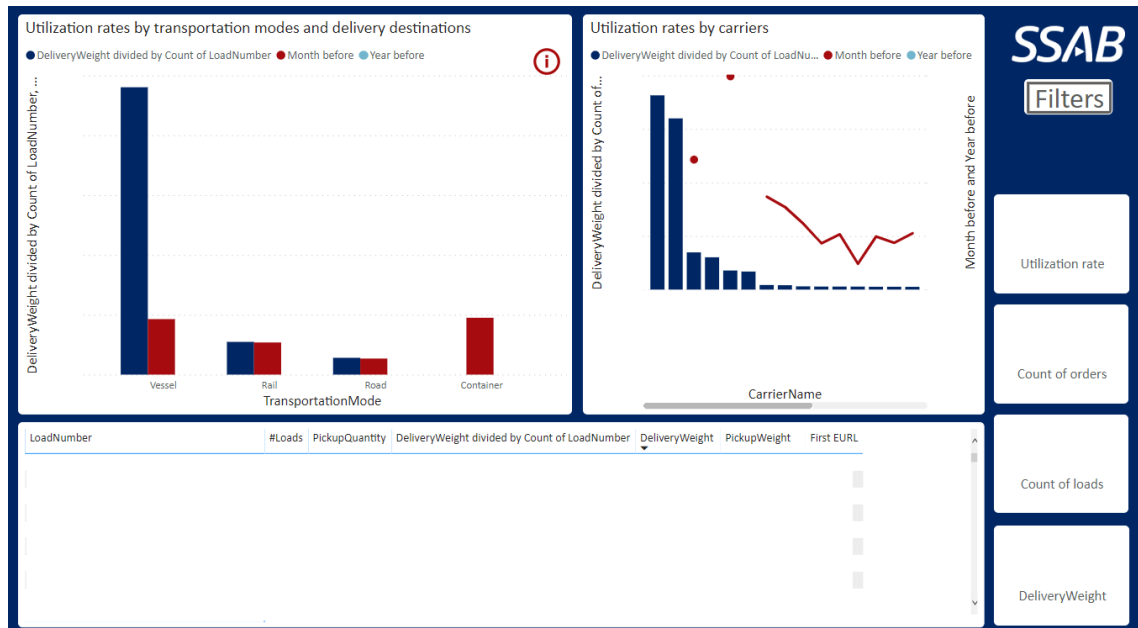
Figure 23. Utilisation rates

The third main page (Figure 24) is handling the ETA to the end customers. When the LSPs pick up the products from the case company manufacturing plants, they offer an ETA to the customers. This ETA is used to create logistics transparency. The customers may be planning their manufacturing based on these ETAs. There are two graphs on this page. The first one is visualising the given ETA versus the actual time of arrival by the LSPs. The second is visualising the same thing but with the drill-through feature (the transportation mode, delivery country, delivery city, and end customers). Also, there is a table that gives the visualised data in more detail. This page can be used to develop the predictivity of transportation. In addition, if there is a need for a reliable LSP, for example, to deliver an urgent batch of products, this page can be used to find out the most reliable performers in the context of given ETAs.
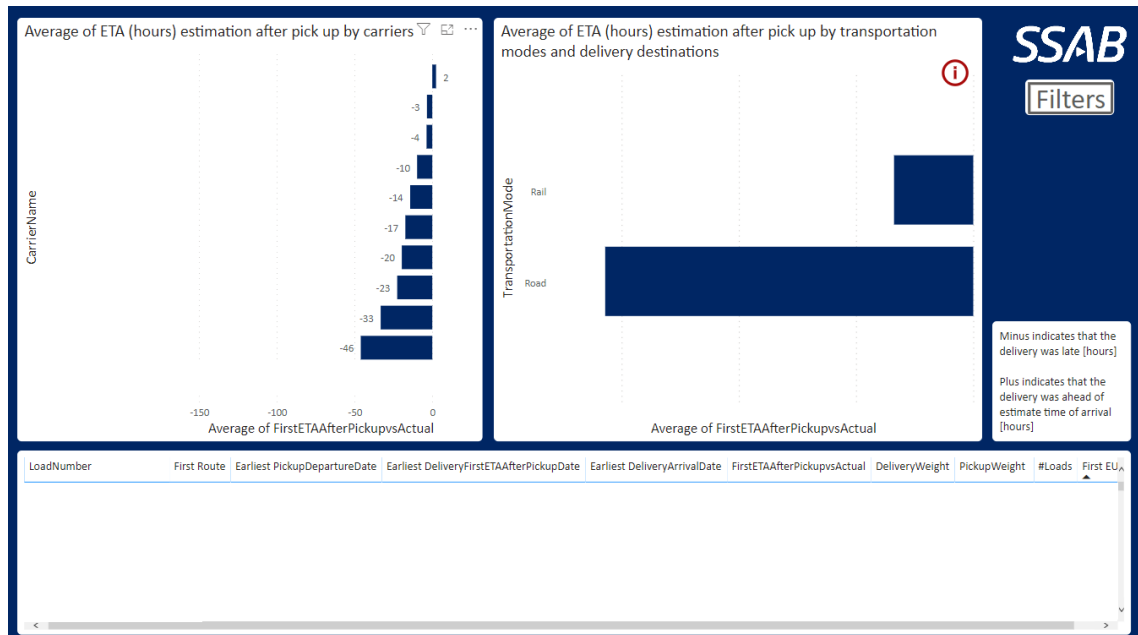
Figure 24. Estimated time of arrival

The fourth main page (Figure 25) visualises pickup accuracy. The pickup accuracy is achieved by comparing the LSPs' actual arrivals for pickup versus the case company's given time for the LSPs to come to pick up the products. The case company values the pickup accuracy because the case company's manufacturing plants are huge and there are multiple loadings done within one workday. The case company's loading processes stay efficient if the LSPs follow the given pickup time. In addition, the case company is providing ETAs to the end customers based on that when the products have left the case company's manufacturing plants. This is the old way of providing ETAs, and the logistics transparency project tries to change this so the actual ETAs can be provided for the end customers. There are a total of four graphs on this page. The first one (left upper corner) visualises the pickup accuracies by LSPs. The second graph (right upper corner) uses a pie chart to visualise different late groups in pickups. There are, for example, pickups that were on time, and pickups that were late and were pickup within the next day. The third one (left lower corner) uses the drill-through feature to investigate pickup accuracies by the transport modes, delivery countries, and delivery cities. The final graph visualises the pick-up accuracies at a week level.
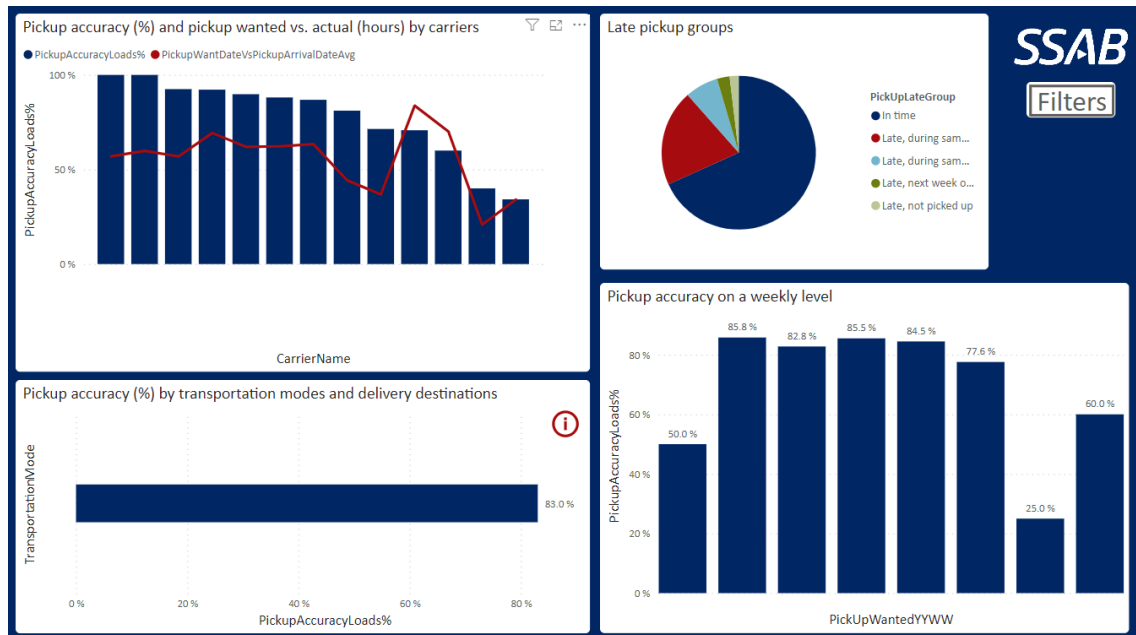
Figure 25. Pickup accuracy

The fifth page of the dashboard is created to monitor loading and unloading times. The loading times occur when LSPs' transportation equipment enters the case company manufacturing plants. Due to the logistics transparency project, the visibility platform has a function that allows drawing geofences on the map. The loading time starts running when the LSPs' transportation equipment enters inside the geofence. And the loading time stops when the equipment leaves the geofence area. The same thing occurs at the unloading when the equipment arrives at the delivery location. When the geofencing areas are determined by humans, it needs to be reminded that the geofencing areas might not be accurate (e.g., a geofencing area is too small for the delivery location). Still, geofencing delivers the best way to analyse loading and unloading times now. The users need to communicate to the administrators of the visibility platform if some geofencing areas are incorrect.

The fifth page is visualised in Figure 26. The page has a histogram that visualises all the loading and unloading times based on the user's filtering. The loading and unloading time difference calculations have been determined manually so it is not possible to visualise the data any other way than by one load at a time (e.g., visualising loading and unloading times by LSPs). Lastly, there is a table that can be used to investigate the details of the loading and unloading times.
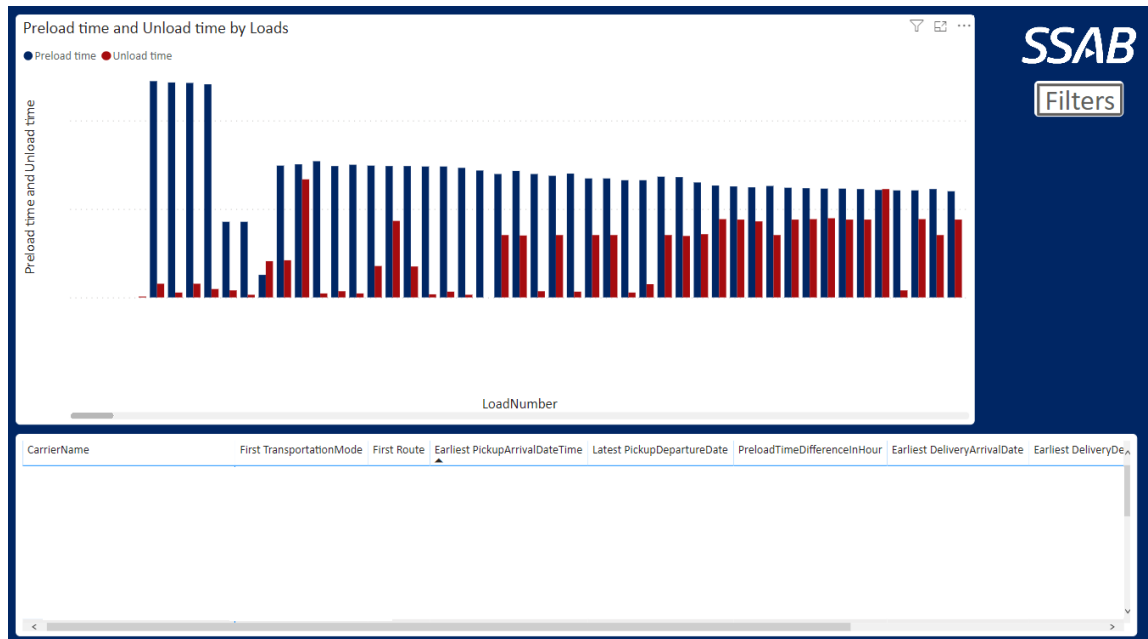
Figure 26. Loading and unloading times

The sixth page is focused on tracking level (IT capability). The tracking level tells the user which of the LSPs have yet to be connected to the visibility platform. During the conduct of this research, the logistics transparency project is still ongoing. Thus, not all the LSPs have yet to be connected to the visibility platform and that's why there was a need for monitoring the IT capability of LSPs.

There is a graph (visualised in Figure 27) that shows the connectivity of LSPs. There are two bars, the first indicates the percentage of the loads by LSPs that are connected to the visibility platform. The second shows the percentage of the grand total of loads handled by each LSP. Then there is a line that shows the percentage of the loads by LSPs that are providing location updates for the visibility platform. There is also a table for a more detailed investigation and data labels for seeing the main performance indicators (e.g., loads tracked before pickup % and how many loads are in the visibility platform).
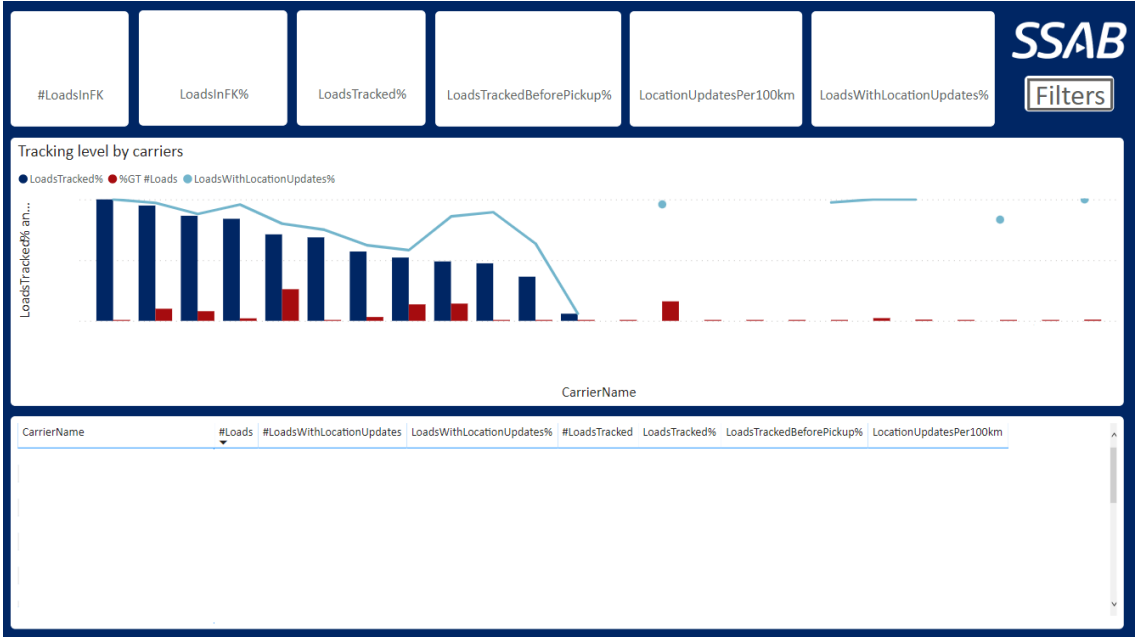
Figure 27. Tracking (IT capability) levels

The seventh page is used to visualise the total volumes of product transportation (visualised in Figure 28). The first graph tells the user how many loads, and the cumulative weight of the loads, have been operated by different LSPs. The second graph tells the distribution of used transportation methods. The third graph can be used to monitor the case company's manufacturing plants' manufactured volumes for transportation. The final graph shows the delivery countries and how many loads have been transported to those countries. There is an option to drill down in this graph to see the delivery cities within those countries.
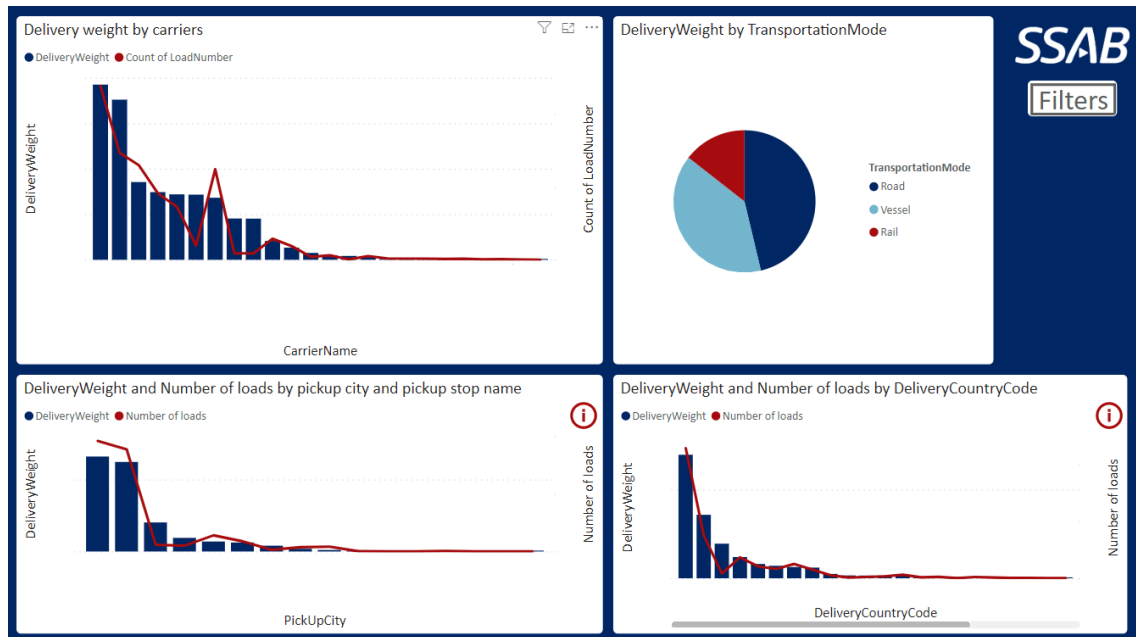
Figure 28. Logistics service providers' performance dashboard's logistics volumes

All the dashboard's pages were addressed. The pages' themes and functionalities were harmonised as shown in the figures dealing with the dashboard. The harmonisation of the pages helps the users to operate all the possible features available on the dashboard's pages. It also creates self-confidence to use the dashboard because the features of the dashboards are the same. If there were a lot of different features on the different pages, the users might not want to use the dashboard because it would be too complex.

6.4.2 Logistics costs and volumes
The second dashboard was created to visualise the costs among the case company's logistics processes. The dashboard has also a front page and filter page, which are like the previous dashboard's front and filter page. In addition, the dashboard's theme is also similar. The first actual page (Figure 29) of the dashboard is focused on all the case company's manufacturing plants. There is data about the manufacturing plants' produced product weights, which have been transported to the customers. Also, the same graph has logistics costs that each of the case company's manufacturing plants have created. The second graph shows the transported weights and their costs by different transportation modes. Then there is a table that shows all the data in a tabular form.
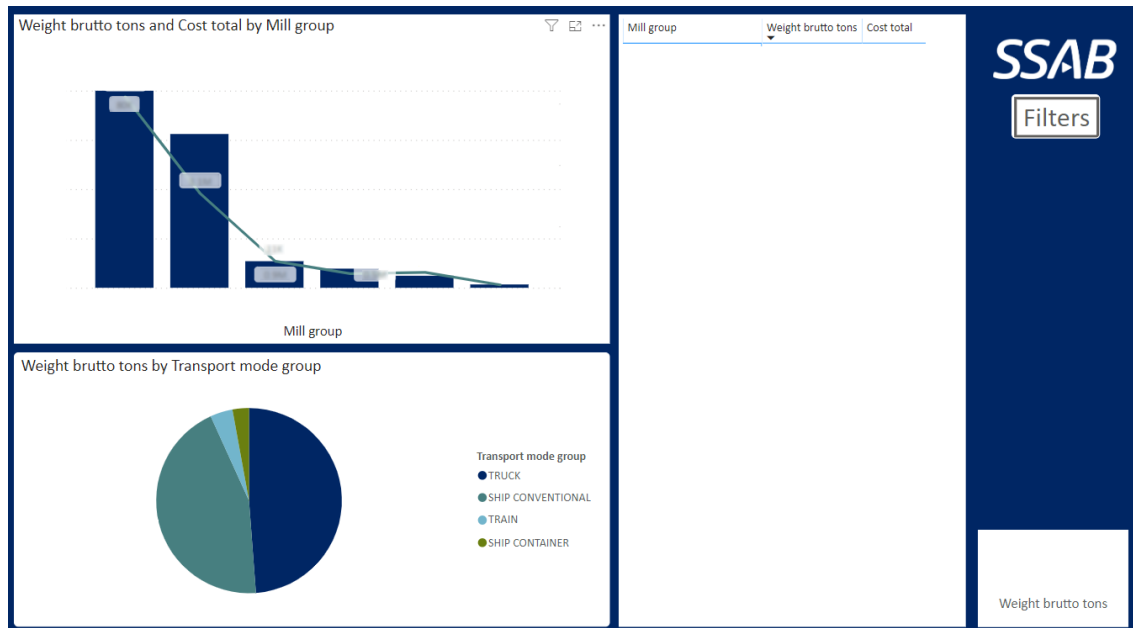
Figure 29. The case company's manufacturing plants' volumes and costs

The second page (Figure 30) shows more detailed information about the selected case company's manufacturing plant. The first graph visualises the delivery countries and cities within them (the drill-down feature). There are transported weights and logistics costs in the graph. The second graph (pie chart) shows weights and costs within different transportation modes. The third graph (the second pie chart) shows weights and costs among the different product categories. Two labels show the selected case company's manufacturing plant and the total weight of the products transported.
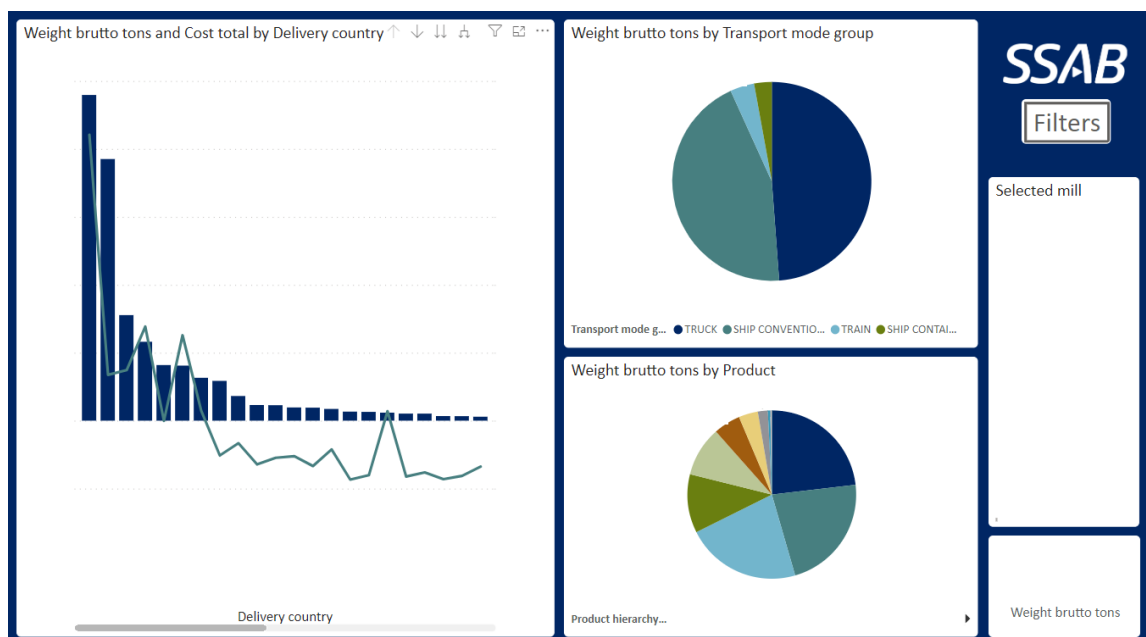
Figure 30. Details of the case company's manufacturing plant

The third page is focused on truck transport and the page is visualised in Figure 31. The first graph shows weights and costs by the delivery countries and cities (the drill-down feature). The second graph shows the weights and costs of different LSPs. The third graph opens more details about the cost structures of truck transport. The graph has truck freight costs, coil mulden costs (a truck transport equipment, which is specialised to steel coil transportation), fuel extra costs, other costs, and waiting time costs (if a truck cannot enter the loading zone within the promised time, the trucking company have an option to invoice the costs). The table has the visualised data in a tabular form.
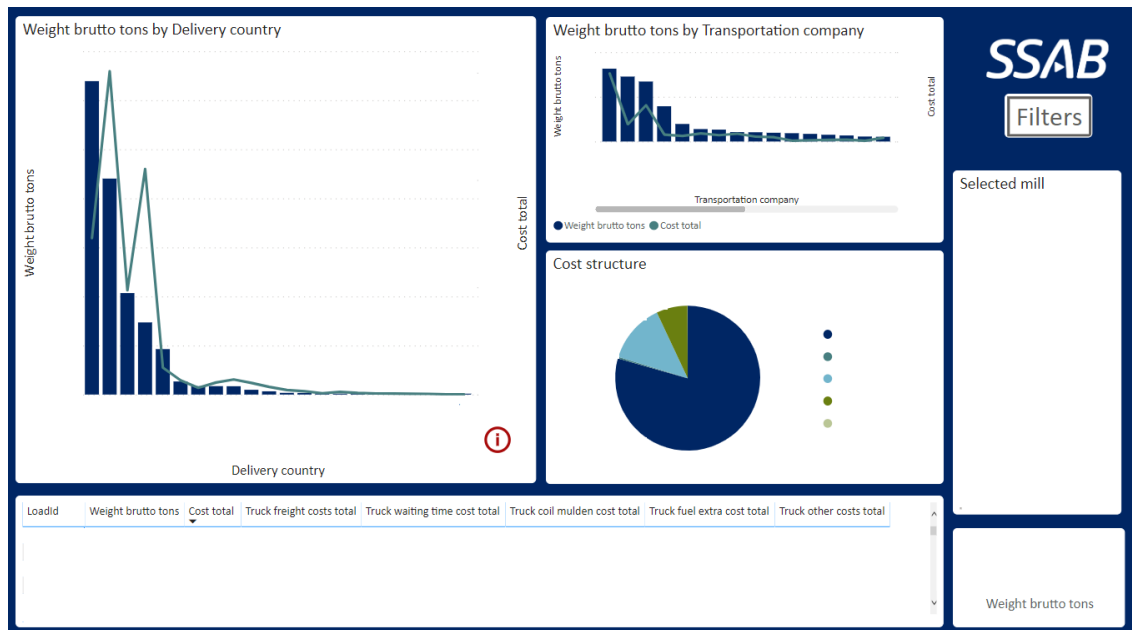
Figure 31. Truck transport

The fourth page is like the third page (truck transports), but this page is focused on sea transport (Figure 32). The first graph visualises the weights and costs of the delivery countries and cities (the drill-down feature). The next graph shows the ratio of conventional and container shipments. In addition, the pie chart shows the cost structure of sea transport. Lastly, there is a table, which can be used to investigate data in more detail.
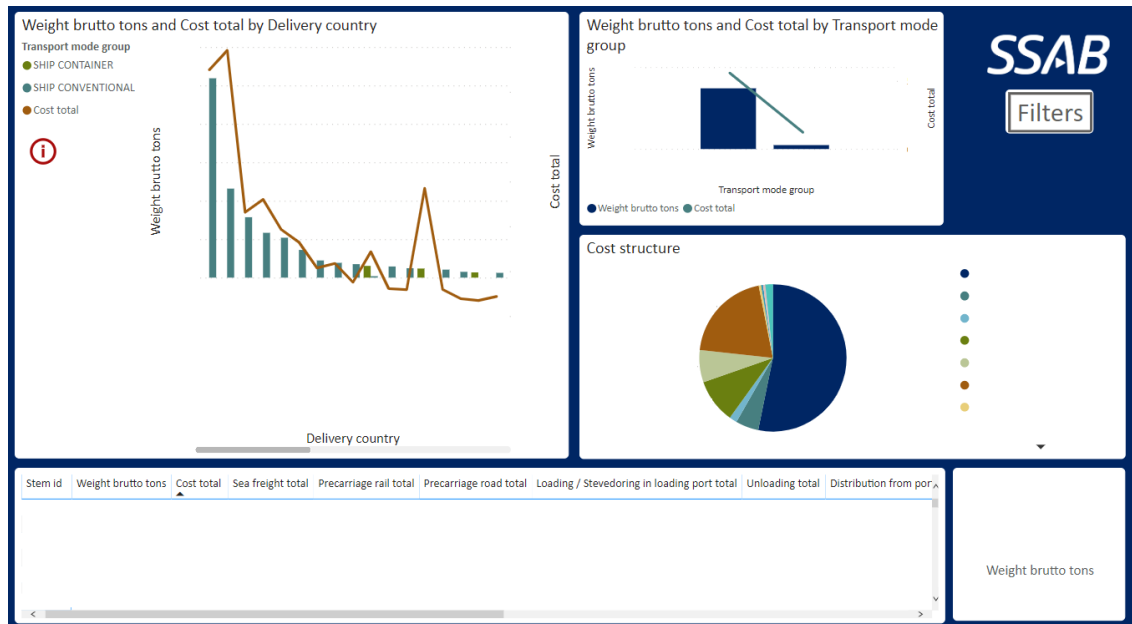
Figure 32. Sea transport

The fifth page is focused on volumes within the logistics operations. The graph used on this page is a decomposition tree (Figure 33) that analyses the transported product weights in a chain. Firstly, the user can see the case company's manufacturing plants and how much they have produced products within the selected period. Then the user can expand one of the manufacturing plants and see how different transport modes have been used. The next option is the consignee region, and then there are the delivery country and city. The main idea of the decomposition tree is that the user can click different attributes to analyse the product shipments.
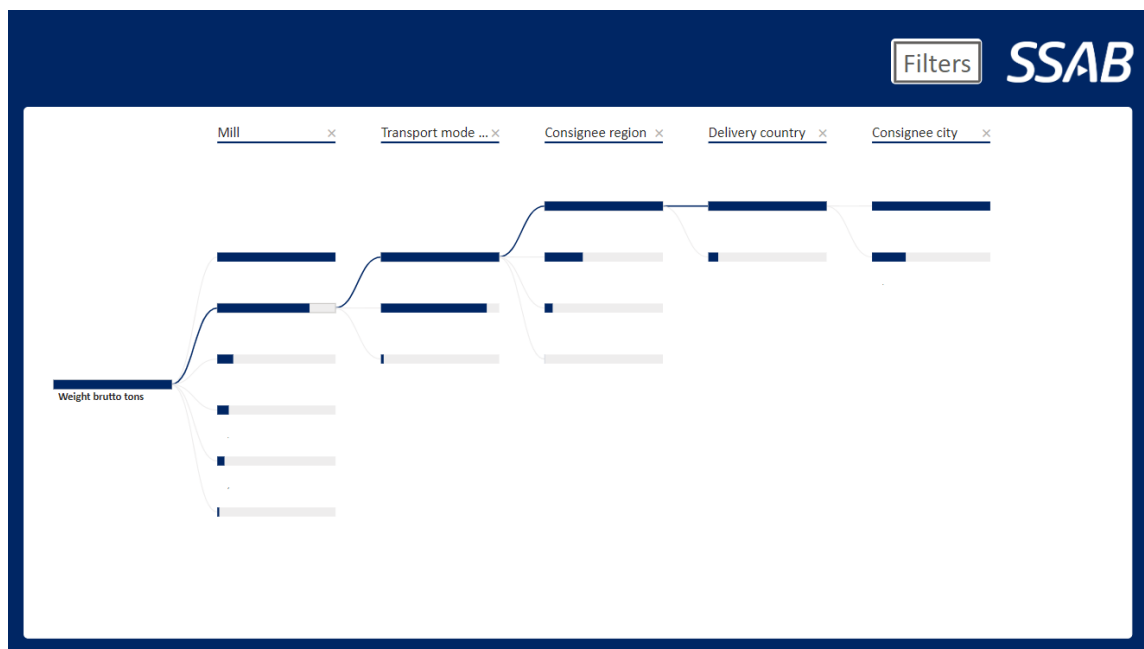

Figure 33. Logistics costs and volumes in a decomposition tree

The sixth and final page is showing the delivery countries on a map as visualised in Figure 34. There are pie charts on the map, and they are showing the product volumes (the size of the pie chart) of the delivery country. Lastly, there is a table that shows the visualised data in a tabular form.
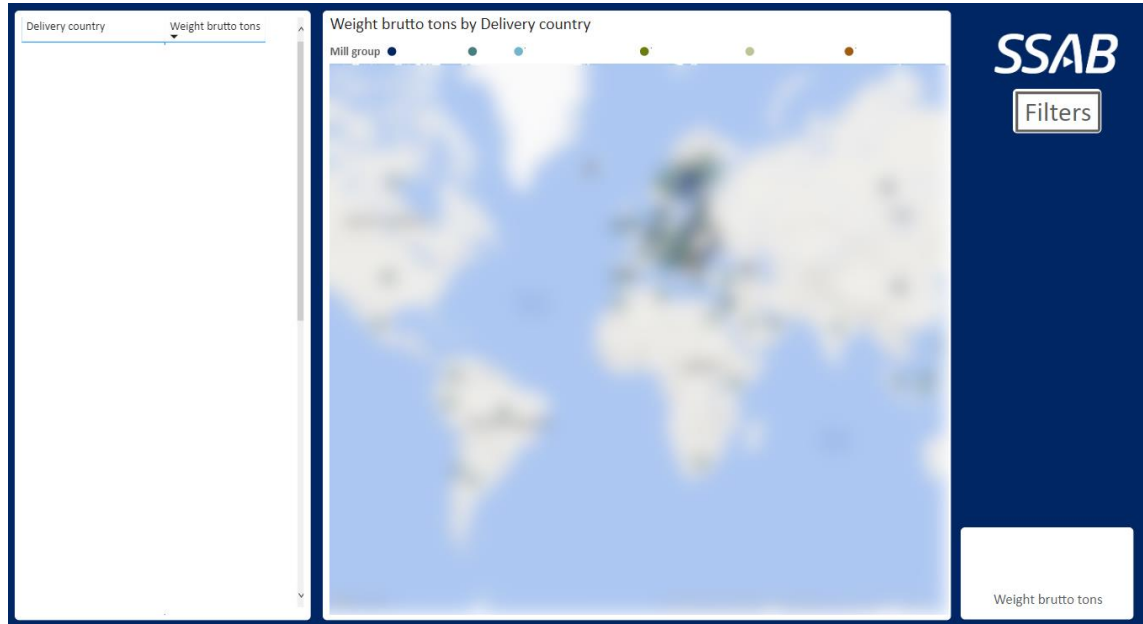

Figure 34. Delivery destinations on a map

All the dashboard's pages were addressed. The main idea of this dashboard was to get the logistics costs that the case company is spending on the logistics services. The different pages for truck and sea transport were needed because the cost structures of these different transport modes are not the same. Also, the pages of the case company's manufacturing plants and their volumes were divided into two pages because the first page can be used to monitor the big picture (all the case company's manufacturing plants included) and the second can be used to investigate one manufacturing plant at the time.

6.4.3 Sea transport KPIs

The third dashboard focuses on sea transport and its performance indicators. The dashboard's main page is in Figure 35 and unlike the other two dashboards, this dashboard does not have a filter page. All the filtering options are available on each page of this dashboard. The dashboard visualises the case company's two manufacturing plants' sea transport operations. There are different pages in the dashboard for these two manufacturing plants but they are similar. Therefore, only another manufacturing plant and its pages from the dashboard are introduced in this chapter.
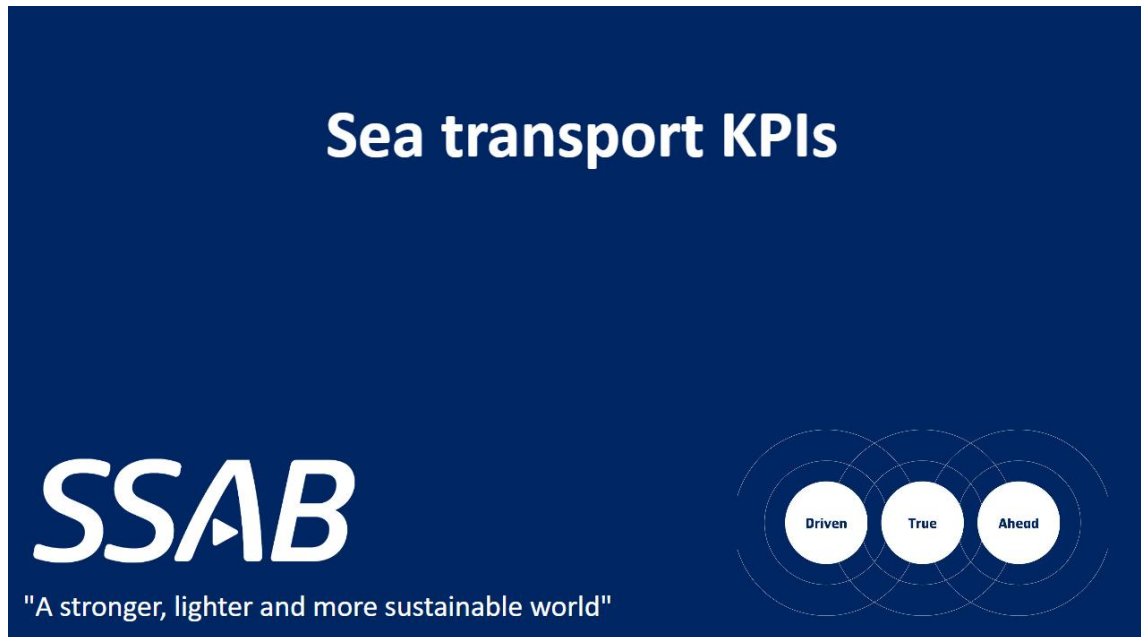
Figure 35. Sea transport KPIs dashboard's front page

The first page is for delivery and nomination accuracy. The delivery accuracy means how well sea LSPs can deliver their vessels to the harbour within the agreed time. The nomination accuracy is related to the case company's personnel and how well they predict the needed transport capacity from sea vessels. The case company's production is giving product estimates for each vessel. The estimates are used to reserve vessel space from the sea LSPs.

The delivery and nomination accuracy are visualised in Figure 36. The filters are on the right, and they can be used to select the wanted date window. Then there are three labels on the upper part of the page. The labels give the user information from what has been the average of late days (vessel arrives later than agreed), what is the late arrival percentage, and how well vessel sizes have been corresponding to the nominations given by the case company. The first graph on the delivery and nomination accuracy page is used to visualise how cargo capacity nominations by the case company's personnel are aligned with the size of the vessels that sea LSPs provided for the transport. Then there is a graph that shows what has been the case company's cargo amount provided for each shipment, and how many orders have been postponed to the next shipments. The graph also shows if some of the next week's orders have been sent in advance. The final graph shows the late days of the shipments. Finally, there is a table that shows data in more detail.
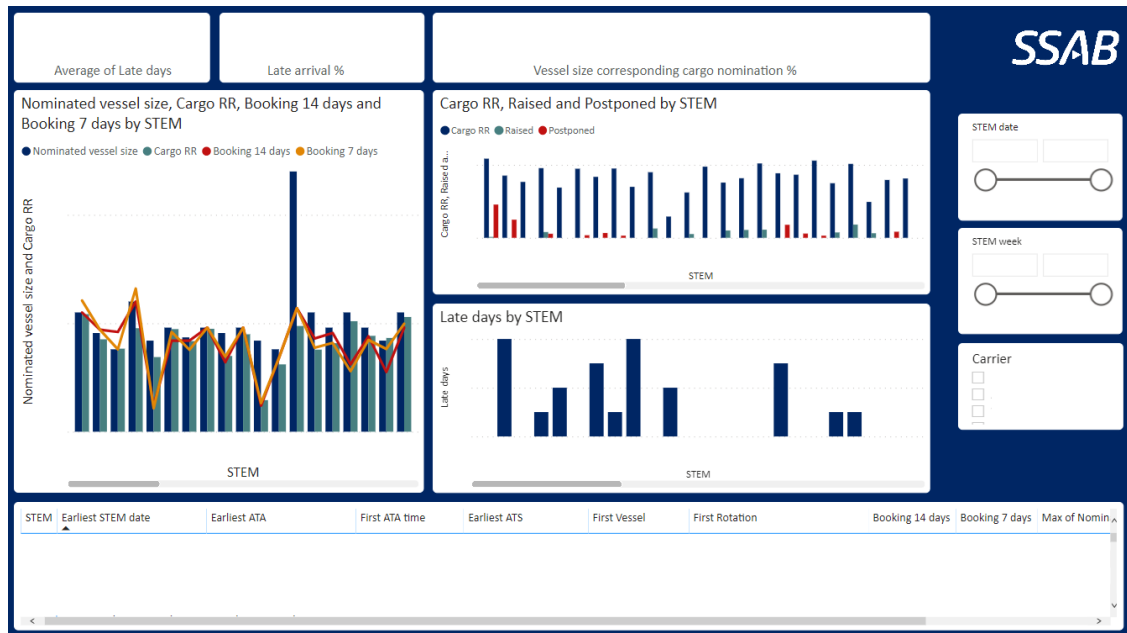
Figure 36. Delivery and nomination accuracy

The next page of the sea transport dashboard is used to monitor claims within sea transport. The claims originate from different stakeholders, for example, an end customer may find a product that is damaged, or a sea logistics company (or a port operator) may discover damage during transportation. However, the dashboard's page helps to understand the big picture within product claims. There are multiple graphs on this page (Figure 37). The first graph (the left upper corner) shows the claim category and how many claims there are within these categories. The second graph (the next one on the right) shows used incoterms within the transportation claims. The third graph counts what kind of claims there have been. The fourth graph tells the responsible for the claims. Then there is a graph that visualises the countries where the claims have occurred. The sixth graph shows the causing unit (e.g., sea or harbour) of the claims. And the last graph uses the data of which harbour the claims have been caused.
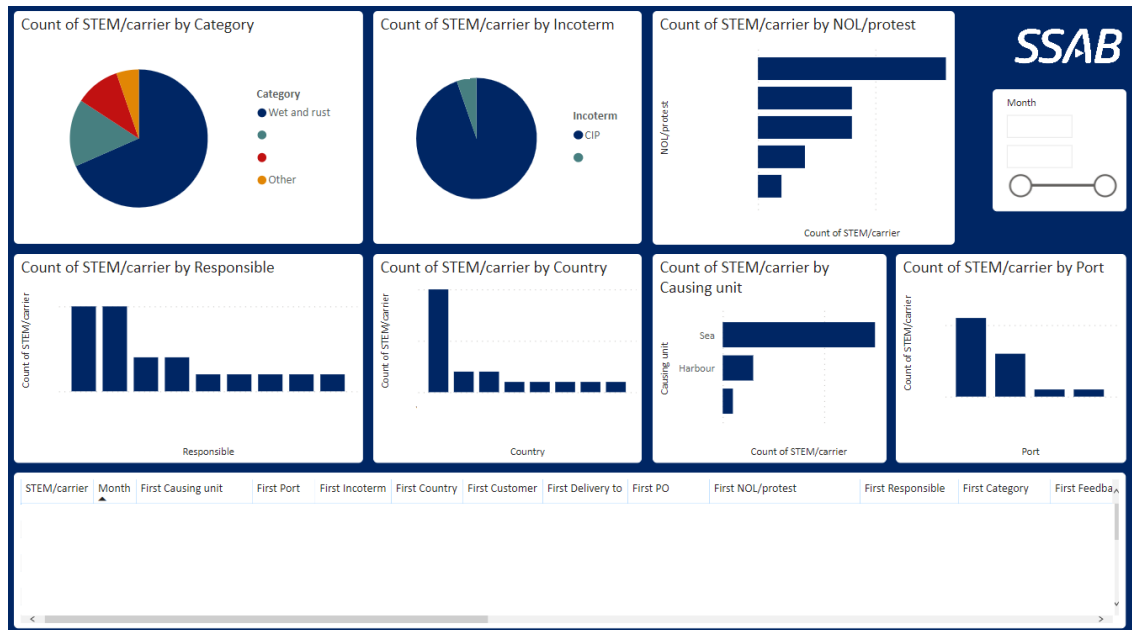
Figure 37. Claims of sea transport

The final page is focused on deviation costs from the case company's sea transport operations (Figure 38). Three data labels tell all the deviation costs with selected filters. The first graph has penalties visualised by shipments. The next one tells the demurrages that have occurred. The final graph visualises the dead freight that the case company have paid to the sea LSPs. There is also a table that shows all the necessary details to investigate deviation costs.
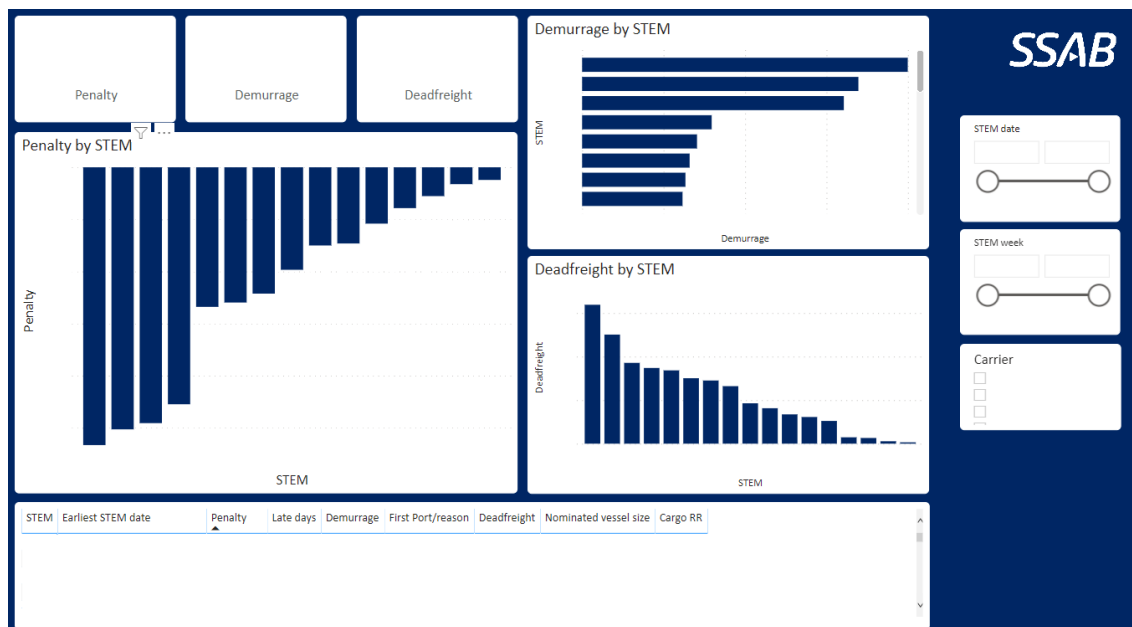

Figure 38. Deviation costs of sea transport

Then there are the same pages as mentioned above but for the other case company's manufacturing plant. This dashboard will help the user to understand the big picture within the case company's sea transport.

6.4.4 Logistics emissions

The dashboard visualising the case company's logistics emissions data is represented in Figure 39. There are a total of three graphs and one table on this page. The first graph (the upper left) represents cumulative CO_2 equivalent and delivered tons to the delivery countries. The drill-down feature is available to investigate delivery cities within the countries. The second graph, which is on the right side of the first graph, is the same but it visualises the average of CO_2 equivalent and delivered tons. Also, the same drill-down feature is available. The third graph (pie chart) gives logistics emissions by transport modes. The table presents the visualised data in a tabular form. The slicers on the right side of the page can be used to filter data.
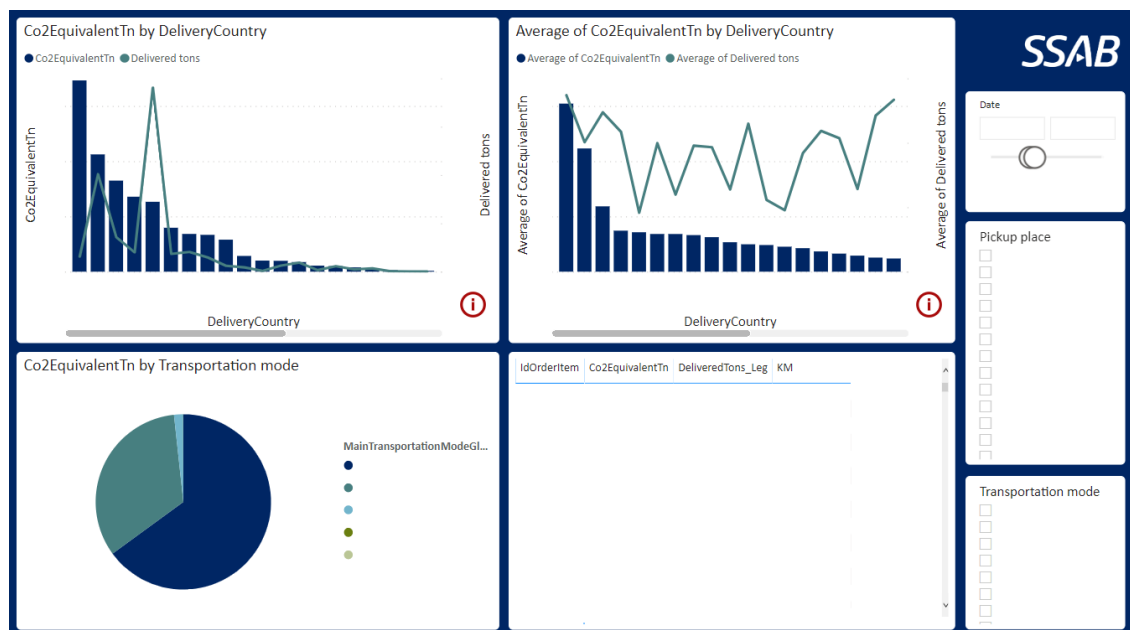

Figure 39. Logistics emissions

The dashboard is using theoretical carbon dioxide equivalent (CO_2-eq). According to Calvin et al. (2009), CO_2 equivalent includes all gas emissions to the atmosphere, and therefore CO_2 equivalent is not the same as atmospheric CO_2. CO_2 equivalent is a metric that enables the comparison of different greenhouse gases because the greenhouse gases are valued by their global-warming potential (GWP) ("Glossary: Carbon dioxide equivalent," n.d.). Emission data's CO_2 equivalent is calculated by multiplying shipments' kilometres, weight, and theoretical emission factors together. Emissions are calculated

by logistics chains, and thus do not consider exact logistics routes. However, the dash-board gives indicative results before the logistics transparency project enables the emissions for actual shipments.

6.4.5 Workshops and how they aided the creation of the dash-boards

There were a total of four workshops and demonstrations of the dashboards during this research. The main idea of these workshops and demonstrations was to go through together with the case company the dashboards and improve them. There were different teams and personnel in these workshops but mainly the personnel included were those who would be using the dashboards in the future. For example, when the workshop concerned sea transport, the personnel were different than in the workshop concerning the costs of logistics processes, and so on. The workshops took about one hour each to conduct. During these workshops, the research author showed the dashboard's pages and then the functionalities and possibilities were discussed. The workshops provided great assistance in the dashboard's development because they directed the development in the wanted direction. And this wanted direction was defined by the persons who would be the possible users of the dashboards.

The first workshop was held on 13 June 2022 and the attending personnel was quite low (three people including the author). Several things were addressed but the things can be divided into two categories, the things that aided the development of the dashboards, and the things that increased the author's knowledge of the available data. Firstly, there raised an aspect that delivery times (in the dashboard using the logistics transparency project's data) should be visible at the load level. So, every load could be visible. This led to that there was a sub-page added that could be reachable with the drill-through feature. The second outcome of this workshop was that unloading times were added to the dashboard using the logistics transparency project's data. The third outcome was the costs, which were wanted to the dashboard. The author had tried to find out the right cost data but without success. With the help of this workshop, the author was guided to the right data model. This led to the creation of the dashboard using the logistics cost analysis data. Also, the author was briefed about the different styles of how pickup accuracy is measured, what are the most important performance indicators within sea transport, and what should be the next steps in the development of the dashboards.

The second workshop occurred on 15 June 2022, just a few days after the first. The audience of this workshop was bigger (five people including the author). Now the at-

tended audience also included the personnel from sea transportation and the case company's logistics development. The claims of transportation were addressed how there was already a report to analyse them, but the report was missing some critical information. The author of this research was briefed on how the critical information could be reported in the claim dashboard. Then there was a discussion about outliers of some dashboard graphs. For example, on the page showing loading and unloading times, there were loads whose unloading times were rather huge. The reason behind this was likely a reporting error that the GPS did not send the location data, so the geofence did not activate when the transport equipment left the end customer's place.

The next development idea was to create a possibility of comparison. For example, there would be a line that shows the same measurable aspect but, in the month, and the year before. This function was implemented on some of the dashboards' pages. The utilisation rate was raised in the conversations and there was a discussion if the utilisation rate could be determined by truck registration numbers because the current way was to calculate utilisation rates by load numbers. The registration numbers could give more accurate results. The registration number method was not possible because there was no combining identifier to connect registration numbers with different products. The final thing that was discussed was the emissions of the case company's logistics processes. The current way of measuring the emissions was based on theoretical values, and the case company's logistics transparency project was trying to change the process that actual emissions would be reported by the LSPs. The outcome of this emission discussion was that the author should create a dashboard that uses the theoretical values to calculate emissions for the current need.

The third workshop was held on 21 June 2022 and this workshop's theme was sea transportation. The attending personnel was the author and the case company's person who manages the sea transportation. The most important outcomes of this workshop were that claims would be added to the sea transport dashboard. The author had tried to understand the claims by himself, but it turned out unsuccessful. The workshop was centralised to help the author to understand the sea transport data. Many different sea transport concepts were addressed. The workshop aided the creation of the sea transport dashboard so the most important things to monitor would be visualised.

The final workshop was on 23 June 2022. There was a total of three of the case company's logistics managers (different BUs) attending. The logistics managers were responsible for the case company's different business areas, but all of them had the same kind of responsibilities within these business areas. The main outcome of this workshop was that the costs from the dashboard using the logistics cost analysis data should be

divided more so the cost structure of the case company's logistics processes would become more transparent.

6.5 Use of dashboards

6.5.1 Operating principles determination

There was a need for instructions so that all the features of the dashboards can be used in the future. The case company's Power BI server did not allow to upload of anything else than the Power BI report files (.pbix). The original idea was to create PDFs containing the main idea and features of each dashboard. Uploading PDFs was not possible, so a different approach was selected. The approach was to create an instruction page for each dashboard. The instruction pages contained information regarding the database used to get data, the purposes for each page of the dashboard, and the features available (e.g., the drill-down and drill-through features). Also, the idea of the filtering page was introduced and the other available functions, for example, the line representing the data of the same time but month and year before. Instruction for the dashboard using the logistics transparency project's data is shown in Figure 40.

Figure 40. Information and instructions regarding the dashboard's usage

When conducting the workshops, it was noticed that not all the case company's personnel were familiar with the Power BI. This led to the operating principles determination of the dashboards as visualised in Figure 40. The instructions were important so if the case company's personnel forget something (e.g., not using the dashboards so often), the

instructions can help to memorise all the valuable features of the dashboards. The instructions also have an impact on the maintenance of the dashboard's data. When errors within data appear, the dashboard user can see the databases that are used in each dashboard. This information can be then provided to the case company's BI team, which is responsible for the correctness of the case company's data. According to Lönnqvist et al. (2006, p. 118), although operating principles are defined for the dashboards, they may change or be specified later.

6.5.2 Evaluation and maintenance of developed dashboards

The case company's BI team is ensuring that the data used in the dashboards are of good quality. The BI team is managing the case company's central data warehouses, but they offer individuals the possibility to make their own dashboards for their own purposes. (BI1) This research's dashboards are using the case company's data models that are maintained by the BI team. When the logistics transparency project is still going on, the dashboards' users must be alerted if data seems to be wrong in the dashboards. As Lohman et al. (2004, p. 277) mentioned, it is important to evaluate the metrics of the dashboards regularly to maintain their relevance. This is especially emphasised when the logistics transparency project adds new opportunities for measurement.

It is noteworthy that data should be investigated in the big picture with the dashboards. Single errors in data can lead to misunderstandings that may affect decision-making negatively (DEV1). If data is somehow incoherent, it should be signalled to the user. This way the user does not make false statements based on biased data. (DEV1)

The case company's BI team is monitoring the usage of different central warehouse data models. For example, when a dashboard is created, it is connected to the data model with a live connection. When there is a data model that does not have any more active users, the BI team will take the data model under a discussion. The results of these discussions may be the data model modification or even removal. (BI1) The future will show the activity of these developed dashboards. Some dashboards will be most likely used more actively than others. For example, the dashboard using the logistics transparency project's data will probably get a larger number of users because the project's possibilities within provided data are new. The location data is a good example of this, and it will be interesting to see it visualised in the form of a dashboard.

7. DISCUSSION

7.1 Critical success factors that cannot be currently measured

There were some CSFs that could not be implemented into the PMS when during this research. The reason behind this was that there was no data available. We will discuss in this chapter what were the unmeasurable CSFs and how they could be implemented in the future. The CSFs that were not implemented into the dashboards were:

1. Reducing transport emissions (actual emissions)

2. Transportation quality (e.g., claims)

3. Responsiveness

4. Safety

5. Compliance with the agreements

6. Service quality

Reducing transport emissions was implemented with theoretical values to calculate carbon dioxide equivalents (CO_2-eq) to different transportation legs. This solution was temporary because it will not give the actual emissions that have been created during the transportation. This is a start, but the final goal is to establish the visualisation of actual emissions. Theoretical emissions serve the purpose for now. The case company's logistics transparency project has a goal that the LSPs would upload their emissions per transport to the visibility platform. Thus, the emissions could be used in reporting by the case company. This was not available when this research was conducted. The case company recognises the reduction benefits of emissions in the development of logistics:

"It is already important to consider emissions-free transport and its development because they can be used to gain a competitive advantage in the future. Later, the competition can be tough, when other players in the market also invest in emission-free logistics solutions." – Logistics Manager (LOG1)

According to Jamali and Rasti-Barzoka (2019), competition within the supply chain enhances the finding of sustainable solutions. LSPs do not want to be left out of the development because otherwise, it could affect their business. The competitive arrangement could be applied in the case company, in which case the availability of emission data could be increased for analysis.

Transportation quality (e.g., claims) as a CSF was implemented for sea transport but not for other forms of transportation. The reason behind this was that the case company already had a dashboard, which was focused on the claims. The dashboard was used by the case company's personnel, so the author of this research did not feel necessary to create another one. It was interesting that during the interviews, not all interviewees knew about the claim dashboard. The information flow about the claim dashboard was not excellent so there would be room for improvement when it comes to marketing the available dashboards in the case company's Power BI server. The current model is that the dashboards available are mostly used by the users for which the dashboards were created in the first place.

Responsiveness was originally ideated that it would capture LSPs' activities if the LSPs requested the cancellation of transport delivery. Often, when the cancellation has been requested, the transport order is rebooked to the LSP. The most common reason behind this is that the LSPs want to optimise their activities, in other words, they do not have the capacity at that moment, but they are willing to transport it later. There is no way currently to get data if the LSP's delivery order has been cancelled and rebooked. It does happen but the data integrations do not register it. The case company's BI team should implement a way to monitor rebooking. For example, the tabular data model should have a column that would be empty if rebooking has not been done. If rebooking has been done, the column would have a new order number or new pickup time in it. A new pickup time would be useful to calculate the difference between the original pickup time (cancelled order) and the new pickup time. This method would also allow a calculating function because if the column is filled with something (e.g., order number or new pickup time), it would cumulatively count it. This would allow the reporting to monitor the LSPs' responsiveness.

The number of safety observations as a CSF was not possible to implement because safety hazards are mainly reported manually. Safety hazards occur, for example, when LSPs' personnel abuse the use of safety equipment. If the LSP's driver does not use a helmet in the case company's manufacturing plants, a safety hazard report is made, and it is sent via email to the case company and the LSP. These emails are then manually archived. However, the case company is planning and conducting a TMS project, which will unify the case company's transport planning and delivery sending processes. There is a plan that the TMS would have a module that would be used to report safety observations. The module would also harmonise the data collection, and the reporting of safety observations would become more meaningful because data could be gained from multiple manufacturing plants. The reporting of safety observations should wait till the TMS

project will be ready because then the full benefits of reporting and visualisations can be achieved.

Compliance with the agreements was a complex CSF. To achieve it, the logistics-related agreements should be unified so that compliance could be reported. The case company's BI team is planning and establishing a process that all logistics-related agreements will be uploaded to a server with metadata that would be used to monitor compliance with the agreements. Thus, this CSF was not implemented in this research because it takes a lot of work when the agreements' metadata will be unified and ready to use. For example, an aspect of the logistics agreement that would be monitored is if the LSP transports products as much as they promised in the agreement. The future will aid to achieve this CSF.

Service quality was an interesting CSF and the process to measure it would be achieved by personnel surveys. There was no time to plan and carry out surveys during the time of this research. Still, the idea of surveys was introduced, and it would be a meaningful way to monitor the case company's operational personnel's experiences with each LSP. According to Kilibarda et al. (2016), service quality by LSPs is not treated with the necessary attention in research or business. Kilibarda et al. continue how measuring the service quality would need tools and approaches so it could be done systematically. The surveys would concentrate on the soft sides of each LSP, for example, how well they have answered different kinds of inquiries. Also, the overall experienced ambience would be covered with these surveys. The survey should be done once a year, and the structure of surveys should remain the same so the development and comparison of answers can be seen in the results. The results should be then available for visualisation.

7.2 Managerial implications

The logistics management can use the PMS to monitor LSPs' performance to evaluate their activities. According to Parmenter (2015, p. 223), it is a good idea to show the results of the PMS to the company's personnel at least once a month. Dashboards can give new ideas to evaluate the LSPs because the dashboards help the user to see patterns and things that cannot be seen otherwise (Villafuerte, 2015, p. 1) Results of the PMS can be taken to frequent meetings with LSPs to discuss how logistics activities have occurred. Managing logistics and LSPs in the Finnish BU is important:

"Logistics is important for Finland because Finland is located on the edge of the market areas. In this case, transport distances are long and logistics chains must be optimised" – Logistics Manager (LOG1)

According to Komatina et al. (2019), the main purpose of a PMS is to indicate aspects that are not achieved in the business processes and when the aspects are found, they can be developed. During the interviews, there was an aspect that it should also be considered that a financial bonus would be attached to these metrics and results if LSPs perform extraordinarily good. For the bonus system to be implemented, the data must be of excellent quality. The financial bonus method would encourage LSPs to develop their processes even more. The financial bonus method alone is not enough to gain the best procedures that are available. The way of doing needs to be collaboration based. Still, the financial method would indicate the results of logistics processes that the case company appreciate.

Another use for this PMS would be a comparison of different logistics chain concepts. Also, the PMS will help to gain predictability because if there is a visible problem within a certain logistics chain, another logistics chain would be used to avoid this problem. (LOG3, LOG4) The dashboards can be used in a way that different logistics legs are analysed at the time and then their performances are compared. However, the developed dashboards may not be the best way to do this because more detailed calculations are often needed. On the other hand, the literature suggests that PMSs' metrics should be reviewed yearly, in which case it is possible to try to implement more detailed data needed to compare logistics chains (Neely et al., 2000). The dashboards provide an agile way to find out possible routes that have been used in history. This may help the users to find proven logistics routes that can be used to develop further. If any problems within logistics chains are noticed (e.g., extraordinary long delivery time), another route can be used to deliver the case company's products. The dashboards' visualisations help in this because outliers are easily noticed.

The PMS can help other internal stakeholders than just the case company's logistics organisation. The case company's sales department can use the dashboards to see average delivery times to different countries. The dashboards provide an agile way to find out average delivery times if an end customer asks about them. This method will spare resources when the case company's logistics personnel do not have to answer ad hoc inquiries about delivery times.

The PMS can also help to develop processes together with the LSPs. The system gives numerical results that are not biased. This is important because when there are changes done within the logistics processes, there must be a tool to monitor the effects of the made changes. The dashboards give objective results. The case company run logistics tendering from time to time. The dashboard's cost data can be used when determining the baseline for the tendering.

It is also noteworthy that unloading steel product cargo from transport equipment can be a difficult process (LOG1). An end customer may need to order specific unloading equipment (e.g., forklift or crane) to conduct the unloading. Ordering the unloading equipment is expensive, so the given delivery time needs to be met. The dashboards can be used to find out the most reliable LSP in the field of delivery times. The dashboards will help to cover important operational decisions in an agile way.

A management view for the dashboards was wanted to be implemented. The management level would have shown all the most important key figures on one page. However, the management level idea was modified because the determined CSFs were such that they needed to be shown in a certain context so that the CSFs measurement makes sense for the user. The idea was further refined by adding labels to the dashboards' pages that tell the most important performance indicators to the users. In this way, the performance indicators can be quickly reviewed for each CSF.

7.3 The case company's future

The case company's logistics should be developed at a more corporation level to achieve synergy benefits (LOG1). The corporation-level developments are also great opportunities for reporting. When the processes among the case company's different BUs' manufacturing plants are unified, the comparison of processes' efficiency becomes possible. This would help to create a more comprehensive dashboard, which would, for example, visualise all costs from different manufacturing plants.

Analytics should be taken into consideration in the case company's logistics department development. Predictive analytics and trend spotting will become an important aspect of executing the case company's logistics processes. For example, predictive analytics could be used in avoiding problems before they will happen.

The case company's supply chain data is now received from many different systems. It is costly and time-consuming when the integrations are made between these systems. Data sharing should be made with the help of cloud computing. Every member of the supply chain would provide its data to this cloud service and willing members would take the needed data from the cloud service. The cloud computing approach would increase the possibilities of reporting. In addition, cloud computing would help to get data from every member of the case company's supply chain. For example, LSPs' possible sub-contractors' data could be available for use.

There have been cases where the LSPs have changed their processes on their own and have not informed the case company. These process changes have then been noticed

when product claims have arrived at the case company. (SHIP1) The case company's claim reporting system would need a monitoring system that would alarm the user when similar claims arrive. This would start an investigation process, which would detect the LSPs' process changes. Yet, the claim reporting processes are not harmonised and there are different styles of processes when comes to claims reporting. Claims are important indicators if something is off with the case company's logistics processes. Claims should be investigated deeply so the root causes can be understood. The case company's reclamation process is currently mostly manual work (SALES1). There should be a module in the coming TMS in which all transportation-related claims would be reported. This would establish a method to visualise claims in more detail.

Among the interviewees, there was also an idea that more responsibility would be given to the case company's LSPs. LSPs would operate more individually, and their activities would be monitored to be aligned with the case company's policies. This method would free up more time to manage the case company's logistics more strategically and tactically. Still, the method is not problem free because the case company would be too committed to LSPs.

A simulation program would be beneficial for planning and creating new logistics chains. The output of this simulation program would be data that could be compared to actual historical data of existing logistics chains. The simulation was commented on as follows:

"A software is needed that can be used to simulate logistics chains. Costs components could be added to the simulation, and they could be tested with different transport modes and quantities." – Logistics Manager (LOG1)

The dashboards could be improved in a way that the simulation data can be uploaded to them if necessary. Thus, new kinds of logistics chains could be tested against historical data of existing logistics chains. The simulation program could provide insight before the new logistics chains are tested in a real life.

8. CONCLUSION

8.1 Key findings

The research process was successful and could meet the case company's needs. The process started with theoretical research, which aimed to establish the base knowledge of the research problem. The theoretical research helped to create an interview structure and to find points of view, which would support finding the aspects that were needed for the PMS in the context of case company logistics. Two different styles of interviews were conducted, the first aimed at finding the dashboards' measurement perspectives, and the second at creating the dashboards in practice. Then the research material was analysed before the creation of the dashboards started. The theoretical framework created by Lönnqvist et al. (2006) was used to create the performance measurement dashboards because the framework was the most suitable for this research. During the research process, workshops, and presentations about the dashboards were conducted and these helped to direct the dashboards in the right direction because the participants would use the dashboards in the future to control the case company's logistics according to the case company's vision. Iteration was a key element in this research process and, for example, extra interviews and inquiries were made so that problems in the development process of the dashboards could be solved. Finally, the developed dashboards were uploaded to the case company's server from which the dashboards can be used in agile with a web browser.

To answer the main research question comprehensively, four research sub-questions were formulated. These sub-questions aimed to cover both the current state of the logistics in the case company and what the literature offers for creating a PMS. Answers to these sub-questions were sought from the empirical and theoretical material in the research's analyse phase. The **first research sub-question** for the research was the following:

"What is being measured in the case company's logistics now, and how is this data used?"

Answering this sub-question was largely based on empirical data obtained from the interviews. The biggest point was that a lot of logistics-related data is collected but it is not used most optimally. There was also no complete certainty about what kind of data was available and where exactly that data is located. According to Neely et al. (2000), the data collection process should be clearly presented and documented. Documentation

could be developed in the case company, so the personnel would know the available data and its possibilities. Still, this did not significantly affect the result of the research because the data used in the dashboards was discovered by testing. However, with uniform data collection processes, new and innovative possibilities for the case company's data could be revealed to help the development of the case company's logistics. According to Miah et al. (2017), using uniform data collection processes improves the use of the company's resources in data collection, speeds up data collection, maintains data quality, and improves transparency.

The most used logistics data was related to costs, delivery quantity, and pickup accuracy. Deviations in supply chains were also widely interested but the data collected from these was not standardised. This lack of standardisation made it difficult to implement some CSFs in the dashboards because collecting data from them was impossible with the current operating model. The case company also brought up various measurable matters, which they wanted to be measured in the future. For example, the fulfilment of logistics agreements by LSPs. Researching such issues was not possible within the scope of this research because there was not enough time or resources. For this reason, management must be committed to the implementation of the PMS, so that new data collection processes can be established in the name company's resources (Bourne et al., 2000, p. 758). Thus, theoretical improvement proposals were created in the discussion section.

However, with the help of interviews, a comprehensive picture was obtained of what kind of data models the case company has and what kind of data they contain. This served as the basis for planning things to be measured in the dashboards.

The second research sub-question aimed to find information on how LSPs can be evaluated. The material for this question is based on both theory and empiricism. The **second research sub-question** was the following:

"How logistics service providers can be evaluated?"

The case company brought up how the evaluation of LSPs is done both during the logistics contract period and during the tender process when logistics agreements are concluded for certain logistics chains. In addition, there are regular meetings with the LSPs, where collaboration is addressed for development purposes. The case company brought up how they do not have tools for agile and quick monitoring and evaluation of LSPs. This research aimed to find an answer to this deficiency.

In the current model, the case company tries to find information about the performance of LSPs by performing calculations in different ways. These calculations are also used

in frequent meetings with the LSPs. The calculations concern logistics costs and perfor-mance in general (e.g., quantities transported and possible complaints or reclamations from the customers). In addition, the case company personnel are asked about their experiences with the LSPs. The case company is aware that in the future both emissions and IT capability will also become important when evaluating LSPs.

The literature research (Chapter 3.4.) recognised that it is important to try to evaluate LSPs because the quality of logistics services is reflected in the satisfaction of the end customers. Communication about evaluating LSPs is important because it improves the transparency of logistics services. Evaluating the LSPs enhance the use of the case company's resources and at the same time develops logistics processes forward.

Juga et al. (2010) brought up different aspects of LSPs' evaluation, such as service qual-ity and operational service quality. The service quality led to a plan to implement a stand-ardised survey for the operational personnel of the case company. The survey would help to evaluate LSPs' operations through experiences. The operational quality added the following to the dashboards: how the LSPs are staying on schedule and how they provide capacity for the case company's product transportation. Gil Saura et al. (2008) also emphasised the timeliness of logistics. In addition, Gil Saura et al. added how LSPs are under pressure to constantly strive to offer sustainable solutions in their logistics services. This is also noticeable in the case company because emissions and IT capa-bility are starting to become important metrics for evaluating LSPs.

The third research sub-question aimed to find an answer to how the PMS could be im-plemented in practice for the case company. This sub-question was answered with the help of both theory and empirics. The **third research sub-question** was the following:

"How to develop a logistics-related performance measurement system for a company operating in a steel manufacturing business?"

The conducted interviews provided a comprehensive perspective of the case company for the implementation which was complemented by the information and frameworks dis-covered from the theory. Through the interviews, the case company provided information about the possibilities and wishes that the PMS should consider. The empirical data helped to specify the desired targets of the PMS so that the dashboards would meet the needs of the case company.

The theoretical research sought to understand the deepest essence of logistics and SCM so that it was possible to understand the possibilities and obstacles of a logistics-related performance system. It was important to understand logistics flow so that their visualisa-tion in the dashboards would be meaningful. Although the theory offered perspectives

for measurement, the bottleneck was the data collected by the case company. Thus, the empirical material took an important role, so it was possible to investigate the case company's data and its possibilities.

A framework for implementing a PMS by Lönnqvist et al. (2006) was chosen for this research. The framework in question offered the most suitable tool for the case company's needs. The framework helped to deal with the research problem in-depth step by step so that the resulting dashboards became justified. The framework's main steps were objectives and measurement perspectives determination, CSFs determination, metrics determination, operating principles determination, and measurement system deployment. During the research, it was noted that the use of implementation frameworks is recommended. This is because, with their help, it is possible to chop the implementation goal into smaller pieces, which are easier to handle so the implementation can be carried out.

The fourth sub-question was formed to get an answer about the status of the case company's logistics and the empirical material was used to answer this question. The **fourth research sub-question** was the following:

"What is the current logistics situation of the case company and how does it affect the creation of a performance measurement system?"

A comprehensive understanding of the current state of the case company was obtained and reported in Chapter 5. The most important observation was that the case company is aware of the problems with data collection and is trying to find answers to them with both the TMS update and logistics transparency project.

The case company's plans with logistics were discussed in the interviews. The ongoing logistics transparency project will provide possibilities for logistics reporting, e.g., accurate reporting of logistics emissions. Actual logistics emissions were not included in this research and emissions were treated through theoretical values.

The empirical research highlighted development targets between the case company's organisations, such as the inefficiency of data sharing. This did not have a direct impact on this research but transparency in the sharing of data and information would be a good thing to strive for in the case company. Information sharing and transparency contribute to the case company's goal of reaching its vision. Everyone must contribute to this goal together.

All four research sub-questions mentioned above supported that the main research question could be answered comprehensively. The **main research question** was the following:

"How can a performance measurement system be developed and used efficiently to evaluate logistics service providers operationally?"

The research sub-questions formed the basis of the main research question and with its help, the PMS was created, and its output was four different dashboards. The developed dashboards can answer the case company's need to evaluate LSPs in an agile way. In the development of the dashboards, attention was paid to usability, so that everyone who wanted could use them. The dashboards were wanted to be detailed but also comprehensive according to the user's choice. This led to various features so the user can interactively explore the data as they wish. Clear instructions were written for each dashboard so that using the dashboards would become familiar.

During the research, it was noticed that the need for iteration in the implementation of a PMS is important. It is important to be able to solve problems in cooperation. In addition, measurement perspectives must also be refined further if necessary, so that the result of the implementation is in line with the implementation project's goals.

The research found the importance of sharing information and knowledge. The interviews revealed how critical information about product deliveries had not been shared with the necessary internal and external stakeholders. This had led to a hectic situation where transport capacity had been sought in a hurry. If the information had been shared in time, the situation could have been prepared with time. The optimisation and development of information flow can be seen to develop the efficiency of the supply chain (Prajogo and Olhager, 2012), and the lack of information flow is reflected negatively in the processes of the case company. Kirono and Hadiwidjojo (2019, p. 1304) made a statement that the more the companies share information with their partners, the more the companies' capabilities will be improved. The development of information flow would also lead to resource savings.

The case company's logistics and BI organisations, as well as LSPs, must continue and develop collaboration even further. This enables the development of information flow to continue, making the case company's logistics to achieve its objectives. Collaboration chains should have different companies and organisations whose knowledge could be utilised in creating new types of value-adding service proposals (Bititci et al., 2004, p. 266). When the mentioned parties work together, combining everyone's expertise leads to improved logistics reporting. Reporting enables development that improves logistics performance. Collaboration must always lead to a win-win situation because the motivation for the collaboration comes from economic advantages (Bititci et al., 2004, p. 255).

The research noticed how logistics agreements play an important role in communicating to the LSPs the strategic goals of the case company. The point of view of the PMS must be considered when drafting logistics contracts. This would make it possible to monitor the agreed matters, in which case there would be conditions for the development of logistics operations. Practices should be created to standardise the metadata of logistics contracts. In this case, specific searches based on metadata would be possible. In addition, it would be possible to compare the performance of agreements with each other. According to Forslund (2009, p. 142), increasing efficiency through agreements is a complex issue that would require further research. Forslund declares that logistics agreements serve as a basis for directing resources to measurement, analysis, and development. Thus, if agreements are not created, it is difficult for companies to invest in the development of collaboration through trust alone.

One of the created dashboards takes data from Excels that are filled manually by the case company's personnel. The data source was not the most optimal solution because in manual work there is a high risk of making erroneous entries. The case company should monitor the use and performance of the dashboard in question. If using the dashboard proves to improve the processes, its data source should be reconsidered. One option could be to try to get the data from the systems, in which case the integrity of the data could be better secured.

8.2 Criticism and limitations

It is important to be aware that the results of this research cannot be directly copied or generalised to another company. The reason behind this is that the result of this research was developed in a unique and specific environment, and it is almost impossible for another similar environment to exist. Although the result cannot be directly generalised, the structure of this research can be used as a reference for other companies in similar environments. In this case, the structure of the research must be modified in such a way that it is suitable for the new research environment.

The researcher has worked in the case company before and already had knowledge about the case company's logistics operating methods and processes. It is important to approach this matter from the point of view of objectivity. Objectivity requires that the researcher examines the research object from the point of view of an impartial bystander (Eskola and Suoranta, 1998, p. 17). Efforts were made to increase objectivity by interviewing members of the case company's various organisations (including external stakeholders) so that the empirical research would not be biased. It was important to be aware of the pursuit of objectivity and the researcher's own experience in the company. In the

analysis phase of the empirical data, the researcher tried not to consider his own opinions and views regarding the case company's logistics. The empirical material was processed as it was obtained from the interviews. In addition, even though the interviews dealt with processes that the researcher already knew, the interviewees were allowed to talk about the processes according to their views.

Two main concepts can be used to examine research quality and these concepts are reliability and validity. Reliability means replicating the research, so if a researcher can conduct similar research with similar key findings, the research can be considered reliable. Validity means the appropriateness of the used measures and methods, accurate analysis of results, and the ability to generalise the key findings of the research. (Saunders et al., 2019, pp. 213–214) According to Eriksson and Koistinen (2005, pp. 41–42), sufficient proof of the presented results in a case study increases the research's quality.

The reliability of the research was strengthened by the selection of interviewees. The interviews dealt with representatives of two different BUs of the case company. The interviewees were also from different organisations of the case company. Since the empirical material obtained from the interviews was heterogeneous, it strengthens the reliability of the research because if only one organisation from the case company had been interviewed, its views could have been biased. And this would have negatively affected the results of the entire research. The reliability of the research's results is influenced by the feedback gathered from the performance measurement dashboards presentation and workshops. The reliability of the used literature was also assessed throughout the research and performance measurement implementation processes from the literature were used. The tools and processes used from the literature increase reliability compared to a case where the implementation process would not have been applied.

Best measurement and implementation practices were used from the literature to improve this research's validity. Greater validity would have been achieved by benchmarking different implementation and measurement practices with each other. However, there was no time for benchmarking within the schedule of this research. Although the research was conducted as a case study, it can be assumed that similar results will also occur in other companies' logistics. In the literature, similar logistics objectives were discovered as the findings of this research. These objectives and findings from the literature and empirical research could be generalised to other companies as well. However, it must be remembered that the implementation process of performance measurement is largely determined by the company's vision and strategy. In addition, the results of the presentations and workshops confirmed that the right kind of implementation framework had been used.

The entire research process was described in this paper. The description plays an important role in increasing reliability and validity. When there is documentation of the research process, it helps to understand the purpose of the research and the chosen methods. The background of the case company was also explained extensively so that the background and goals of the research could be communicated clearly.

8.3 Future development

The PMS of this research can be developed in the future based on emissions and predictability. Emissions and their reduction are important in the case company and the transparency of emissions reporting is a crucial goal. Visualising emissions by logistics chains is necessary because it helps to understand where emissions originate. When it is known precisely where emissions originate, it is possible to systematically reduce them with the help of developing logistics processes.

Predictability has been identified in the case company as an important tool to improve the value created by logistics for the customers. Predictability and its visualisation would help improve decision-making towards the case company's strategic goals. If the performance measurement dashboards would show predictability, it would be possible to examine scenarios and make the best decisions with their help.

According to Garengo and Bititci (2007), the use of a PMS tends to change organisational culture. It would be beneficial to study how this is realised in practice in different environments. A PMS can be used to guide daily activities toward the company's strategic goals. It would be good to study the effect of using the PMS in the longer run.

In addition, the developed PMS's dashboards and the framework used for their development should be tested in other companies' logistics for research purposes. When similarities are found, they would help strengthen the idea of how PMSs can guide daily logistics activities toward the company's strategic goals. Also, studying the logistics of another industry than steel could bring an interesting perspective on how much the industry of the manufacturing company affects the performance measurement implementation process. This could enable the comparison of logistics efficiency in different fields' supply chains. As Bititci et al. (2004) stated, the information shared in collaboration chains can be seen as a shared asset that creates value for the customers. Thus, this asset must be valued and managed for its utilisation to produce the wanted results. Shared information about logistics performance can help companies in various fields to find new types of innovations, which will help the role of logistics in value creation to become even stronger.

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APPENDIX A: THE INTERVIEW FRAMEWORK FOR CSFS

Background
1. What is your current position and what kind of responsibilities are included with it?
2. Describe your current relationship with logistics?

Current activities
3. How do you use logistics data and the information led from it nowadays?
4. How would you describe the current level of collaboration with logistics-related internal and external stakeholders?
5. Related to the previous question, how data and information are shared through these collaboration chains?
6. How would you describe the following within the context of logistics metrics?
    a. Current strengths?
    b. Current challenges?
7. Which logistics processes are now working efficiently, and which might need development?

Critical success factors
8. What would be the most important metrics for you in the context of evaluating logistics providers? How about overall logistics?
9. What kind of use you would find for logistics metrics?
10. In your opinion, what are the main factors that affect the development of logistics processes?
11. How would you describe the ideal user interface for a dashboard representing logistics-related metrics?

Future
12. In your opinion, in what direction the case company's logistics should be developed in the future?
13. What kind of logistics tools should be developed more in the future, or should there be some kind of logistics tools that are missing nowadays?

Ending
14. Is there something more you would like to add?
    a. Are there any tips for conducting this research?
    b. Did we miss something important you would like to add?

APPENDIX B: THE INTERVIEW FRAMEWORK FOR THE TECHNOLOGICAL FOUNDATION

Background
1. What is your current position and what kind of responsibilities are included with it?
2. Describe your current relationship with logistics?

Current activities
3. How logistics data and the information led from it is used nowadays?
4. How would you describe the current level of collaboration with logistics-related internal and external stakeholders?
5. Related to the previous question, how data and information are shared through these collaboration chains?
6. How would you describe the following within the context of logistics metrics?
    a. Current strengths?
    b. Current challenges?

Critical success factors
7. What would be the most important metrics in the context of logistics?
    a. Metrics that you think are helping to achieve the most value-adding goals
8. How do you see what are the strategic goals within logistics?
9. In your opinion, what are the main factors that affect the development of logistics processes?
10. What would be the most suitable platform for a performance measurement system?
    a. How do you see that this performance measurement system would align with existing systems?
11. What are the most important aspects of (a performance measurement) system maintenance?
    a. How do you see that the evaluation of this system should be conducted?
12. How would you describe the ideal user interface for a dashboard representing logistics-related metrics?

Future
13. In your opinion, in what direction the case company's logistics should be developed in the future?
14. What kind of logistics tools should be developed more in the future, or should there be some kind of logistics tools that are missing nowadays?

Ending
15. Is there something more you would like to add?
    a. Are there any tips for conducting this research?
    b. Did we miss something important you would like to add?