UNIVERSITY OF GOTHENBURG
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How can we measure and evaluate transportation performance?

A case study at ICA South-West

Master`s Thesis in Logistics and Transport Management

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Best regards,
Fredrik Appelgren

Abstract

Transportation continues to be an important part of business operations, where efficient transportation is used as a competitive advantage, to reduce costs and to facilitate service quality. In this context, measuring and evaluating transportation performance is an essential aspect of ensuring that goal targets and certain levels of performance are achieved. Frameworks for assessing transportation performance can however be complex and multilateral, where risk of both under and- over evaluating exist. Finding more united frameworks for assessing transportation performance is therefore of major interest for both businesses and actors involved in the transportation process. The purpose of this study is therefore to develop and test a conceptual model with metric areas for assessing transportation performance, to evaluate the model's applicability as a framework for transportation performance assessment, but also to assess the transportation performance of the studied case. The model is applied to the case study ICA South-West as an example for evaluating transportation performance. This study is made through action research, where the researcher has had an active role within the studied case. This study utilizes qualitative semi structured interviews and quantitative transportation data processing to gather empirical data.

The study highlights how ICA South-West performs well within three out of five key performance indicators for transportation performance assessment. The study further recognizes different areas of operational transportation improvement, but also suggested revisions to current routines for measuring and assessing transportation performance at the company. Furthermore, the aspect of the reverse transportation flow is acknowledged as a potential additional metric area to the conceptual model. The study suggests how a revised conceptual model including the metric area of the reverse transportation flow yields a balanced framework approach for transportation performance assessment. The study also concludes how the concept of measuring and assessing transportation performance is a complex and overlapping process, involving many different measurements and metric areas more connected than separated from each other. This study enables further research on the subject area, where among many suggestions, the developed conceptual model in this study could be applied and tested on other case studies.

Keywords: *Transportation assessment, Transportation performance measurements, Metric areas, ICA South-West*

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Abbreviations

LSP	Logistics service provider
TSP	Transport service provider
KPI	Key performance indicator
TMS	Transport management system

1. Introduction

The following sections give a background into the theoretical problematization of this research. The introduction starts with a research background, followed by the purpose and research questions of this study.

1.1 Research background

Many companies are operating in large and complex business systems, demanding frequent measurement and evaluation of business processes and operations. In this context, transportation is a major competitive function (Tracey, 2004) responsible for moving goods between actors (Sanchez-Rodrigues, Potter & Naim, 2010), verifying that the right shipments are delivered to customers within the given time frame and made by a high service quality (Forslund, 2007). The measurement and assessment of transportation performance is an essential aspect of logistics and transport management, where the estimations will give indications on how well operations and deliveries are working in relation to set goals (Forslund, 2007: Gunasekaran, Patel & Tirtiroglu, 2001). Forslund (2007) further describes how logistic measurements are a prerequisite of business success, where actors with high level performance principles can control, evaluate, and monitor their processes. Transportation measurements can further entail value creation (Fawcett & Cooper, 1998) as well as higher performance of business operations (Forslund, 2007), by highlighting potential bottlenecks and rooms for improvement within transportations. In addition, focus on logistic performance measurements can open for alliances with high performance partners who value the concept of performance measuring (Forslund, 2007), as well as increase channel integration between actors (Fawcett & Cooper, 1998).

The incitement for catering a high transportation service quality and enabling transportation performance measurements originates from companies' willingness to meet and exceed customer expectations, cut costs and to gain revenue (Simkova, Konecny, Liscak & Stopka, 2015; Sanchez- Rodrigues, Cowburn, Potter, Naim & Whiteing, 2013). It also emanates from potential fear of losing opportunities and orders through disappointed customers (Simkova et al 2015). In these contexts, a customer can be described as the actor receiving a delivery as well as the actor utilizing an external transport service for transportation (Fawcett & Cooper, 1998; Forslund, 2007). Conversely, a lack of measurement and evaluation can create uncertainty among performance management, where there is no real indicator on how operations are going in relation to set goals, jeopardizing customer satisfaction and process quality (Fawcett & Cooper, 1998). This includes a higher risk for transport inefficiencies which can result in increased time and costs associated with re planning and administration of transport loads (Woxenius, 2012). With this concern, evaluation of transportation performance becomes important to facilitate a high service quality that can be utilized as a competitive advantage (Krasnyanskiy & Penshin, 2016: Forslund, 2007).

At the same time, it is vital to develop relevant measurements and to set reasonable goals before conducting logistic performance assessments (Fawcett & Cooper, 1998). Gunasekaran et al (2001) discusses risks with over measuring performance as well as having an unbalanced measurement approach. Gunasekaran et al (2001) further describe how adding of too many measurement parameters to certain areas can be counterproductive, where a focus is put on the number of measurements rather than quality. This includes a potential liability of giving an unfair picture of overall business performance, where too much time and resources are being spent on measuring one specific area (Gunasekaran et al, 2001). Additionally, this could also entail risk of operating with complex and expensive performance evaluation systems, unnecessary for the actual transportation network (Thompson & Sutter, 2012).

The intended goal targets and ways of measuring and evaluating must therefore be anchored in the service and performance expectations of a specific operation, formulated together between operator and customer (Forslund, 2007; Fawcett & Cooper, 1998). For measurement data to be useful, it must be put in a context, analysed, compressed into information, and compared to defined metric goals (Forslund, 2007; Simkova et al, 2015). Only when executed in a correct way, specialised, and tailored to operations of a specific actor, can performance measurements work as useful tools to create knowledge about current logistic capabilities and to drive decision making (Fawcett & Cooper, 1998). In this regard, Forslund (2007, p.906) suggests a model for conducting logistic performance management within a company as the following steps: choose objectives to investigate and the purpose behind, select and define performance metrics and measuring variables, formulate goals for measurement variables and conduct measuring, analyse results and take potential improvement actions.

Krasnyanskiy & Penshin (2016) also discuss how measuring of service levels and other metrics within transportation assessment cannot be limited to just one measurement, but rather include different perspectives of measurements that are being merged. Similarly, Forslund (2007) describes how logistic metrics include a range of different measurements, making the performance evaluation process complex. Within transport performance management, there is thus a wide range of previous research focused on different metric areas and key performance indicators (KPI) that can be a part of transport performance evaluations. The different general metric areas are measuring fields, supposed to be more applicable to evaluate any type of transportation performance, while KPIs can be measurements, more subjective to specific goals or purposes of operations (Simkova et al, 2015; Fawcett & Cooper, 1998).

Correspondingly, there are challenges associated with selecting relevant transport performance metric areas to focus on as well as choosing the right measurement parameters to assess transportation performance for a specific business. However, the literature illustrates many benefits of conducting different performance evaluations on transportation operations. Concurrently, many studies clarify endanger with substandard transportation performance assessment routines, where actors might lose control and follow up of performance in relation to set goals. It is also being recognized how an over measuring of performance could potentially impact a transportation actor negatively, where too many resources are being put on the measuring and evaluation process. These perspectives therefore give current literature an acknowledged need for more united transportation performance evaluation models, where different relevant metric areas for measuring transportation performance can be identified and included. In this regard, it becomes interesting to further investigate metric frames for evaluating transportation performance. Accordingly, previous research can be utilized to develop and test a conceptual transportation performance assessment model based on discussed metric areas used for measuring transport performance within current literature.

The author of this study was further given the opportunity to evaluate and analyse the transportation performance of the Swedish food retailer ICA South-West (from now on referred to “ICA S-W" in this paper). In this regard, the application and evaluation of such a conceptual model for assessing transportation performance previously discussed can therefore be applied and tested on the case study company ICA S-W. ICA S-W is responsible for delivering groceries to roughly 800 independent ICA stores around the south and west regions of Sweden. The company utilizes ten external hauler companies to conduct outbound transportations of picked and packed groceries between the main distribution centre in

Helsingborg and the ICA stores. This includes intermediate transportations from the distribution centre to smaller transhipment hubs located around the region, where local reconsolidation of goods take place before departure to the stores (Acklid, 2021). Consequently, ICA S-W is operating with a large transportation network, demanding continuous evaluation of transportation operations to ensure high transport performance and service quality (Simkova et al, 2015; Krasnyanskiy & Penshin, 2016).

ICA S-W has together with their haulers and the ICA stores agreed upon specific important goal targets for the company's transportation performance. Both ICA S-W and the haulers register and document arrivals, dispatches, transport loads and other lead time - and operational related measures. Similarly, both ICA S-W and the haulers are obliged to report deviations and other changes of the original transportation plan that takes place before, during or after transportation (Acklid, 2021). These processes thus give ICA S-W large amounts of valuable data as well as performance goals guidelines, both essential for evaluating transportation performance (Simkova et al, 2015). Additionally, ICA S-W has a well-documented history of handling and measuring large transportation volumes through different transportation flows (Acklid, 2021). In these regards, ICA S-W becomes a relevant case for transportation performance evaluation, where the company can operate as an example to assess a developed conceptual model for evaluating transport performance. Similarly, a conceptual model can function as guidelines to drive the transportation performance assessment of ICA S-W transportation flows.

1.2 Purpose

The purpose of this study is to develop a conceptual model for assessing transportation performance in relation to company set goals. The model will be applied to the case study ICA S-W, where the aim is to identify possible areas of improvement in relation to the transportation performance of the business, as well as potential developments to the proposed conceptual model.

1.3 Research questions

Q1 *What metric areas are important to consider when evaluating transportation performance?*

Q2 *How does the transportation flows of ICA S-W perform in relation to the goals formulated by the company?*

Q3 *What operational areas of improvement exist?*

The research questions have been formulated to support this research and to facilitate the purpose of this study. The three questions are anchored within different sections of the intended purpose and will thus be answered through somewhat different methods. Question one is mainly focused on evaluating the proposed conceptual model developed in this study. This question will further be answered through the main empirical findings of the conducted interviews. Question two and three are more related to the transportation performance of ICA S-W. These questions will be answered through the empirical findings of the interviews, as well as with analysis of the quantitative transportation data.

Furthermore, the answering of the three questions will be conducted in their formulated order. The three questions are formulated on different detailed levels, connecting each question to each other. Therefore, question one must be answered prior to question two and three, where each question yields prerequisites for the next question to be answered. Through this structure, the aim is to systematically guide the research to aid the purpose of this study.

1.4 Delimitations

As discussed more thoroughly within Appendix 1, ICA S-W is a part of the company ICA Sweden. However, this study only focuses on the outbound transportations of the South-West region of this company. Outbound transportation includes transportation flows which operate from a distribution centre to an ICA store or to another warehouse. The study's purpose was formulated within the transport department of ICA S-W and was therefore only considering this region's transport operations and flows. Extending the research and conducting a similar study of ICA Sweden would include several disconnected analyses of the different transportation -and hauler networks with individual flows and haulers that exist within the company. Consequently, this would yield a research range and scope fair beyond the reach and frame of this research.

Another delimitation of this study is the exclusion of ICA S-Ws intermediate transportation flow between Helsingborg and Linköping and the distribution transportation from the transhipment centre in Linköping to the ICA stores (for transportation network details, see Appendix 1). The previous haulage company conducting these transportations are no longer going to be in service for ICA S-W. In this regard, both transportation flows conducted by new haulers have not gathered enough data to be included within this study. Similarly, current data of the Linköping transportation flow concerning the previous haulage company is no longer relevant to evaluate. However, it is important to note that the frozen transportation flow of Linköping will still be included, as this flow is being operated by the same hauler company as before.

Furthermore, the decision was made to exclude the perspective of how ICA S-W works with costs and follow up of different cost- related KPIs. This choice was determined based on the large scope of the cost perspective within the context of transportation, where many different aspects must be discussed and compared before any analysis can be made. This includes several different price contracts and budgets for the separate transportation flows and hauler companies of ICA S-W, making the follow up of costs somewhat of a separate field of evaluation. The cost aspect will still be displayed as an important part of a transportation performance assessment literature and framework. However, for this studied case, it will mainly be integrated into the analysis of the other metric areas related to ICA S-W rather than analysed and discussed on its own.

2. Methodology

The following parts will present and discuss the main features and decisions regarding the methodology used in this study.

2.1 Research design

This research has been conducting a case study on the Swedish food retail actor, ICA S-W. A case study is concerned with investigating characteristics of a particular phenomenon such as a business (Collis & Hussey, 2014), as well as studying the complexity of this context (Näslund, 2002), to receive insight and knowledge about the area (Collis & Hussey, 2014). The case study approach therefore became a relevant method for this research, were the case of ICA S-W were to be studied.

The theoretical structure of this case study can be characterised as both deductive and inductive. This means that theories from the literature were used and assessed throughout this study, but also that theory was generated through the empirical findings (Collis & Hussey, 2014). Within this context, a literature review regarding transportation performance assessment was utilized to develop a conceptual model with relevant metric areas for measuring transportation performance. This model was then applied to the case of ICA S-W to evaluate the model's relevance for assessing transportation performance, hence the deductive research aspect of this study. From this perspective, the case study can also be described as an explanatory case study, where existing literature and theory was used to understand the situation of ICA S-W (Collis & Hussey, 2014). At the same time, the empirical findings could yield additional insights into the existing theoretical framework of this study illustrated through the revised conceptual model in Figure 4, which gave this section of the research an inductive approach.

Similarly, the research paradigm of this study can be decorated as somewhere in between the approach of positivism and interpretivism. This means that the reality approach used, captures both natural science objectivity and subjective reasoning as relevant aspects of what is considered real and true knowledge (Collis & Hussey, 2014). On this subject, the interpretivist perspective was mainly included when conducting the qualitative data gathering on this case study, to understand the social context of ICA S-W that the interviewed respondents exist in (Collis & Hussey, 2014). Correspondingly, the more positivistic aspect was admitted during the transportation data gathering, where the statistical data output could be displayed as measurable and therefore more objective (Collis & Hussey, 2014).

This study was further conducted through an approach of action research, where the author has had an active role within ICA S-W throughout the study period (Collis & Hussey, 2014). Action research can be described as a process of combining research with action, where a researcher is participating in the work and changes facilitated by the studied group (Näslund, 2002). In this context, borders between researcher and research group are reduced, where the researcher is integrated into the studied process (Somekh, 2006). Just like Näslund (2002) and Collis & Hussey (2014) describe action research, this means that the author has been participating in developing this case study frame, as well as driving the study process forward, rather than just observing and analysing given materials.

Additionally, this study's author has a previous background within the case study company ICA S-W. The author is currently working for the company's transport department at their main distribution centre in Helsingborg. The work is focused on transport administration and business support, including documentation and compilation of weekly transportation loads, transportation deviations and payments going out to hauler companies who are operating for ICA S-W. The author is therefore anchored in some of the work and routines concerning transportation performance and assessment taking place within the company, which further enhances participation of action research (Näslund, 2002). Somekh (2006) also discusses how the history and social context of the studied group and the researcher’s role within this group have an important role in determining how action research will be carried out. Somekh (2006) mentions how awareness of the researcher's position within the studied group is highly important for research quality. In this context, further discussions regarding the researcher’s role within the studied case will be elaborated on in section 2.5.1.

To summarize, the two main methodological design decisions of action research and case study were developed through the purpose of this study, where an engagement in and understanding of current transportation flows and routines of ICA S-W benefited the execution of this research. The action research approach influenced the way this case study was made, where involvement within the work process of ICA S-W assisted the researcher to gather the right information to test the conceptual model of this study and evaluate the transportation performance of ICA S-W (Näslund, 2002).

2.2 Description of case study company

ICA S-W is a part of the company ICA Sweden. ICA Sweden is the largest grocery retailing actor of the Swedish grocery industry, with a total market share of over 30 percent (ICA Gruppen, 2021a). ICA Sweden is a part of the company ICA Gruppen, which includes ICA real estate, ICA Bank, the pharmacy Apotek Hjärtat as well as the Baltic retail actor Rimi Baltic (ICA Gruppen, 2021b). However, ICA Gruppens main business is ICA Sweden and grocery retailing, where the other functions work as support offerings to the main grocery business (ICA Gruppen, 2021a). ICA Sweden also obtains procurement and sales of non-food related products through the different ICA stores with their "ICA special" department. In this context, ICA special works as a wholesaler to the ICA stores (ICA Gruppen, 2021c). Additionally, ICA Gruppen is listed on the Stockholm stock exchange market, where the common association of ICA-retailers are the largest majority stockholders (ICA Gruppen, 2021b). Furthermore, the ICA stores connected to ICA Sweden are independently owned and therefore separated from other stores and the main business of ICA Sweden. This means that store owners have more responsibility to manage and plan their own operations and costs, but also that they have more freedom to change offerings and take part of potential earnings. The ICA stores are mainly divided into four different types of stores in relation to their sizes: ICA Maxi, ICA Kvantum, ICA Supermarket and ICA Nära (ICA Gruppen 2021c).

In this context, ICA Sweden's main task is to work as a retailer towards the different ICA stores, where ICA Sweden is responsible for operating large parts of the grocery retail supply chain. ICA Sweden manages the main purchasing, warehousing, and consolidation of goods as well as outbound transportation of deliveries to the stores. In addition, ICA Sweden aids stores with general marketing of the ICA brand and its products as well as new IT functions and sustainability initiatives (ICA Gruppen 2021c). With the large share of the Swedish grocery retail market and its presence among Swedish society with around 1300 stores (ICA Gruppen, 2021b), ICA Sweden receives a large supply chain and transport network.

Within the main supply chain, ICA Sweden currently has four main distribution centres, which are together working with purchasing, warehousing, and transport planning to serve the different regions of Sweden. These main distribution hubs are in Helsingborg, Stockholm, Västerås and Borlänge. In addition, ICA Sweden receives two relatively new developed E-commerce warehouses in Gothenburg and Stockholm to serve their online market. Here, the

South-West region of ICA Sweden (ICA S-W) which is the focus of this study, is the largest operating area of the business, serving around 800 stores. The South-West region extends from the south of Skåne all the way to the county of Värmland, including areas such as the county of Småland as well as the areas around Linköping and Jönköping (Acklid, 2021). Further details about the transportation network of ICA S-W can be found in Appendix 1.

2.3 Data gathering methods

The data gathering of this study was made with both quantitative and qualitative methods. The primary data, which is data generated by the original source (Collis & Hussey, 2014) was collected through qualitative interviews and quantitative transport data processing. Additionally, this study was also based on secondary data, which is data retrieved from existing sources (Collis & Hussey, 2014). The secondary data was gathered through a literature review about transportation performance assessment.

The utilization of mixed research methodologies and gathering of data from various sources made in this study can be described as triangulation (Collis & Hussey, 2014 and Mangan, Lalwani & Gardner, 2004). Mangan et al (2004) describe benefits of conducting triangulation when managing a case study, where researchers can receive a greater depth of knowledge about the researched case. Similarly, triangulation can reduce data source bias and increase both validity and reliability of the study (Collis & Hussey, 2014), as well as strengthening theories that are being tested (Mangan et al, 2004). Through this, both the primary and secondary data were used to answer the three research questions of this study, where the qualitative and quantitative methods complemented each other.

2.3.1 Interviews

As described by Collis & Hussey, (2014), interviews can be used for gathering data on participants' opinions and interpretations of certain topics. The interviews of this study were initially used to gather knowledge about transportation operations and flows of ICA S-W. In addition, the interviews were also facilitated to prepare and improve prerequisites of gathering right and relevant data for the quantitative transport performance analysis on the company. This included discussions regarding what performance metric areas that were relevant to include for ICA S-W, but also where and how to find the right type of data to expedite measurable parameters that could be utilized for the metric areas.

Furthermore, the interviews were used to give context to what was considered relevant areas for transportation performance assessment as well as giving insight into different transport performance goals of the company. Just as Näslund (2002) discusses, qualitative methods within logistic research can be utilized to develop understanding of complex logistic contexts before other measurements are being made. The interviews of this study therefore aided the process of testing the conceptual model of this study by selecting, gathering, and processing correct transport data for the transportation performance evaluation on ICA S-W. The interviews also helped to acknowledge what was considered good or bad transport performance, to receive goal targets to compare the quantitative transport data findings to. In this context, the interviews were conducted with different relevant stakeholders involved in the transportation flows of ICA S-W.

The access, planning and execution of the different interviews were facilitated through a mix of natural and snowball sampling (Collis & Hussey, 2014). The initial interviews of this study were conducted through connection with the ICA S-W supervisor of this project, Rebecka Acklid. Throughout these interviews, suggestions were made to get in contact with other persons with specific types of knowledge or business focus areas, relevant for this study. Through this snowball sampling, extended interviews could be made with other respondents who were specifically involved in different aspects of transportation operations and performance evaluations. In this regard, the interviews continued throughout the study process, where additional important empirical findings could be added to the study results. Subsequently, the different interviews aided the process of finding and accessing more persons to interview and thus extending the interview data sample used in this study. Through discussion of certain subjects with multiple persons, the sample method also assisted in verifying relevance of certain thoughts and perspectives, where more persons could give their take on the same subjects (Collis & Hussey, 2014). This could for example include a consensus to include a specific parameter when evaluating transportation performance.

As this research was concerned with the case study of ICA S-W, it was essential to collect empirical data from respondents with deep knowledge about the transportation flows and performance measurement routines of the company. From this perspective, other types of sampling methods, such as random or stratified sampling (Collis & Hussey, 2014) were not relevant for this study. Further details regarding the specific interviews are found in Table 1.

Furthermore, all interviews were executed through the digital platform Microsoft Teams, which is the standard tool used for online communication at ICA S-W. Due to the current situation with the Covid-19 pandemic, all interviews had to be done remotely, as most official employees at ICA S-W are not supposed to enter the offices. As described by Collis & Hussey, (2014), the main limitation of online interviews can be the necessity of an internet connection. However, this was not perceived as a problem for the interviews of this study, as the changing working conditions due to the pandemic demanded the respondents to already have a strong server and internet connection to do their job. The researcher is also aware of potential disadvantages of conducting interviews remotely, where shorter responses are harder to perceive and interpret (Bryman, 2012). However, the interviews were conducted with an active video camera from both researcher and respondent, to strengthen the experience of the interviews as being face-to-face. Through this decision, the aim was to understand each other's reactions and inputs (Bryman, 2012) more easily. Additionally, every interview was made in Swedish, which assisted understanding and communication of company specific terms as the majority of ICA S-Ws operations are executed through Swedish.

Interview	**Respondent**	**Respondents' Title**	**Date**
1	Rebecka Acklid	Manager Business Support, Transport Department, ICA S-W	22/1/2021
2	Joanna Swiatek	Transport Analyst, Transport Department, ICA S-W	27/1/2021
3	Rebecka Acklid	Manager Business Support, Transport Department, ICA S-W	1/2/2021
4	Erik Wickmarck	Investigator Damaged Goods & Claims, Transport Department, ICA S-W	3/2/2021
5	Rebecka Acklid	Manager Business Support, Transport Department, ICA S-W	5/2/2021
6	Amanda Fältman	Transport planner, Transport Department,	23/2/2021

		ICA S-W	
7	Rebecka Acklid	Manager Business Support, Transport Department, ICA S-W	4/3/2021
8	Sebastian Skoog	Project coordinator/Transport planner, Transport Department, ICA S-W	5/3/2021
8	Fredrik Zidén	Manager Tactical Transportation Planning, Transport Department, ICA S-W	1/4/2021

Table 1: Interview overview

The interviews were further conducted in a semi structured manner, where the interviewer facilitated the interviews with a couple of wide and open questions anchored in the subject of measuring transportation performance within ICA S-W (Bryman, 2012). Like the way Collis & Hussey (2014) describe semi structured interviews, were not all the following questions prepared in advance. Depending on what was said during the interviews, other follow up questions could develop throughout the talks, which yielded more empirical data and a deeper understanding of certain topics. Additionally, the asked questions were in some cases adjusted to suit the specific interview. This could for example entail specific questions related to certain metric areas for measuring transportation performance within ICA S-W. The different interview discussions were mainly impacted by what work position that the respondent had at the company. Furthermore, the respondents did know what type of subject the interviews were going to cover, where the interviewer had briefed the subject to the respondents when initially making contact. This means that the respondents were somewhat prepared for the interviews and the subjects.

The decision to utilize semi structured interviews was based on the aim to make the interviews both comfortable and flexible (Bryman, 2012), to receive the most valuable information from the respondents. Accordingly, the main questions were developed to keep structure within the interviews and to avoid risk of discussing non relevant subjects. However, the questions were not necessarily asked in a particular order (Bryman, 2012), but rather existed as a reminder to not miss out on particularly important topics. Further details regarding the interview questions can be found in the interview guide in Appendix 2.

Concurrently, through the aim of having comfortable interviews, the decision to not record was made. The researcher is aware of the benefits of recording, where the researcher can come back and listen to certain sequences of the interviews afterwards (Bryman, 2012). However, in this context it was important to direct focus towards open discussions for the respondents, rather than make them think about how they are being asked both difficult questions and taped. Instead, detailed notes regarding focal points of the discussions were taken throughout the interviews (Bryman, 2012), which yielded enough empirical data to continue with the gathering and processing of transport data as well as the study analysis. Additionally, the respondents were given the opportunity to read drafts of this paper, to ensure that what was said during the interviews were interpreted correctly by the interviewer.

2.3.2 Transport data

The quantitative data used in this study was facilitated with transport data from ICA S-W. This data was extracted from company spreadsheets and databases, where information in terms of numerical statistics about different transportation operations of ICA S-Ws transportation flows are kept. As discussed within section 2.3.1, the decisions regarding what statistical data to use, was made during the initial interviews with the respondents of this study. After extraction, the transport data was processed into different relevant contexts facilitated by the researcher, where further analysis could be made. These contexts were anchored in the different transportation flows of ICA S-W, where the data could be filtered into more specific categories of the transportation network. This could for example include a division of the data between the different types of transportations going to specific scatter points or between the hauler companies that are operating within the different transportation flows.

Additionally, the transport data was extracted from the months of September, October, and November in 2020 as well as January of 2021. The aim was to receive as recent data as possible to make the analysis more relevant to current operations. However, the decision was made to exclude the month of December from the data analysis. An analysis of data from large weekends such as Christmas and New Year’s Eve would show larger transported volumes together with more deviations, delays and transportation inefficiencies, days prior to and during the weekends. The month of December would therefore not be proportionate to the remaining four months used in this data set. For the data to be comparable, statistics must be taken from time periods where operations run under similar circumstances. Although the transportation performance during holidays could be interesting to investigate further, it was not relevant for the scope of this dataset where data regarding the general performance of ICA S-W transportation flows during normal circumstances were to be analysed.

In a similar manner, the influence of the covid 19 pandemic could also be thought of as having a potential impact on the output of the transport data. During the initial phase of the pandemic, food retailing businesses could identify an increase of sales and bunkers of food from the customers as well as changes in shopping patterns, creating potential challenges and pressure on the food retailing operations (ICA Gruppen, 2021d). However, as the transport data of this study is extracted from the later part of 2020 and the beginning of 2021, it can be assumed that the transportation flows of ICA S-W had somewhat adapted to potential changes due to the pandemic. In this regard, the extracted data can be acknowledged as data taken from the current normal business and transportation operations circumstances that exist.

2.3.3 Secondary data

The literature review of this study was conducted through an information search within academic journals, scientific publications, books, and online articles regarding the subject of transportation performance assessment. The secondary data sources gathered online were mainly retrieved from the search engine tool provided by the university of Gothenburg, Super Search as well as the google service for scientific publications, Google Scholar. The researcher is aware that the publication year of the different literature sources can shift throughout the literature review. However, this has been done with the purpose of covering the full scope of the research field by referencing original sources regarding important aspects of transportation performance assessment. In addition, it can also be acknowledged how this research field does not necessarily have any expiration date, where the concept of measuring transportation performance cannot be considered as a new phenomenon. Sometimes, multiple sources from different years were utilized within the same paragraph. This was done to illustrate the relevance of that specific literature perspective, where authors from different times discuss similar essential aspects of transportation performance assessment. In this context, both older and newer sources brought important aspects into the theoretical framework of this study.

The execution of the literature review was therefore an essential prerequisite to facilitate the deductive research approach used in this study (Collis & Hussey, 2014), where the literature review assisted development of the conceptual model. Additionally, other broader secondary data such as websites were used to fill potential information gaps within the research. This could for example include general information about ICA Sweden and ICA S-W, gathered from the company's own public websites. Subsequently, the secondary data and the conceptual model became central parts of this study, where the application of the model on ICA S-W was used to aid the purpose and answer the research questions of the study.

2.4 Data analysis process

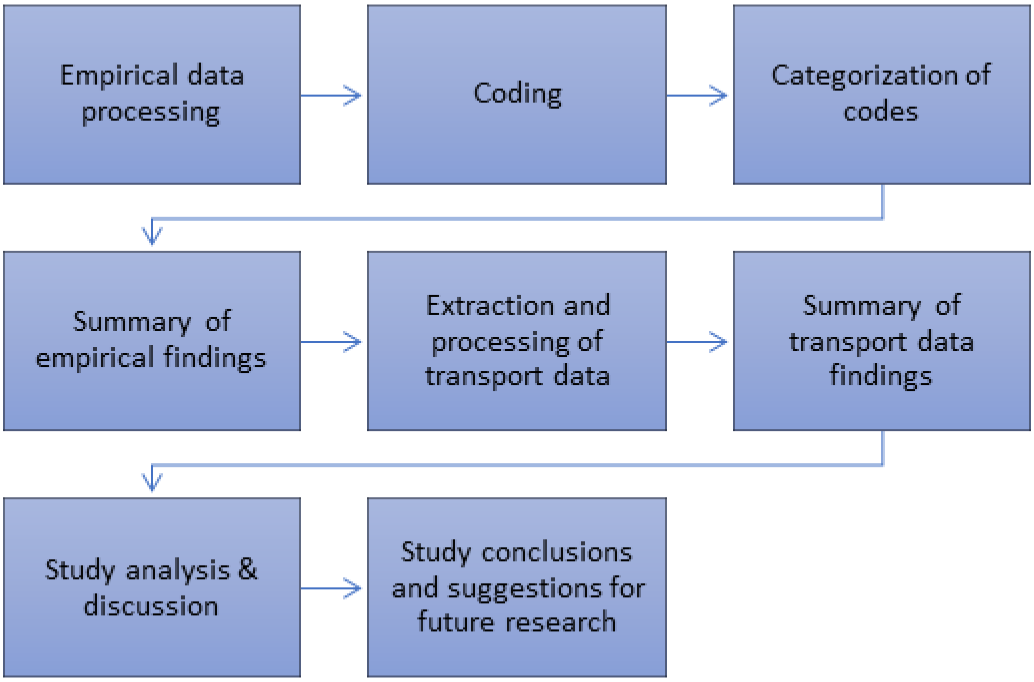


Figure 1: Flowchart of data analysis process

The analysis of the gathered data had to be made in different steps. These steps can be presented in Figure 1. As previously mentioned in section 2.3.1, the utilized transport data was selected through the interviews. This means that processing of the empirical data had to be made prior to the gathering, extraction, and analysis of the transport data. In this regard, the empirical data was processed with the concept of coding (Collis & Hussey, 2014), where different labels were used to structure the different notes made during the interviews. As this empirical data was used to facilitate testing of the conceptual model as well as a prerequisite for extraction of the transport data, the code system had to be made in different sections.

Initially, the codes followed the different metric areas categories of the conceptual model, where codes could be made regarding how and within what areas that ICA S-W works with transportation performance assessment. This aided the connection between the empirical findings and the developed theoretical framework of this study. The second coding part focused on how to measure the transportation performance of ICA S-W through the extraction of transportation data and compare it with set goals. In this regard, the codes were more related to different KPIs as well as goals that were supposed to measure different metric areas found within the initial coding. Like Collis & Hussey (2014) describe the benefits of coding, this system aided the process of categorizing the empirical data into different segments or phrases that could be utilized for further analysis.

The transportation data was then extracted, separated, and analysed between the different transportation flows of ICA S-W. Due to the characteristics of the transportation network, not all KPIs could be utilized for all transportation flows. After illustrating the main aspects of the empirical and transportation data findings, this process culminated into the study analysis. In this context, findings of the empirical data were being analysed and compared with the conceptual model of this study. Furthermore, analysis regarding the transportation performance of ICA S-W were conducted, where the results of the transportation data were compared to set goals formulated by the company. Beyond this, additional discussions took place regarding the applicability of and potential developments to the conceptual model as a suggested framework for measuring and evaluating transportation performance. This included discussions regarding possible areas of improvement to the transportation operations and routines for measuring transportation performance within ICA S-W. In this regard, the data analysis process aided the accompaniment of this research, where the research questions of this study could be answered and where connections between the case study and the conceptual model could contribute to the theoretical literature regarding transportation performance assessment.

2.5 Research quality

Collis & Hussey (2014) mention how the two main theoretical concepts of reliability and validity are typically used when assessing research quality of a study and its findings. Collis & Hussey (2014) discusses how reliability refers to correctness of the study and possibilities of replication of the results if the study were to be repeated. If reliability is high, conducting the same study twice should yield similar results. In comparison, validity of a study is concerned with how well the study measures what it wants to measure. This means how well the measurements used will facilitate reasonable results to answer the questionnaires of the study (Collis & Hussey, 2014). However, when conducting more qualitative research, Bryman (2012) and Halldorsson & Aastrup (2003) discuss how quality criterions for the research should be based on trustworthiness. In this regard, trustworthiness is based on four categories for evaluating research quality: credibility, transferability, dependability, and confirmability (Bryman, 2012). As previously discussed, this study was initiated through the approach of action research and with the method of qualitative interviews. Decisions regarded what type of transport data to use was also developed throughout the interviews. Therefore, it seemed relevant to evaluate the research quality of this study from the more qualitative perspectives of trustworthiness. The following section will therefore present the research quality of this study from these four perspectives.

A study's credibility focuses on to which degree the findings of research can be trusted (Bryman, 2012). As previously mentioned, the transportation data and findings of this study were based on information generated through interviews. The interviews were facilitated with different knowledgeable persons at ICA S-W, involved in the processes of both leading and conducting daily transport operations as well as evaluating transportation performance. Accordingly, the given information and parameters to measure transportation performance can be assumed to have a high credibility, as it was provided by persons with experience and knowledge of transportation operations and assessment. The findings credibility could also be interpreted as further strengthened throughout the spread of interviews, where multiple persons indicated similar areas and measurements as important for measuring transportation performance.

Furthermore, dependability can be related to reliability, where the possibility of replicating a specific study is in focus (Bryman, 2012). This study has been highly related to the case study company ICA S-W. Accordingly, goals related to transportation performance and measurements used for assessing transportation performance can be context based. Conducting the same research within this study on another company could therefore yield different results. At the same time, the utilization of triangulation (Mangan et al, 2004) within this study has allowed the findings to be generated from two separate types of sources, making different connections and conclusions somewhat more stable and reliable. In this regard, managing this case study twice on ICA S-W would therefore most likely give similar results.

The transferability aspect is concerned with the level of generalizability of the findings (Bryman, 2012). Within this case study, the results of the transportation performance evaluation were highly subjective to the transportation flows and operations of ICA S-W. These specific results can therefore be difficult to generalize to other contexts. At the same time, results concerning the effectiveness of the developed conceptual model of this study could be applicable to other situations. However, the process of transportation performance assessment is very situation dependent. Accordingly, applying and evaluating the model based on just on case study could still make the effectiveness of the findings difficult to generalise.

Additionally, Bryman (2012) discusses how conformability is associated with researcher bias and how involvement of the researchers own opinions within a study potentially can impact the research results. The action research approach of this study has yielded a high level of participation of the researcher, where the researcher's position within ICA S-W has aided the study process. However, the data used to facilitate this study has originated from qualitative semi structured interviews and quantitative transport data from ICA S-W. As discussed in part 2.3.1, the interviews were facilitated through a snowball sample, where all the respondents were selected through recommendations by earlier respondents. The interviews were made in a relatively open manner, to give the respondents a chance to answer questions regarding factors, measurements, and goals they would consider as important when evaluating transportation performance at ICA S-W. Furthermore, the used transport data was administered by different transport operators throughout the course of the months that the data was registered to. Beyond potential administration errors, the data gave a relative straightforward picture of how a specific flow or operator was performing in relation to the original transportation plan and the transportation performance goals. Through these terms, the level of conformability of this study can be illustrated as low, where the researcher has followed and analysed the data brough to him by the respondents and the transport data at ICA S-W.

2.5.1 Working with action research in a familiar setting

The author´s previous background of working within ICA S-W has given this case study some specific prerequisites for conducting action research. Initially, the author has had previous knowledge of routines and working processes associated with ICA S-Ws transportation flows and operations. This has given the researcher previous time to reflect and understand the transportation networks of ICA S-W, but also to evaluate potential strengths and weaknesses of business areas connected to the researchers work. Through this, the aspect of system thinking within action research was easier to apply, where different interrelationships within the transportation flows of ICA S-W, at an early stage, were being investigated and understood by the researcher (Näslund, 2002).

Furthermore, the author's background within ICA S-W made the data gathering and processing more convenient. Concerning the interviews, this included already existing trust from the persons being interviewed, where researcher and respondents knew each other. In addition, the researchers' knowledge about company specific terms made the interviews more continuous, where less time had to be spent on explaining certain details about ICA S-W. These two factors therefore aided the process of receiving a lot of valuable information from the interviews, where researcher and respondent could have a smooth and comfortable conversation about the subject. Additionally, the researcher could through company admittance easily access all the files necessary to gather relevant transport data for the analysis. This included knowledge about where to look for specific data but also how to sort according to company standards and rules to divide data into the different segments of information that was needed for the analysis. Just like Näslund (2002) describes, organisational problematizations can be unstructured and complex. Näslund (2002) further emphasizes the relevance of system thinking in action research, to understand patterns of change and behaviours within the studied organisation. In this regard, the researcher has utilized his current position at ICA S-W as an advantage to facilitate an easier data gathering and processing phase, by knowing where to look and how to process existing transportation data.

At the same time, there are some potential risks with being too active or involved within a company that is being studied. Collis & Hussey (2014) discuss the danger of becoming too problem solving, where a researcher is getting deeply involved within the details of the studied case. Collis & Hussey (2014) further describes how this could create a gap between information that is thought of by the author and the information that is delivered. This means that some of the descriptions that might seem obvious to the writer, could be unfamiliar or misunderstood information for the reader. Here, it is vital to make sure that different aspects related to the studied case are being explained in detail, to be understood by anybody (Collis & Hussey, 2014). In the context of ICA S-W, this could entail a lack of explanation of certain business-related names for the different transportation operations of the company.

Furthermore, a high involvement within and access to a research case could potentially create a situation of narrow-minded thinking. Kock (2004) discusses threats of being too subjective and emotionally involved within a study process, potentially yielding researcher bias into the study results. In this situation, it might be difficult to consider other thoughts than the ones already presented to you by yourself or other involved actors within the studied case (Kock, 2004). Like before, in the example of ICA S-W, this could include missing important KPIs that are not often talked about for measuring transport performance.

2.6 Ethical considerations

Ethics in research is concerned with moral principles associated with conducting research and presenting results, where the principles are typically connected with persons involved within the study (Collis & Hussey, 2014). Collis & Hussey (2014) discuss the importance of considering transparency, information sharing, confidentiality and voluntary participation between the research and the participants of a study. In this research, every respondent was informed about the purpose and frame of this study. The respondents were also asked permission to publish their names, work titles and other relevant data. Consequently, all respondents mentioned in this research paper agreed to participate and publish their personal information.

Furthermore, the researcher and respondents had a continuous communication throughout the study process, where more practical perspectives of research structure, data extraction and study findings were discussed. This was done with the purpose of facilitating a high level of transparency between the researcher and respondents as well as to receive a mutual understanding and agreement of how the results were going to be presented. This included a focus on ethical reciprocity (Collis & Hussey, 2014), where this study aimed at benefiting both the researcher as well as the participants from ICA S-W.

3. Literature review

This consequent part will present the main aspects of transport performance assessment within the literature. Initially, the question of why businesses should measure transport performance will be presented, followed by a discussion regarding how the measuring could take place. Furthermore, this literature review will demonstrate what metric areas that are important to consider when measuring and evaluating transport performance. This part will begin with a presentation of the developed conceptual model used in this study, accompanied by a discussion regarding each section of the model.

3.1 The importance of measuring transportation performance in transport operations

Within transportation, it is important to assess the performance of vehicles, drivers, and transportation chain actors. Ploos van Amstel & D'Hert (1996) discuss how demand for operational control, efficiency and cost reduction has driven the development of transportation measurements. From this point, measuring has also evolved with the purpose of ensuring that transportation operations are performing in relation to expectations of the customers (Fawcett & Cooper, 1998). Fawcett & Cooper (1998) further discuss how measuring performance can aid logistic actors in developing distinctive capabilities, where measuring and control of one's logistic operations can yield competitive advantages. This includes adding value to business operations, where measuring gives beneficial insights into operational performance, that can be a basis for future decision making (Fawcett & Cooper, 1998). Equivalently, Woxenius (2012) mentions how measuring gives prerequisites for improved performance, where actors get greater visibility of potential operational inefficiencies and deviations.

Furthermore, Lai, Ngai & Cheng (2002) discuss how transport performance measurements can aid evaluation of a full transportation chain. Lai et al (2002) refer to a transport chain as the combination of a shipper, transportation service provider (TSP) and consigner. Similarly, Ploos van Amstel & D'Hert (1996) discuss three main activities within a transportation process: loading, driving, and unloading. In this regard, measuring within or between the different processes can assist the evaluation of how different sections of a transportation chain operates together (Lai et al, 2002). Similarly, Sanchez-Rodrigues et al (2010) also elaborate on five main places for transport uncertainties impacting transport performance key ratios: dispatching shipper, transport carrier, customer, transport control systems and external uncertainties. Correspondingly, measuring the full length of a transportation chain does not only become important to identify room for business improvement but also to locate uncertainties and potential weaknesses within the overall transportation operations (Lai et al 2002).

3.2 Approaches for measuring transportation performance

Forslund (2007) elaborate on the importance of taking necessary actions before conducting measures related to logistic performance. In this regard, as presented in Figure 2, Forslund (2007) has developed a model for logistic performance management.

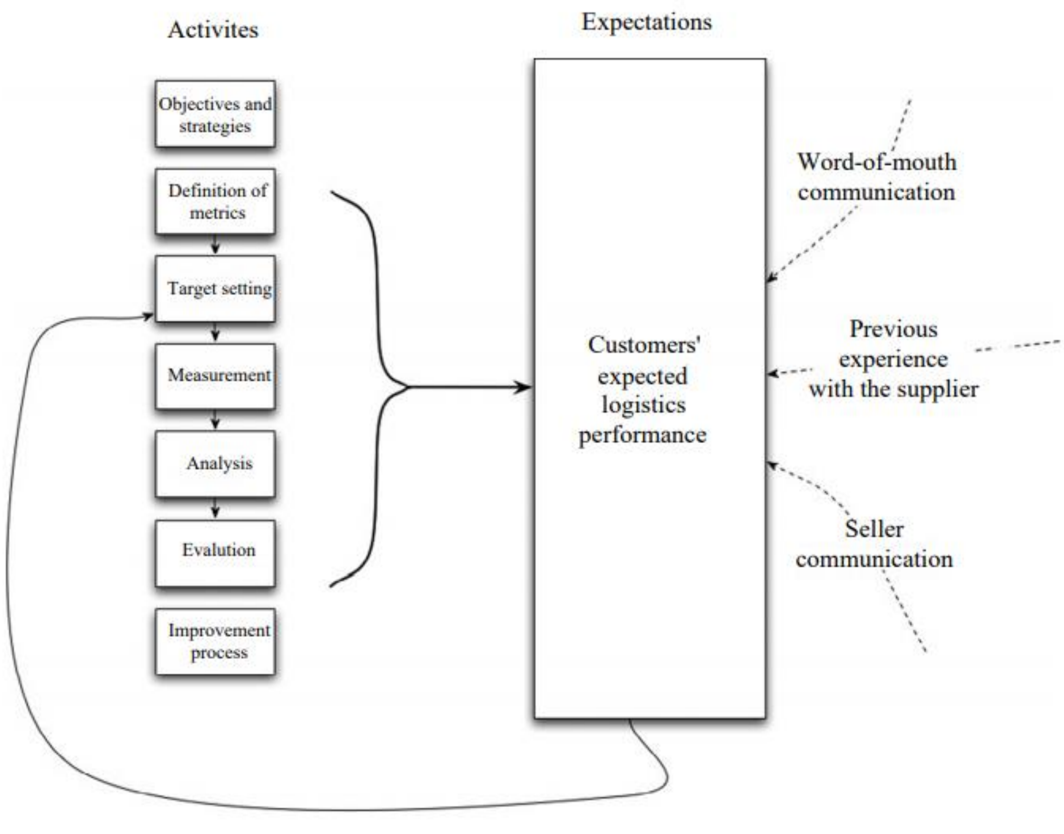


Figure 2: A logistic performance management model developed by Forslund (2007, p.906).

Within this model, Forslund (2007) acknowledges the need to define main purposes with measuring performance related to goals of a logistic actor before conducting measurements. Forslund (2007) emphasizes how measuring in itself does not create any value, but rather is a tool used to ensure that customer expectations and company goals are being met. Furthermore, the model illustrates the need to formulate metric areas relevant for measuring, where different aspects related to operations can be assessed (Forslund, 2007). Each metric area consists of different measurements, anchored in a company's goal targets, used as basis for analysis, evaluation and to drive decisions making and change within an organisation (Forslund, 2007).

Like Forslund (2007), Simkova et al (2015) mention how transportation evaluation can be divided into different measurement areas, where specific formulated key performance indicators (KPIs) are used to measure the performance within each measurement area. Utilization, and development of measurement areas and KPIs can aid companies in identifying important assessment standards for their business (Simkova et al, 2015). Simkova et al (2015) further describe KPIs as company specific success factors that can be quantified and measured. Similarly, Woxenius (2012) discusses how KPIs can be used to monitor performance management and to develop business processes. Woxenius (2012) emphasizes how KPIs can be measured on different scales, yielding important data for multiple business levels and activities. Li, Mcneil, Foulke, Calhoun, Oswald, Kreh & Trimbath (2011) also discuss the importance of having available data infrastructure and documentation that serves and assists the different measurements. Li et al (2011) further mention how problems such as data system errors or missed data registrations can limit measurements, where the available data does not compile with the data needed to conduct transportation performance assessments.

Like Forslund (2007), Simkova et al (2015) as well as Woxenius (2012) discuss how KPIs of transportation are subjective to the industry or company being observed. Sanchez-Rodrigues et al (2013) also discuss the subjectivity of performance, where a company's strategy and differences in customer demand might create different prerequisites of what is considered bad respectively good transport performance. Sanchez-Rodrigues et al (2013) illustrate how industries with customers less sensitive to longer lead times, generally can be more acceptable with a lower time transport performance standard. Similar reasoning can be made with other types of performance measurements, yielding a situation where transportation performance evaluation becomes highly context based (Sanchez-Rodrigues et al, 2013).

In these regards, it becomes clear how preparation is an essential part of the transportation performance evaluation process (Forslund, 2007), but also how measurements used for assessing performance must be anchored in the specific business environment and different goal targets formulated between logistic actor and their customers (Sanchez-Rodrigues et al, 2013).

3.2.1 Logistic service provider contracts

In transportation, many actors utilize formulated performance standard contracts with their logistic service providers (LSP) to facilitate performance assessment (Forslund, 2009). Kleinsorge, Schary & Tanner (1991) discusses how performance standards between shippers and carriers have developed through establishment of common partnerships. Kleinsorge et al (1991) further emphasize how a continuous relationship between a shipper and a carrier yields incitement for formulating both short term and long-term performance goals. Furthermore, Forslund (2009) describes how contracts are used to ensure a certain level of performance facilitated between collaborating parties. These contracts are typically formulated in a two-way fashion, where both parties will agree upon certain levels of performance and responsibilities that shall be met by each party (Forslund, 2009). As relationships mature, it can be expected how performance between the actors increases, which might result in changes to existing performance standard levels (Kleinsorge, 1991). Contracts also safeguards actors against unagreeable situations, where certain measures and standards have already been decided (Forslund, 2007).

Forslund (2009) further discusses how actors operating with LSP performance contracts can be both pro and against using penalties for under performance and incitements for over performance. Penalties can be regarded as for example financing emerging costs for the LSPs customers due to deficient performance (Forslund, 2009). Conversely, actors against penalties describe themselves as a part of the problem, hence resulting in LSP underperforming (Forslund, 2009). Furthermore, Forslund (2007) argues that actors operating with pre-agreed contracts typically have higher expectations than ones without a contract. This includes higher expectations on order and delivery accuracy as well as lead times (Forslund, 2007). Usage of contracts could therefore potentially increase transportation performance, but also ensure that formulated performance agreements are decided upon between parties involved within transportation, to reduce uncertainties regarding performance standards and potential conflicts due to non-existing agreements (Forslund, 2009).

3.3 Conceptual transportation performance assessment model

The following conceptual transportation performance assessment model illustrated in Figure 3 is a theoretical summary developed through the literature review of this study, where the focus of the model has been put on main metric areas used to measure transport performance within the literature. Subsequently, this model has been utilized for the ongoing transportation performance analysis within this case study, where the model has been applied and tested on ICA S-W. Throughout the continued literature review, each section of this model will be presented and discussed.

Figure 3: A developed conceptual model with metric areas for measuring transportation performance within the literature

3.4 Measuring service quality

The concern with delivering a high service quality is a central aspect of transportation performance assessment (Fawcett & Cooper, 1998). Fawcett & Cooper (1998) acknowledge the need for actors to look beyond pure cost measurements and focus on customer perception and customer satisfaction as performance measurements. Simkova et al (2015) emphasize the importance of measuring service quality to ensure that performance standards are met. Additionally, Simkova et al (2015) also discuss how service quality measurements can be utilized to go beyond plain expectations of customers to reach competitive advantage. Furthermore, Forslund (2007) discusses how performance management is linked with both logistic performance and logistic service. Forslund (2007) argues that logistic service levels are subjective to the experienced or expected performance of customers. Simkova et al (2015) also elaborate how frames for service quality are generally created through specific customer demands together with the TSPs. Similarly, Gunasekaran et al (2001) discusses how service quality is related to on time deliveries, where delivery performance in relation to promised delivery times and order fulfilments will impact overall service levels. Furthermore, Forslund (2007) argues how service expectations can change depending on which department within an organization a customer is used to communicating with. Customers communicating with marketing or sales departments tend to have higher expectations on lead times, availability of capacity and information sharing, compared to those communicating with logistic departments (Forslund, 2007). Accordingly, through experience, logisticians tend to decrease expectations of logistic performance, lowering risk of unsatisfied customers (Forslund, 2007).

Simkova et al (2015) further discuss service performance as associated with both time and customer perception related KPIs, such as percentage of late deliveries and complaints. The list of service related KPIs can be expanded with additional measurements such as promised inventory availability, undamaged consignments, accuracy of orders, level of update on transport deviation information (Forslund, 2007) as well as delivery consistency (Fawcett & Cooper, 1998). Additionally, Fawcett & Cooper (1998) discuss information communication and documentation accuracy as important factors for logistic quality. In this regard, not only shall logistic operators deliver what has been promised in terms of transportation, but also facilitate a smooth information and documentation exchange throughout the transportation process (Fawcett & Cooper, 1998). Within KPIs, Simkova et al (2015) also mention how overall service quality of TSPs are a blend of multiple factors during transportation operations. This means that service quality consists of more KPIs than just the ones directly related to the service segment of measurements (Simkova et al, 2015). Simkova et al (2015) describe how service quality performance assessment is one of the main factors involving the full TSP business operations, making it an important aspect of business success and transportation performance evaluation.

Beyond this, Genchev, Glenn Richey & Gabler (2011) mention reverse flow of returns as another important aspect of transportation performance assessment. Genchev et al (2011) discuss the relevance of developing pre-determined agreements regarding how, when and with what transportation mode potential returns should be handled. Huang, Yang, Wuang & Tsui (2010) also elaborate on the importance of establishing a reverse flow strategy as well as different performance measurements to assess these operations. Consequently, both Huang et al (2010) and Genchev et al (2011) refer to overall effectiveness and lead time of the reverse flow as essential measurements for this process. In this regard, both efficiency and routines for dealing with reverse logistic become important aspects for perceived customer service, where good practices can minimize unsatisfied customers (Genchev et al (2011).

3.5 Measuring time

Some of the most common ways of tracking transportation performance is with timely procedures (Fawcett & Cooper, 1998). Forslund (2007) discusses how time measurements are closely related to logistic service quality while Krasnyanskiy & Penshin (2016) mention speed and time of deliveries as a main criterion for transport service quality. In this regard, comparison between performance goals formulated between transporter and customer, and actual performance will have high impact on perceived service (Forslund, 2007). Sanchez-Rodrigues et al (2013) also discuss responsiveness and flexibility as two indicators impacting transport performance. This includes capabilities of quickly adapting transportation capacity whenever a certain demand changes (Sanchez-Rodrigues et al, 2013).

Time assessment can be measured with different indicators, such as average length of transport (Sanchez-Rodrigues et al 2010) or on time delivery (Fawcett & Cooper, 1998) as well as lead times (Forslund, 2007). With reference in previous discussions in part 3.1 regarding transport chains, Krasnyanskiy & Penshin (2016) emphasize how time performance is dependent on shipper's willingness to prepare goods, as well as delivery urgency and driving performance. In this context, Chae (2009) discusses the relevance of separating time measurements into two different sections: the level of on time departure from the shipper, and the level of on time arrivals at the receiver. Details of each time measurement can thus be broken down into each activity of a transport function, giving more specific information regarding transportation performance (Chae, 2009). From these perspectives, timely measurements become important aspects of assessing transportation, where time indicates how efficient a transportation performs in relation to a planned schedule (Fawcett & Cooper, 1998).

3.6 Measuring operational efficiency

Sanchez-Rodrigues et al (2010) discuss measurements associated with internal operational efficiency as another key aspect of transportation performance assessment. Similarly, Woxenius (2012) mentions how performance assessment is linked with the purpose of operational efficiency and to cut costs. Sanchez-Rodrigues et al (2010) further argue how follows up of operational efficiency typically aims at ensuring that transportation plans of routes and vehicles can demonstrate at a high capacity with a favourable utilization rate. Both Sanchez-Rodrigues et al (2010) and Simkova et al (2015) refer to average fill rate and number of miles running a truck empty as two main KPIs for operational performance. In addition, Sanchez-Rodrigues et al (2010) discuss the handling factor of goods as a potential indicator for measurement. The handling factor can be displayed as the process associated with arrival and dispatch of a vehicle at the supplier but also the arrival and departure from a customer (Sanchez-Rodrigues et al, 2010).

As discussed in previous sections, measurements standard for transportation performance is highly context based (Sanchez-Rodrigues et al, 2013), as well as typically formulated between demands of customers and TSPs (Simkova et al, 2015). Subsequently, Woxenius (2012) emphasizes how decisions regarding transportation can be made as trade- offs, where extra rerouting or time could be exchanged with consolidation of goods into fewer vehicles at distributions centres. As a result, Woxenius (2012) mentions how some KPIs could be prioritised over others, impacting operational efficiency. Woxenius (2012) also argues that consolidation of goods at distribution centres typically create two separate transportation chains. Accordingly, one transport chain exists before and another after the consolidation, resulting in two separate transport performance evaluations (Woxenius, 2012). Similarly, Lai et al (2002) discuss how there can be different conflicting goals within the supply chain of a transport chain. This means that different actors involved in a transport chain might prioritise separate aspects of performance (Lai et al, 2002). As the activities of loading, transportation and unloading operate as a common chain (Ploos van Amstel & D'Hert, 1996), it is vital that the goals of these separated processes are synchronized for the chain to function efficiently (Lai et al, 2002). It can therefore be acknowledged how operational measures are important for transportation performance assessment (Sanchez-Rodrigues et al, 2010), but how goal standards can be highly context based (Woxenius, 2012) and inter conflicting (Lai et al, 2002).

3.7 Measuring costs

To facilitate long- term competitiveness, transporters must be aware of different costs associated with their operations (Krasnyanskiy & Penshin, 2016). Simkova et al (2015) discusses how transport costs measurements can be divided into unit, time, or general driving cost specific assessments. This includes for example average costs per running mile or per delivered unit (Simkova et al,2015). Assessments can further be separated to include either fixed or variable costs, giving room for more detailed cost evaluations (Krasnyanskiy & Penshin, 2016).

However, to get a full cost picture, Simkova et al (2015) argue that information regarding fixed costs such as vehicle, fuel, depreciation, and maintenance should be included in transportation cost measurements. As previously mentioned, a transport chain typically involves more cost- related activities than just transportation (Lai et al, 2002; Ploos van Amstel & D'Hert, 1996). Krasnyanskiy & Penshin (2016) and Ploos van Amstel & D'Hert (1996) discuss the importance of including costs related to unloading and loading of a vehicle into the total performance evaluation of a transport chain. Ploos van Amstel & D'Hert (1996) elaborate how these costs can be divided into single timely or unit measurements, but also be added to the full cost calculation of a transport chain. Therefore, it can be illustrated how measuring costs is an important aspect of evaluating transportation performance (Krasnyanskiy & Penshin, 2016), but how the assessment must be related to what is being included in the calculations (Ploos van Amstel & D'Hert, 1996).

3.8 Measuring risk and safety

Measuring aspects of safety and risk management is another central part of evaluating transportation performance (Liu & Moini, 2015). Certain situations taking place before, during and after transport can result in risks such as accidents, damage, as well as theft or cargo attacks, where driver, vehicle and cargo might be wounded (Tubis & Werbińska-Wojciechowska, 2017). Tubis & Werbińska-Wojciechowska (2017) mention how these types of risks create problems for transport operations, where shippers and carriers need to deal with the incident as well as finding new ways of delivering what was initially promised. Depending on agreements concerning when and where responsibility and risk of cargo moves from one actor to another, one or multiple actors must replace lost values of cargo (Glitz, 2011). Whenever an accident occurred before, during or after transportation will thus have a significant impact on the responsibility of the shipment (Glitz, 2011). Furthermore, delays of deliveries might create additional complications, where a planned cargo receiver might be dependent on the delivery taking place, resulting in additional lost revenues (Wilson, 2007).

Within safety measures for transportation performance, Krasnyanskiy & Penshin (2016) discuss different indicators related to cargo safety, where measures should be made regarding the number of losses or damages to cargo over time. Similarly, Simkova et al (2015) elaborate on KPIs related to compliance and maintenance, which include number of traffic accidents, maintenance defects and infringements within a transport chain. Somewhat similar, Jeon, Amekudzi & Guensler (2013) mention measurements such as accidents and crashes per mile travelled as a part of the larger social sustainability of a transportation network. Jeon et al (2013) further discuss the relevance of integrating factors of safety and security into the larger prospective goals of transportation operations with increased transportation mobility and overall system performance.

Concurrently, Tubis (2018) discusses how many transport actors tend to look at accidents as random occurrences and therefore mainly take procedures such as obtaining strong insurances. Tubis (2018) further elaborates that transport actors need to conduct more risk analysis regarding accidents and take action to improve safety of their operations. In these regards, measurements regarding safety and risk are essential aspects of transportation performance evaluation (Liu & Moini, 2015), where assessment can yield better visibility of how much resources, repairs and time that is being devoted to different incidents, potentially creating further incitements for taking actions where it is possible (Tubis, 2018).

3.9 Measuring environmental impacts

Being aware of the environmental impact of one's operations is a central aspect of transportation assessment (McKinnon & Piecyk, 2009). Jeon et al (2013) discuss how environmental sustainability assessment is a part of the evaluated effectiveness of a transportation system. In that sense, measuring environmental emissions is generally concerned with yielding information of the environmental impact associated with transportation operations within a transportation system (Jeon et al, 2013).

McKinnon & Piecyk (2009) discuss how measuring of carbon dioxide is frequently used for transportation services. Likewise, Jeon et al (2013) mention measuring of miles and tonnage of cargo transported in relation to different types of emissions. Another environmental - related measurement for transportation is fuel efficiency (Sanchez-Rodrigues et al, 2010;

McKinnon & Piecyk, 2009), and fuel consumption (Jeon et al, 2013). Similarly, Sanchez-Rodrigues et al (2010) discusses the relationship between road congestion and fuel consumption and how this measurement can be used for measuring both carbon footprint and operational efficiency. In this context, routes containing high levels of congestion can have a negative impact on the effectiveness of both transportations and their emissions (Sanchez-Rodrigues et al, 2010). Similarly, McKinnon & Piecyk (2009) elaborate on how fuel efficiency of specific truck fleets can be compared with general transport KPI standards of fuel efficiency for specific industries.

Within measuring techniques, Liu, Barth, Scora, Davis & Lents (2010, p.58) refer to "Portable emission measurement systems" as an effective tool to measure and compare different types of emissions from vehicles in multiple sizes and with distinctive fuel types. McKinnon & Piecyk (2009) further describe how measurements are typically being monitored during transportation but also initially simulated with different driving and vehicle options, to identify emission levels of different transportation patterns. When conducting and comparing these types of measurements, it is vital to consider the sort of vehicle being used, geographical scope of routes as well as cargo type activity (McKinnon & Piecyk, 2009). In this regard, transportation dedicated to specific consignments and industries as well as size of vehicles tend to have different levels and standards of emissions (McKinnon & Piecyk, 2009).

Furthermore, decisions regarding operational actions described in previous parts will have an impact on emissions of a transporter's operations (Tang, Wang, Cho & Yan, 2018). Focus on for example high frequency of transportation might yield a larger amount of less filled vehicles, moving between shipper and consignee, increasing overall emissions of transportations (Tang et al, 2018). Measuring environmental related aspects can therefore yield interesting performance assessment outputs regarding emission of transportation operations (McKinnon & Piecyk, 2009), but also indicate how different types of operational decisions impact emission levels (Tang et al, 2018).

3.10 Measuring deviations of transportation

Beyond previously discussed measurement for performance assessment, Sanchez-Rodrigues et al (2013) emphasize the importance of considering measurements for disruptions within transportation. Disruption is generally concerned with transportation delays (Fowkes, Firmin, Tweddle & Whiteing, 2004) or other unexpected situations occurring, which make transportation deviate from its original transportation plan (Sanchez-Rodrigues et al, 2013). Similarly, Sternberg, Stefansson, Westernberg, Boije Af Gennäs, Allenström & Linger Nauska (2012) discuss different wastes within transportation which negatively impact efficiency of transportation operations.

Furthermore, Sanchez-Rodrigues et al (2013, p.828) describe these types of deviations as "Extra Distance", while Sternberg et al (2012, p.59) refer to it as "unnecessary movement", where transportation time and distance is being added due to modifications of the delivery plan. Sanchez-Rodrigues et al (2013) further mention how these measurements can include operation- related problems such as transportation route changes, volume or fill rate of vehicle un expectancies or demands for extra transportation trips. Subsequently, deviations from the transportation plan can impact the overall performance of the transportation actors, where costs and environmental footprint increases (Sanchez-Rodrigues et al, 2013), but also create risks and vulnerability within the transport chain (Sanchez-Rodrigues et al, 2010).

Woxenius (2012) also discusses the relevance of measuring transport detours through use of directness as a KPI. In this context, directness originates from the concept of direct transportation accuracy, but takes into consideration a more holistic approach of tracking and dividing detour causes into different segments. When different levels of detours occur, the directness of a consignment is being impacted, where unexpected detours might change the transport performance of a consignment (Woxenius, 2012). Woxenius (2012) further emphasizes how GPS and RFID barcodes could benefit the tracking and data gathering of a directness KPI, but how companies must conduct direct analysis to causes of detours. Similarly, with reference in previous discussions in part 3.1 regarding places of transport uncertainties (Sanchez-Rodrigues et al, 2010), Sanchez-Rodrigues et al (2010) emphasize the necessity of uncertainty mitigation to understand outputs of specific uncertainty measurements. Correspondingly, through more detour analysis, Woxenius (2012) argues how companies could separate between detours that can be derived to operational issues and problems that are beyond company's control. From these perspectives, measuring deviations becomes important within transportation performance assessment, where companies can assess and divide between deviations that are within reach or outside control of their organisation (Woxenius, 2012).

4. Empirical findings

The following section will present the main empirical findings of this study with regards to current transportation performance assessment practices and goals of ICA S-W.

4.1 Existing transportation performance goals

ICA S-W has together with their haulers agreed to measure and follow- up specific measurements for transportation performance assessment. These measurements are divided between different metric areas that are considered central for evaluating transportation performance of ICA S-Ws transportation flows. The measurements are supposed to be measured and followed-up for each hauler company individually (Acklid, 2020). The measurements with included goal values are illustrated in Table 2.

Measurements	**Metric Area**	**Goal value**	**Definition of goal value (explained in further detail down below)**
Arrival to distribution point	Time	95 %	1 - (number of late arrivals/total number of arrivals)
Dispatch from distribution point	Time	98 %	1 - (number of late dispatches/total number of dispatches)
Time window arrival to ICA S-W stores	Time, service quality	92,5 % or 83 %	1 - (number of arrivals after time window / total number of arrivals) OR 1 - (number of arrivals before and after time window/total number of arrivals)
Provision of extra transportation capacity	Operational, service quality	95 %	1 - (number of failures to provide extra capacity/ total number of requests

			for extra capacity)
Empty load carrier collections	Operational	98 %	1- (number of failures to execute empty load carrier collections/ total number of collections in the transportation plan)
Handling deviations of transport plan	Deviations	95 %	1- (number of failures with follow up reported recurring deviations /total number of created recurring deviation cases)
Handling deviations related to incidents	Risk and safety	95 %	1- (number of failures with follow up reported incidents /total number of created incident cases)
CO_2 feedback	Environment	1,0 kg CO_2 ekv/litre	Fuel emissions of less than 1 kg CO_2 per litre consumed fuel

Table 2: A summary of ICA S-Ws current transportation performance goals

The measurement of arrival to a distribution point is concerned with how many transportations, out of the total number of transportations that manage to be on time according to the planned loading schedule. Similarly, dispatch from distribution point is focused on how many transportations that are leaving on time from the distribution points. Dispatches and arrivals which are considered late, are transportations that arrive to or dispatch from a distribution point later than 30 minutes after the scheduled plan (Acklid, 2021). The goal agreements also contain measurements for time windows to the different ICA stores. In this context, the time window is set at 30 minutes prior to 60 minutes after the planned arrival to a specific store. As presented in Table 2, there are two different goals related to this measurement. The 83 % goal is concerned with the number of transportations that arrive within the time window. The 92,5 % goal includes both percentage of transportation within the time window, as well as before the time window (Swiatek, 2021).

Furthermore, there are also goals related to provision of transportation capacity. This means that the hauler companies within each transportation flow shall provide sufficient additional transportation capacity when needed. A lack of provided capacity means that another hauler company than the original one must facilitate the additional capacity or that the transportation will not be completed. The main exception to this demand is potential lack of communication from ICA S-W, which can impact the possibility for the original hauler to provide extra capacity when needed (Skoog, 2021).

Beyond the transportation plan related to deliveries of goods to the different stores, ICA S-W also receives a plan for empty load carrier collection at the stores. In this regard, ICA S-Ws goal value is concerned with the number of empty load carrier collections that is being executed in relation to the numbers of collections in the empty load carrier collection transportation plan (Skoog, 2021).

Within deviations, ICA S-W has formulated two main goal areas. Initially, the goal of handling deviations of the transportation plan is focused on internal recurrent events taking place that impact performance of transportations. This includes frequent delays at a specific store or other potential bottlenecks within the transportation flows. The goal is concerned with the level of reporting of these types of deviations. When a recurrent deviation is taking place, it is vital that the haulers report the problem to ICA S-W. Through a transparent report system, further investigation and follow up are then being made regarding the different deviations cases. In this context, it is thus important to differentiate between recurrent internal deviations and external deviations. External deviations typically take place outside the reach of the company. Therefore, the goal target of ICA S-W only focuses on reporting of recurrent internal deviations that can be handled and dealt with within the organisation (Skoog, 2021).

The goal of handling deviations related to incidents is also concerned with reporting of these situations. From ICA S-W, an incident is defined as accidents or deviations related to conducting the transportation task professionally. This can for example include deviations of driver behaviour or other factors impacting the direct service quality of the transportation (Skoog, 2021). Whenever an incident is taking place, ICA S-W is supposed to create a case and send it to the involved hauler company. The hauler company is then obliged to report back within a three-day period with a suggested action plan for the incident. If this process succeeds, the handling of the deviation is correct. The goal target is thus concerned with the number of deviation handlings that are being processed in the right way (Skoog, 2021). Furthermore, ICA S-W receives goals related to CO2 feedback for their different transportation contracts and flows. In this context, the existing goal value is related to the carbon dioxide emissions levels per litre of burned fuel during transportation (Swiatek, 2021).

4.2 Routines for measuring transportation performance

ICA S-W has different types of continuous routines for measuring performance of the company's transportation operations. Initially, Swiatek (2021) elaborate on how weekly analyses are being made regarding time window arrivals to the different stores, separated between each hauler company and the different flows that they are operating in. These time window analyses are divided between arrivals within the time window as well as arrivals before and within the time window and therefore connected to the two separate time window goal targets illustrated in Table 2 (Swiatek, 2021). Additionally, Swiatek (2021) mentions how weekly summaries of late arrivals at distribution centres as well as waiting time for the haulers before dispatching from distribution centres are being withdrawn and compiled. These timely delays are then translated into monetary values and added or deducted as costs from the weekly payments that are being facilitated between ICA S-W and the haulers (Swiatek, 2021 & Fältman, 2021). Within arrival to and dispatch from distribution centres, ICA S-W operates with a periodic follow up of overall performance, also separated between each hauler company. From the point of both time window analysis, arrival to and dispatch from distribution points, output is compared with performance goals (Swiatek. 2021).

In a similar way, ICA S-W is conducting monthly analyses of fuel efficiency and environmental impact of each transportation contract. The transportation contracts of a hauler are typically divided between the different flows that the hauler is operating in (Swiatek, 2021). The haulers send emission extractions regarding their vehicles to ICA S-W, which are being analysed and compared with the emission standard goal, as well as the type of transportation route that the vehicle is operating in (Swiatek, 2021). The different fuel extractions are then calculated against separate emission factors which considers what type of fuel that is being used. This means that the prerequisites for comparing different emissions of transportations will be similar, regardless of if the type of fuels used might have different consumption rates per transported kilometre or separate emission levels per litre burned fuel (Swiatek, 2021).

Furthermore, ICA S-W and the haulers are obliged to report any other type of deviation that takes place during transportation. Deviations are events that result in an increased time and length of the original transportation plan. The deviations are being collected and compiled in different documents that are further being shared between the parties. Depending on the circumstances of the different deviations, these will also be added or deducted as costs from the weekly payments between ICA S-W and the haulers (Fältman, 2021). The deviations include fines for not complying with the planned delivery schedule. This compiles for example a fee whenever a hauler does not deliver a truck according to the planned schedule. Similarly, ICA S-W must pay compensation if ICA S-W cancels a planned delivery for the hauler company (Fältman, 2021).

However, as Fältman (2021) further describes, these types of deviations are not always considered recurring or internal deviations, but rather deviations that take place outside the reach of the organisation. Similarly, Skoog (2021) discusses how more recurring deviations are being handled when noticed, in dialogue between ICA S-W, stores and the haulers. When a similar deviation is frequently occurring, this might mean that changes or other actions need to be made to the current transportation plan (Skoog, 2021). In comparison, Skoog (2021) describes how ICA S-W handles deviations related to incidents with a case-to-case approach. This means that discussions between involved parties are being conducted, and then a potential action plan is being executed for each specific case (Skoog, 2021).

Contrarily, Zidén (2021) mentions how some deviations that are being added to the weekly payments from the deviation summary documents are not in themselves deviations. Zidén (2021) describes how certain details regarding specifications of a transportation route can be challenging to plan in advance, and incorporate into the current transportation management system (TMS) of ICA S-W. In this regard, it is currently difficult to give the TMS right specification prerequisites for each transportation route, where the total number of conditions within the routes are many and because each route is highly individualized. In addition, the TMS lacks functions for dealing with these issues combined with some shortage of knowledge within ICA S-W regarding the TMS full potential (Zidén, 2021). Therefore, when the transportation management system transfers the weekly transportation loads and units into monetary values, some additional specifications of certain transportations must be added as separate costs. In the current routine system that exists, these types of specifications are thus added onto the deviation documents and handled as deviations (Zidén, 2021).

4.3 Areas with potential for improved performance measuring

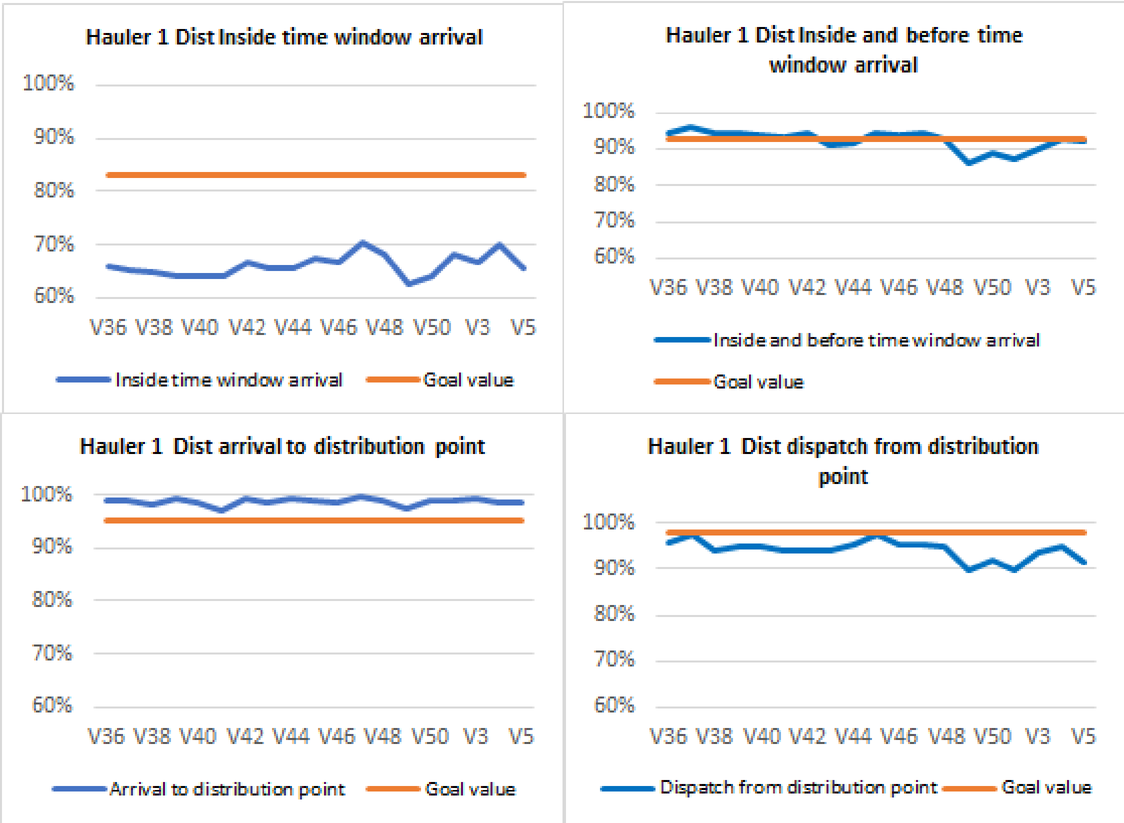
At the same time, the respondents acknowledge different operational areas of the transportations with capabilities for improved follow up of performance. Wickmarck (2021) mainly discusses the perspective of damaged goods as a suggested field for performance evaluation. In this regard, ICA S-W currently handles cases of damaged goods in a one-to-one system, where discussions regarding each case is being dealt with between the involved parties. At the same time, there is currently no real long-term documentation or tool for collecting and analysing statistics of damaged goods over time within different transportation flows of the company (Wickmarck, 2021). Wickmarck (2021) discusses how ICA S-W would benefit from increased follow up of damaged goods, where a greater visibility of these situations would yield a better picture on how this area impacts deliveries, costs, and transportation performance.

Additionally, both Skoog (2021) and Acklid (2021) mention how there is potential to develop more routines regarding performance assessment of empty load carrier collections as well as delivered provision of extra transportation capacity. Acklid (2021) discusses how these routine developments could yield better and wider insight into the performance of transportations, but also for following up these related goals between ICA S-W and the haulers. At the same time, Skoog (2021) and Acklid (2021) emphasize potential challenges with finding systematic ways of measuring these two perspectives, where the right actors must be involved within the measuring process to receive correct data.

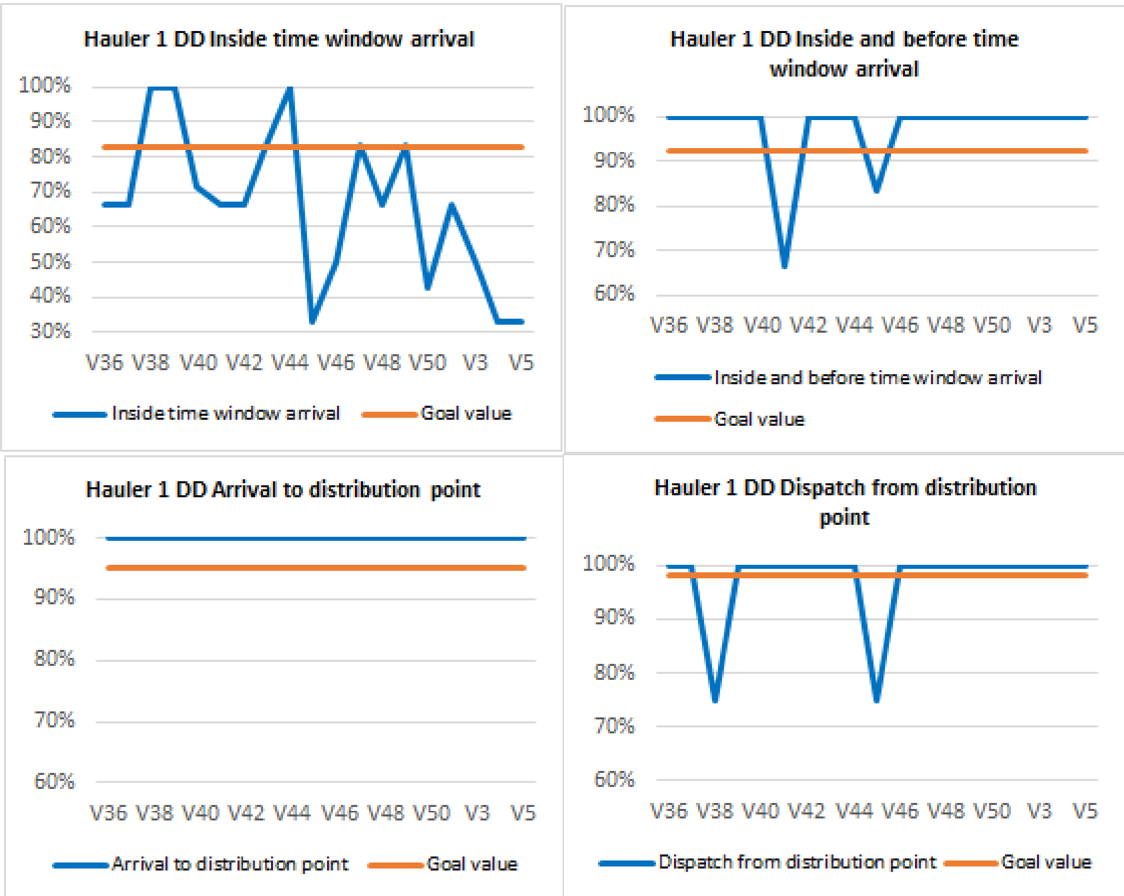
By referring to previous discussion regarding routines concerned with deviations, Fältman (2021) mentions how there are currently no direct procedures for following up deviations, beyond the pure adding or subtracting of them as costs to the payments. In this sense, Acklid (2021) argues how ICA S-W needs greater visibility of different deviations over time. Acklid (2021) further mentions how more analysis and clarity on everyday deviations could give better classification of potential recurring deviations that have not yet been identified. Correspondingly, Zidén (2021) emphasizes the need for further deviation analysis and follow up, to separate between recurring deviations, deviations outside the reach of the organisation as well as deviations that are just costs associated with the original transportation plan. Similarly, Skoog (2021) explains how current routines for handling incidents as well as recurring deviations might yield difficulties with evaluating how these aspects are performing in relation to set goals.

4.4 Transport data findings

As previously mentioned, the used KPIs for measuring transportation performance of ICA S-Ws transportation flows were brought to attention during the interviews with the respondents. In this regard, the following transport data findings are anchored in the current routines for measuring transportation performance that were presented during section 4.2. Furthermore, the decision was made to present the findings of the different transportation flows for each hauler individually, to receive some structure for the reader. An exception to this was made on the declaration of the CO2 emissions, where the difference in measuring scale compared to the other KPIs made it better suited to be presented on its own. Additionally, this was also done to facilitate some type of comparisons between the CO2 emissions of different haulers as well as to avoid presenting too many individual graphs in this paper. Accordingly, each of the following graphs will be shortly commented, to put some context into the output of the figures. Further details and summary information with average outputs of the data within the different graphs are illustrated in Appendix 3. As mentioned in part 2.2, specifications regarding names and characteristics of the transportation flows as well as haulers operating within each specific transportation flow can be more displayed in Appendix 1.

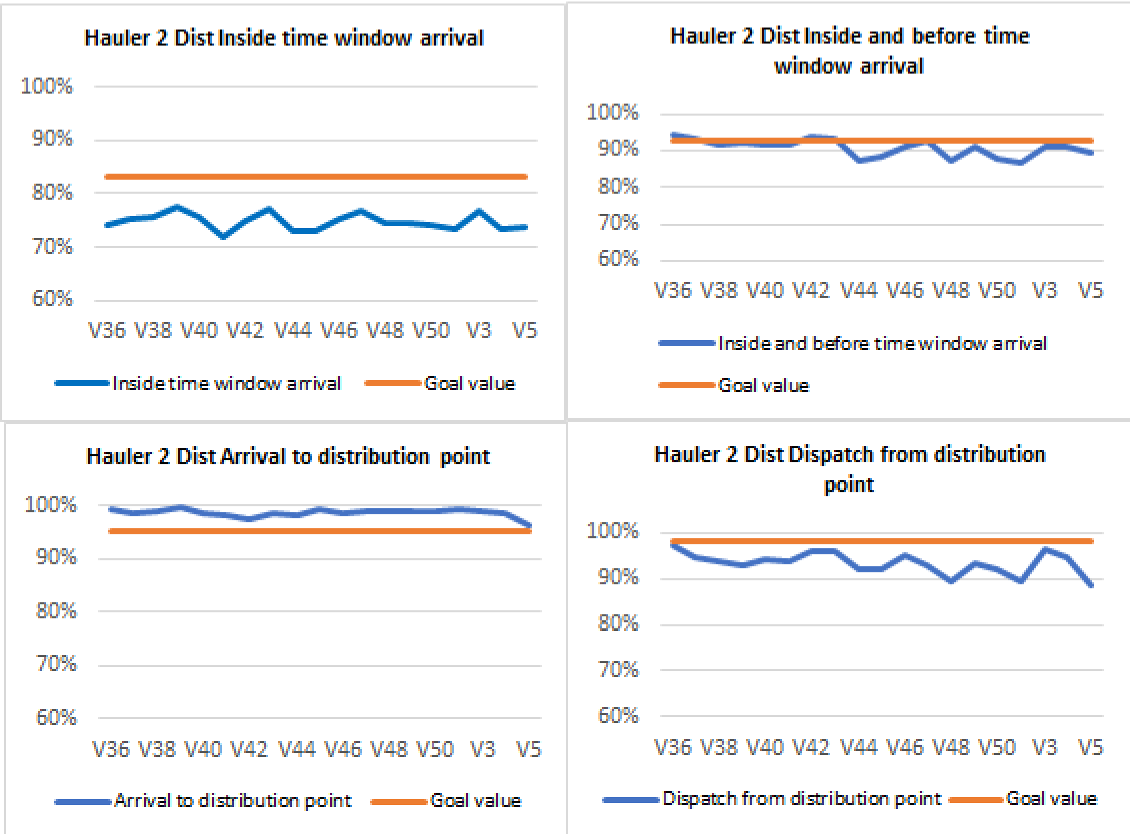


Graph 1: KPI statistics of Hauler 1 Distribution Helsingborg

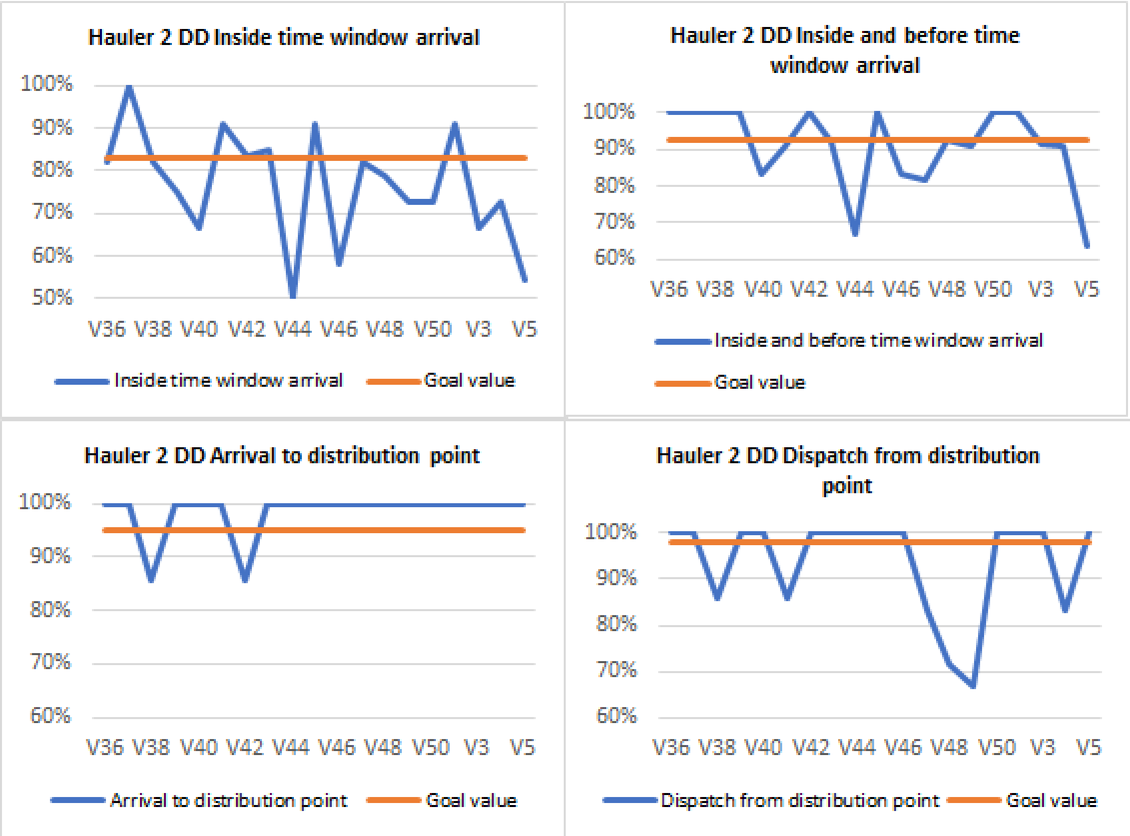


Graph 2: KPI statistics of Hauler 1 Direct Distribution Kungälv

As presented in Graph 1, Hauler 1s distribution flows have a stable performance curve throughout the observation period. Conversely, Graph 2 shows a high variability of the data output during the same period for Hauler 1s direct distribution transportations. In this context, it is significant to mention that the number of direct distribution transportation conducted by Hauler 1 is low compared to the total number of distribution transportation. Consequently, the direct distribution transportations are more sensitive to single transportation errors.

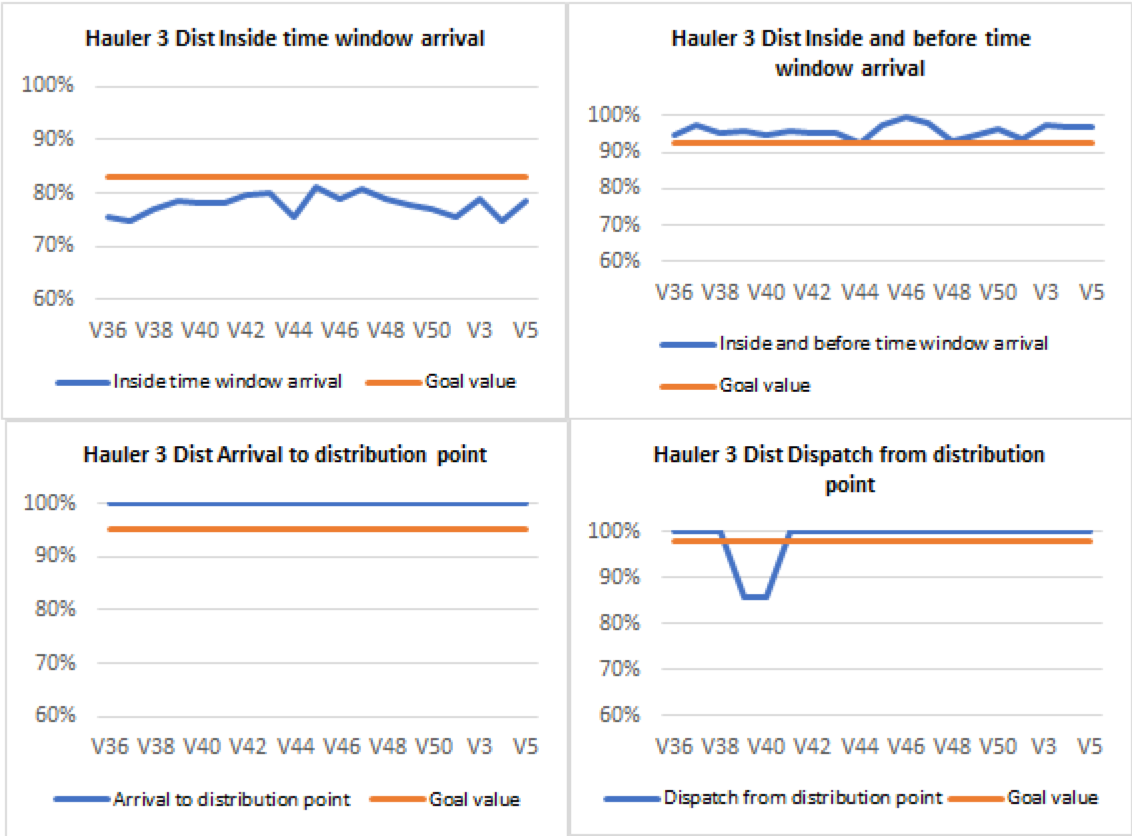


Graph 3: KPI statistics of Hauler 2 Distribution Helsingborg

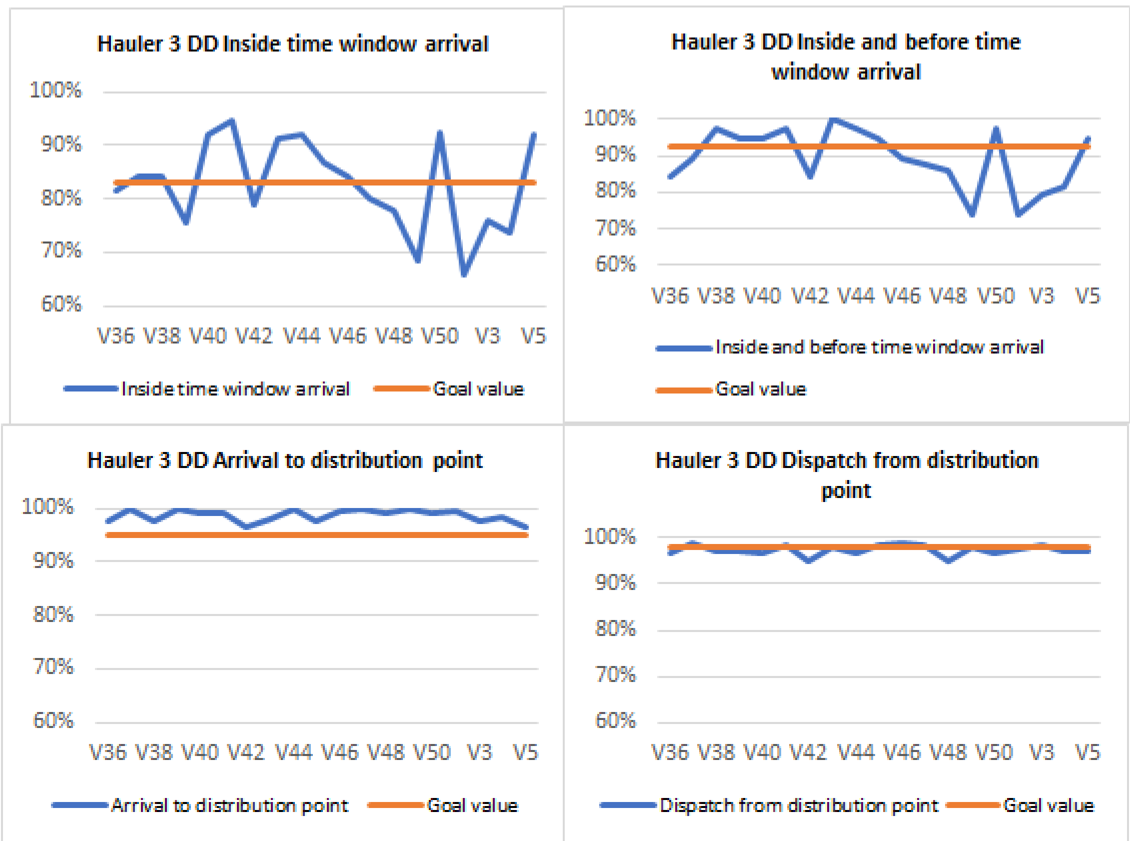


Graph 4: KPI statistics of Hauler 2 Direct Distribution Kungälv

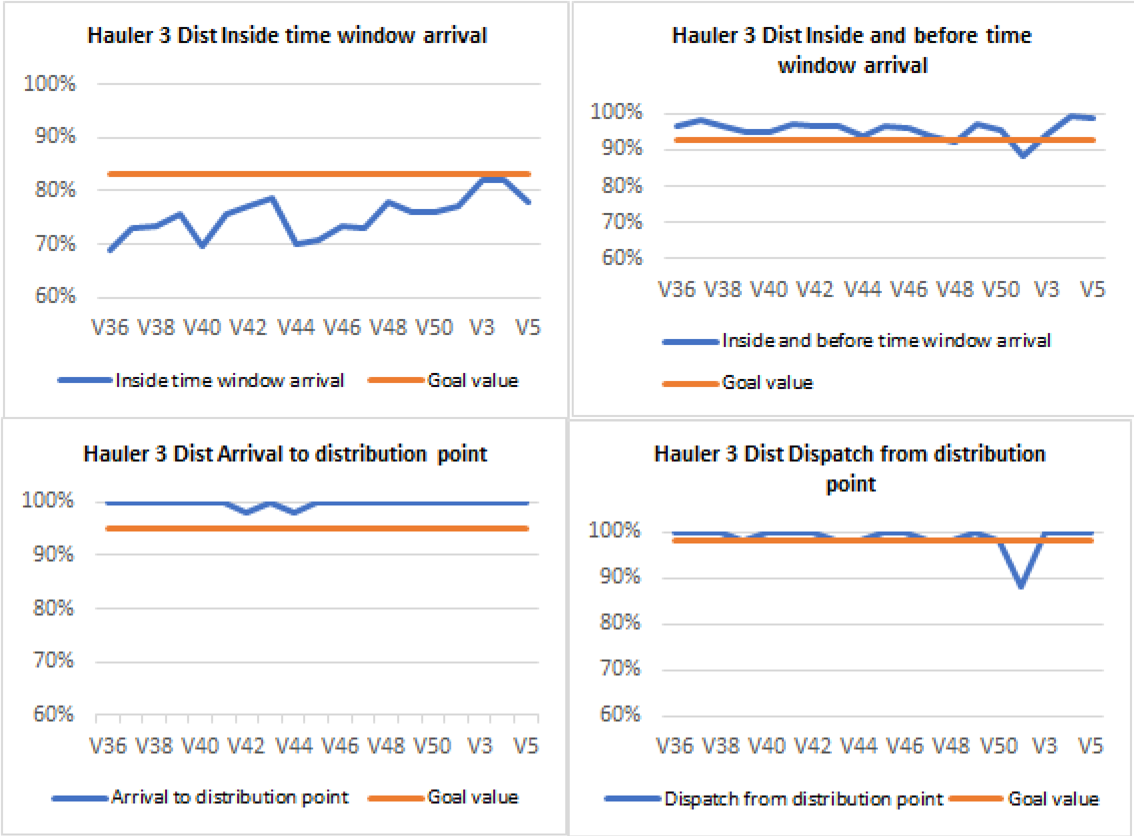
Like Hauler 1, Graph 3 illustrates how Hauler 2s distribution flow has a stable output curve throughout the data period. At the same time, Graph 4 acknowledges a high variability of the data output during the same period. Just as Hauler 1, Hauler 2 had a low number of direct distribution transportation in comparison with distribution transportation during the observed time span.



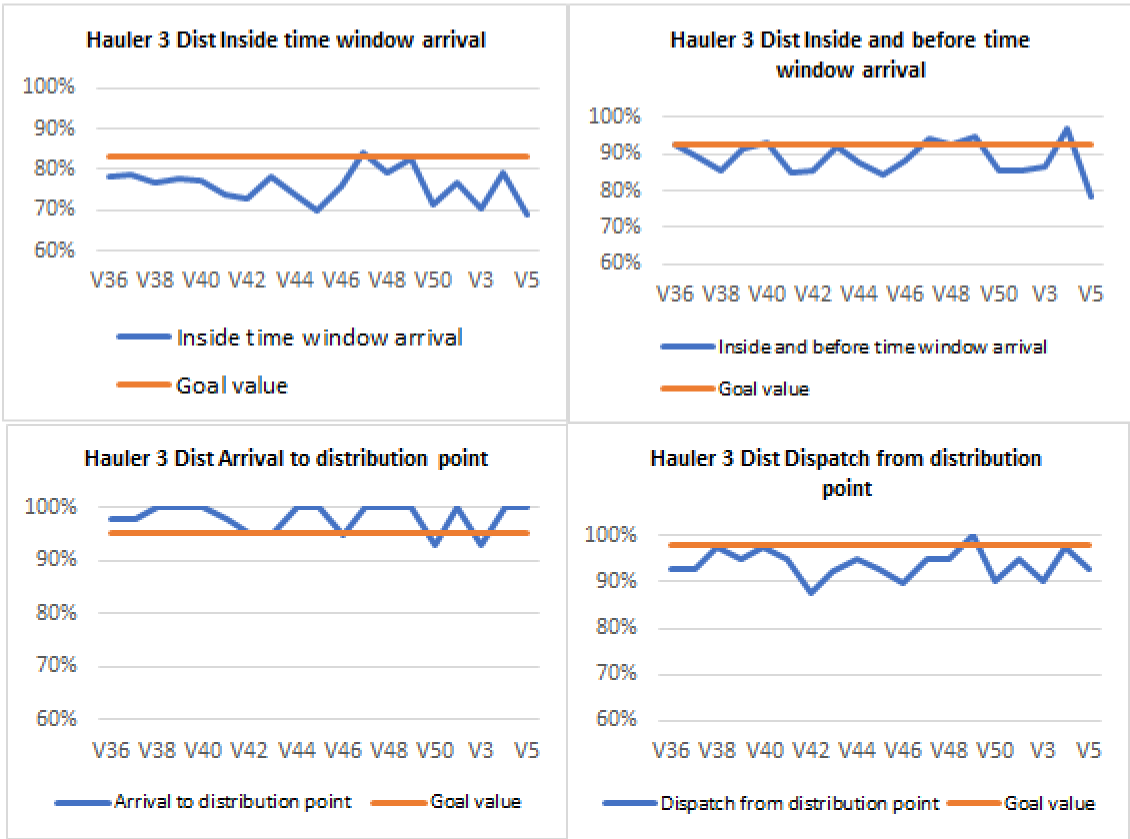
Graph 5: KPI statistics of Hauler 3 Distribution Helsingborg



Graph 6: KPI statistics of Hauler 3 Direct Distribution Kungälv

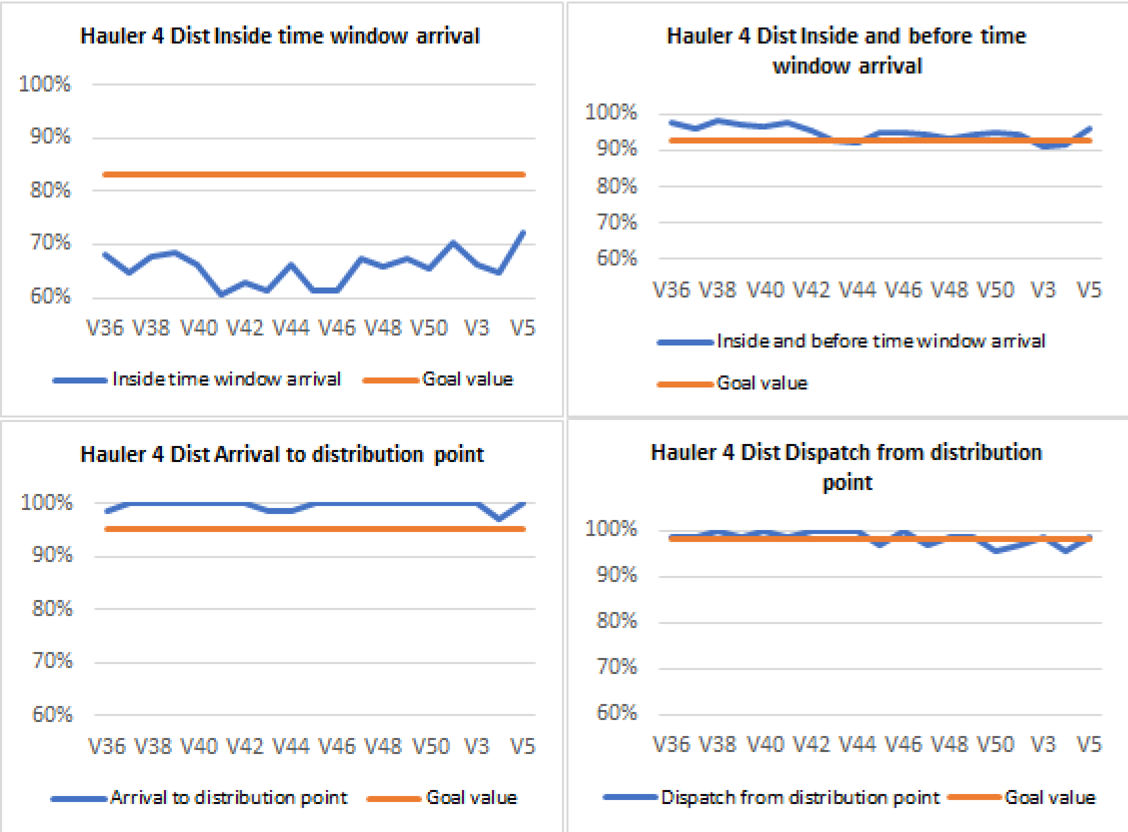


Graph 7: KPI statistics of Hauler 3 Distribution Värmland

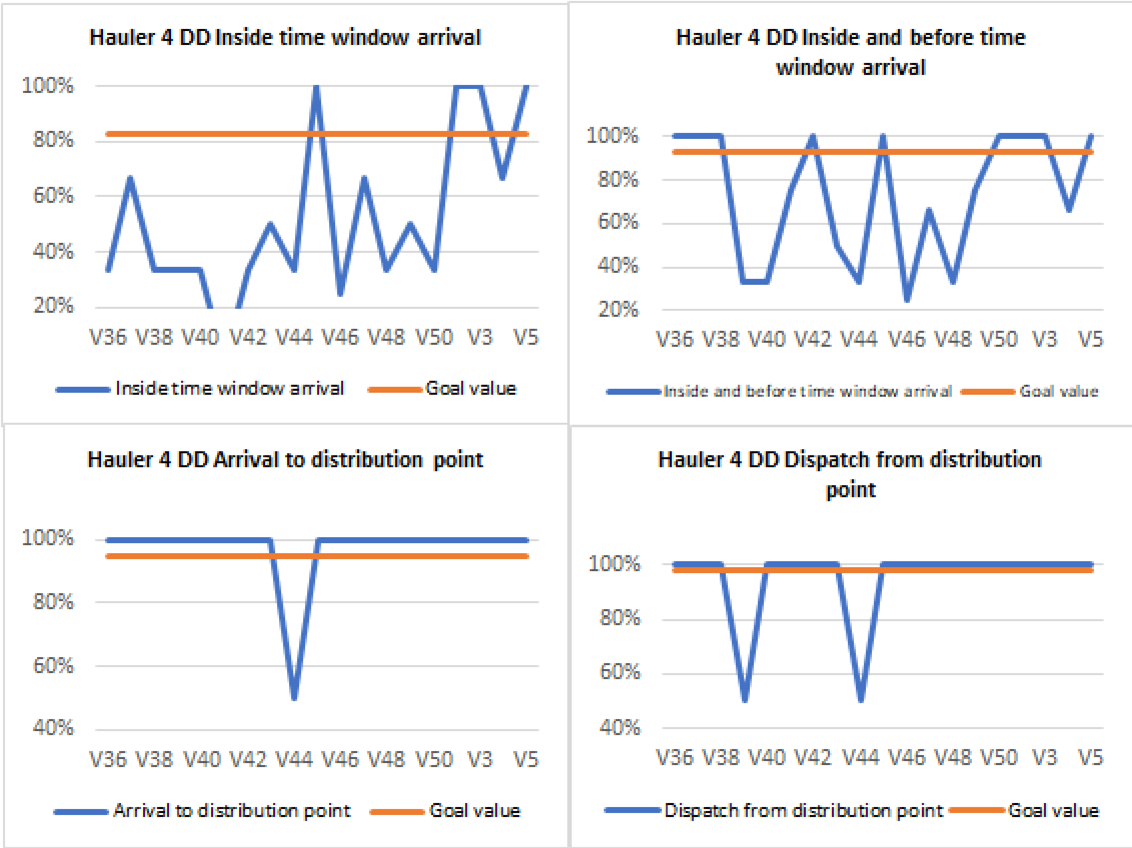


Graph 8: KPI statistics of Hauler 3 Distribution Kungälv

As shown in Graph 5-8, Hauler 3 operates within different transportation flows throughout ICA S-Ws transportation network. At the same time, Hauler 3 conducts a high number of direct distribution transportation throughout this data period compared to other haulers. In this regard, it is being decorated how some of the KPIs within Graph 6 are somewhat more stable than other comparisons, but how KPIs related to time window arrival yield a high variance of output.

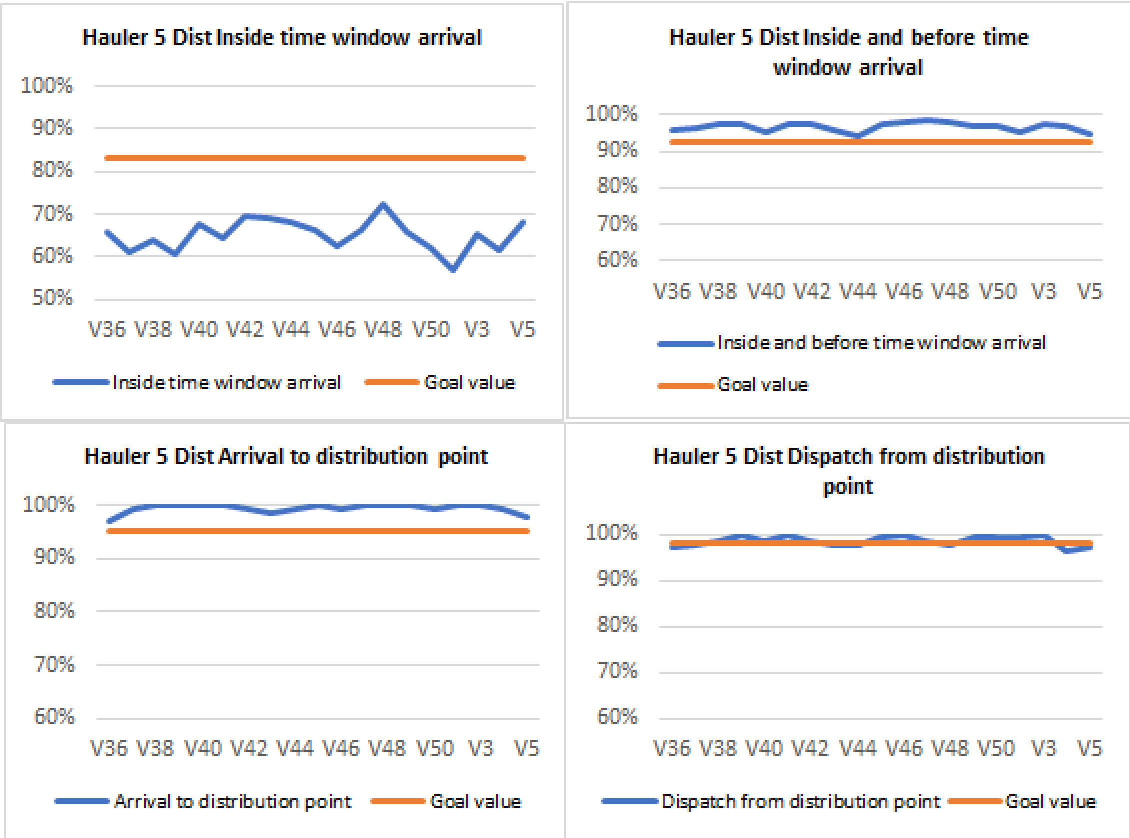


Graph 9: KPI statistics of Hauler 4 Distribution Kungälv

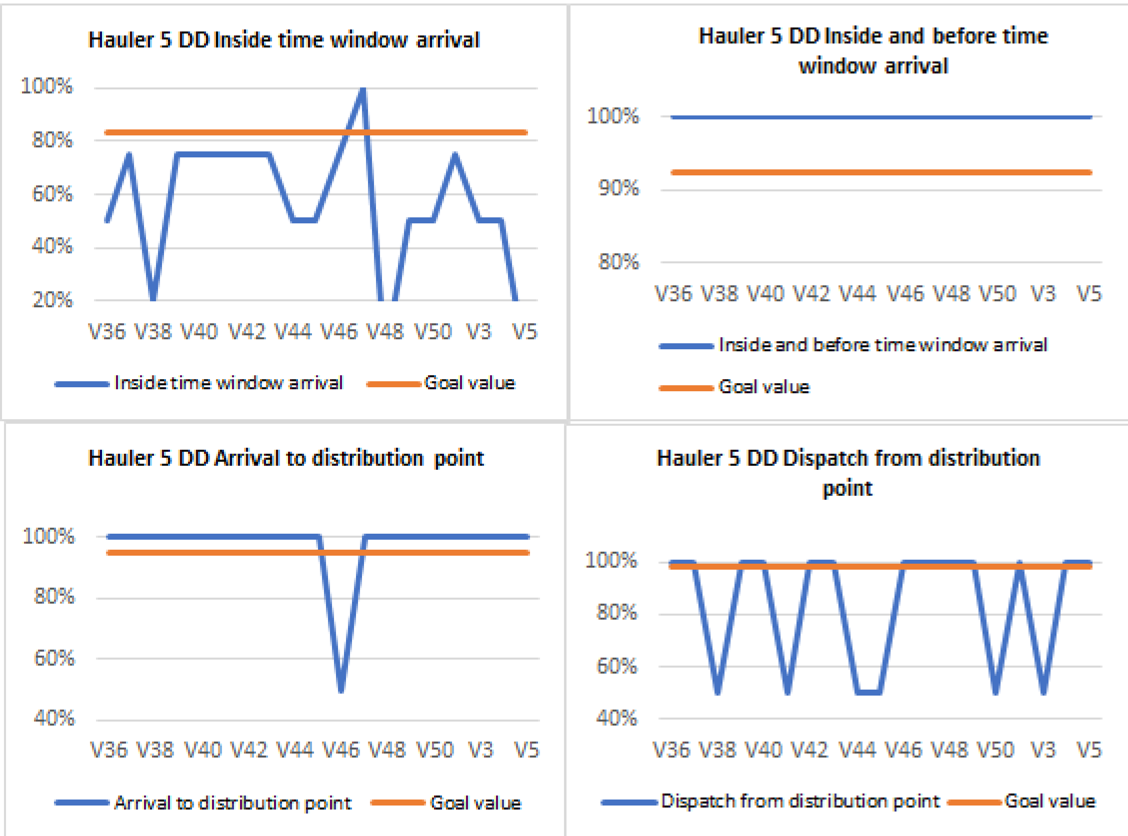


Graph 10: KPI statistics of Hauler 4 Direct Distribution Kungälv

Like other haulers conducting direct distributions, Graph 10 illustrates a high variation within the data output for Hauler 4s direct distribution transportations. Some fluctuation within the KPIs of arrival to distribution point and dispatch from distribution point is acknowledged during some weeks of the observed period. On the contrary, Graph 9 shows a relatively stable data output for distribution transportations for most KPIs throughout the observation period.

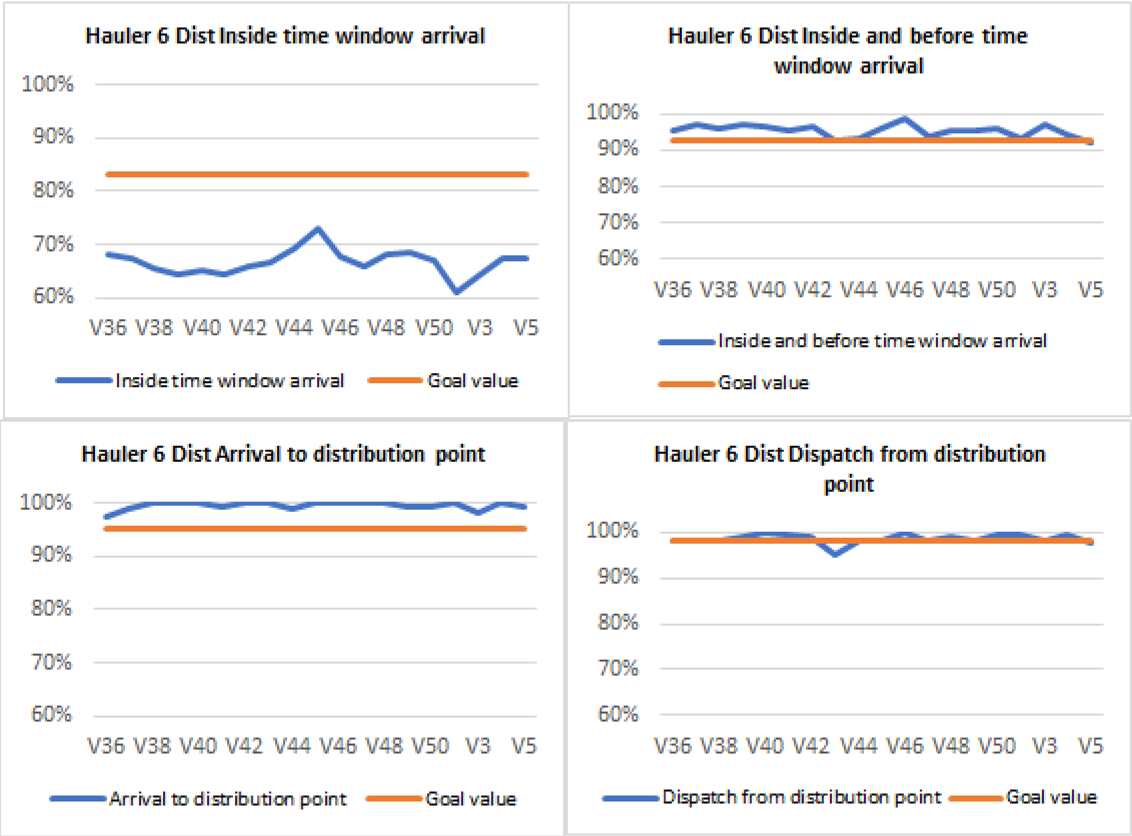


Graph 11: KPI statistics of Hauler 5 Distribution Kungälv

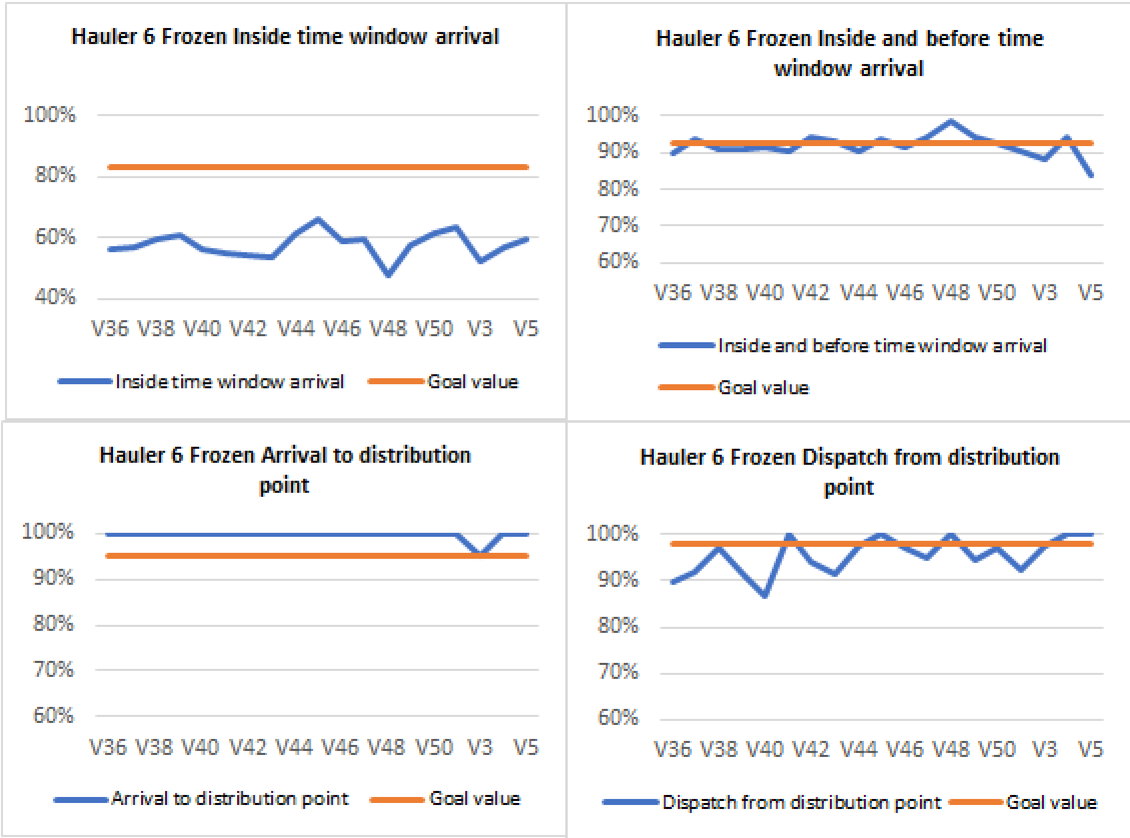


Graph 12: KPI statistics of Hauler 5 Direct Distribution Kungälv

Likewise, Hauler 5 shows similar patterns within graph 11 and 12 to other haulers conducting both distribution and direct distribution transportations. Accordingly, the output data of direct distributions is highly volatile, while distribution transportations stay more stable.

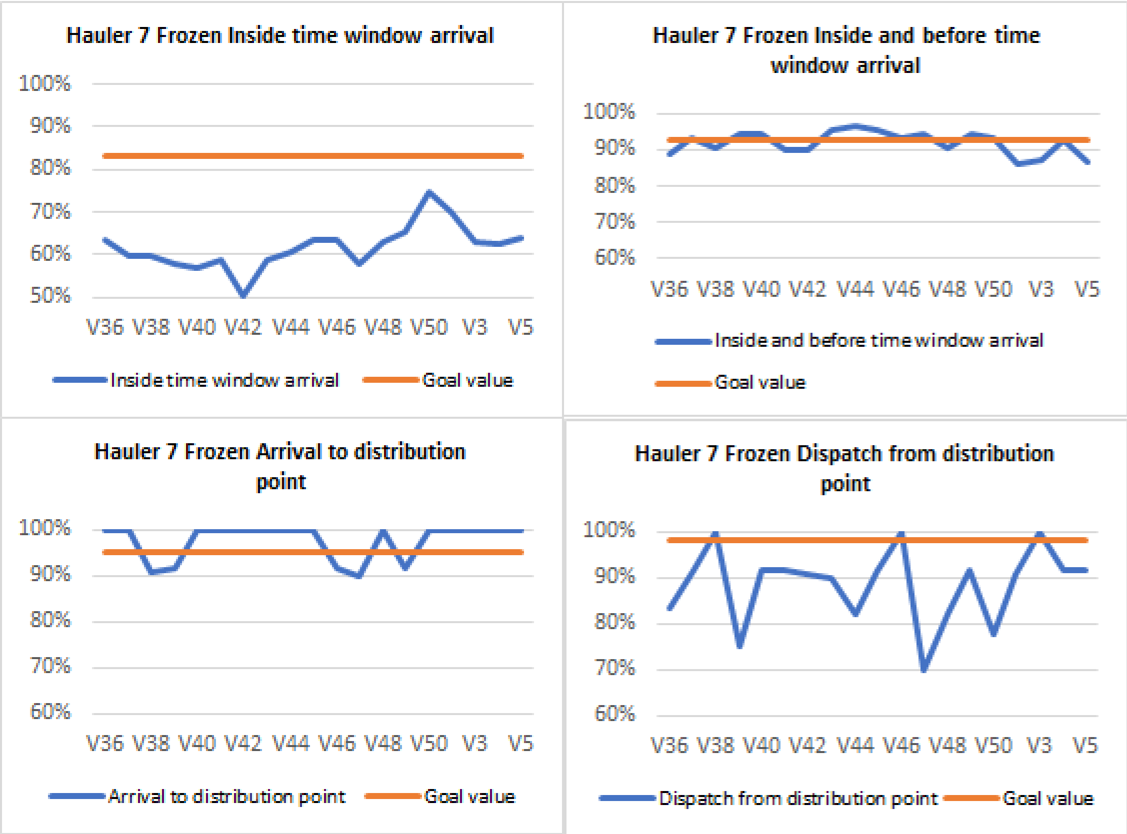


Graph 13: KPI statistics of Hauler 6 Distribution Kungälv

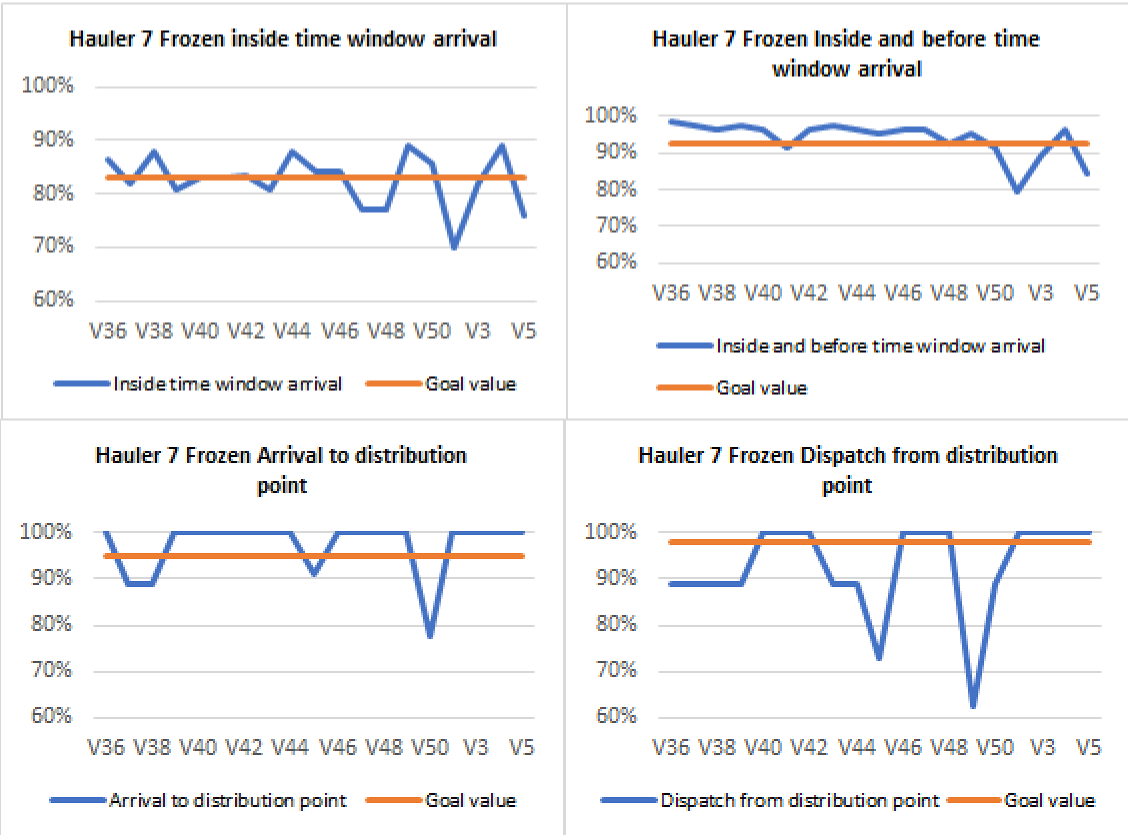


Graph 14: KPI statistics of Hauler 6 Frozen transportations Kungälv

Within distribution from Kungälv, Hauler 6 is the hauler which conducts the most amount of distribution transportation in this area during the data period. Graph 13 shows how this data output has been overall stable throughout the observed time. Graph 14 further present the data findings of the first frozen transportation flow of part 4.4. In this regard, it is vital to mention that the number of transportations are overall lower within the frozen transportation flows compared to the distribution transportation flows.

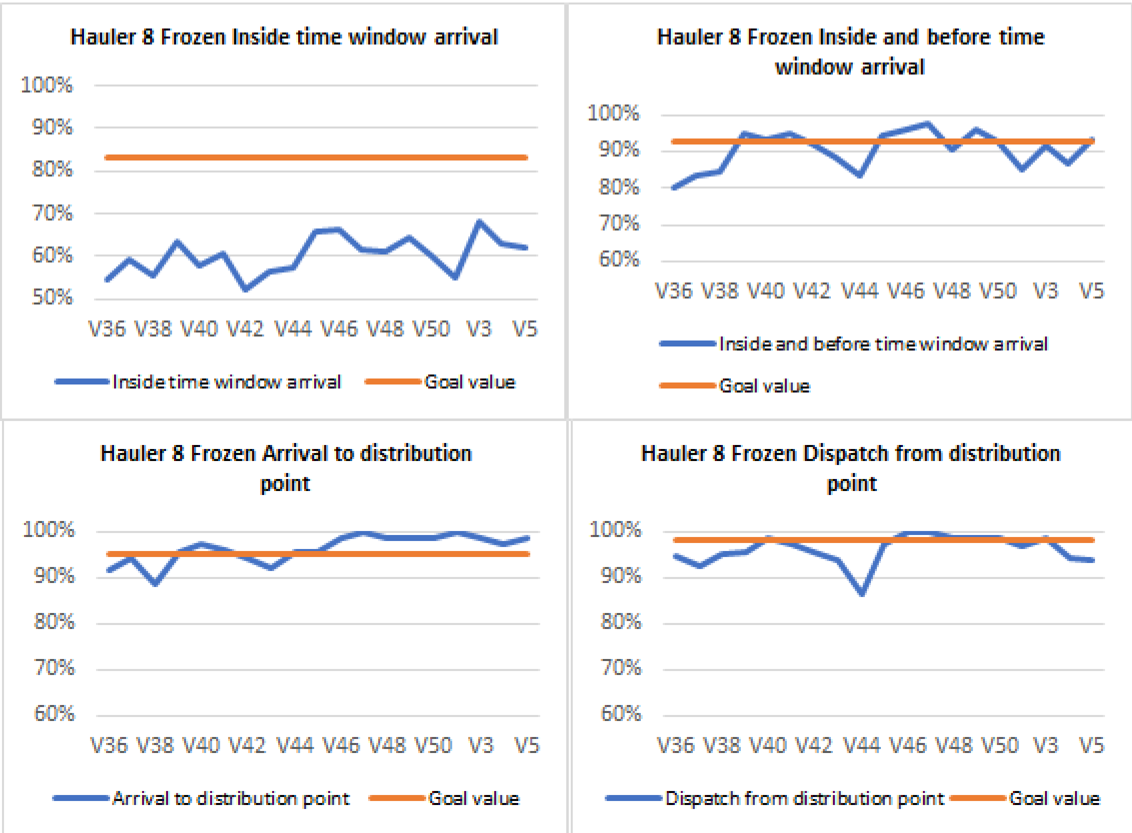


Graph 15: KPI statistics of Hauler 7 Frozen transportations Karlstad

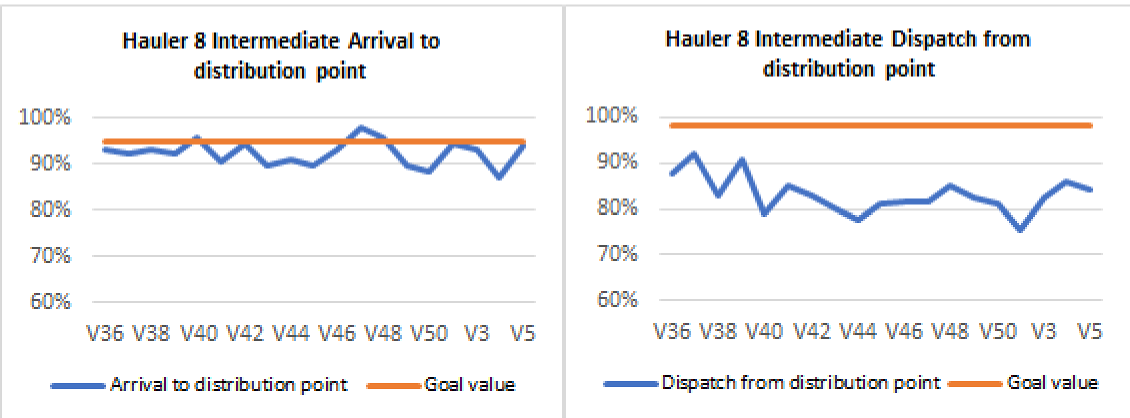


Graph 16: KPI statistics of Hauler 7 Frozen transportations Skara

Graphs 15 and 16 display the individual frozen transportations conducted by Hauler 7 to Karlstad and Skara. Although the overall number of frozen transportations are somewhat evenly distributed between the different haulers, these two transportation flows are being made with a lower number of transportations during the data period. The graphs further present a relatively high variation within the data output, where the KPI of dispatch from distribution point within both the transportation flows have the highest data dispersion.

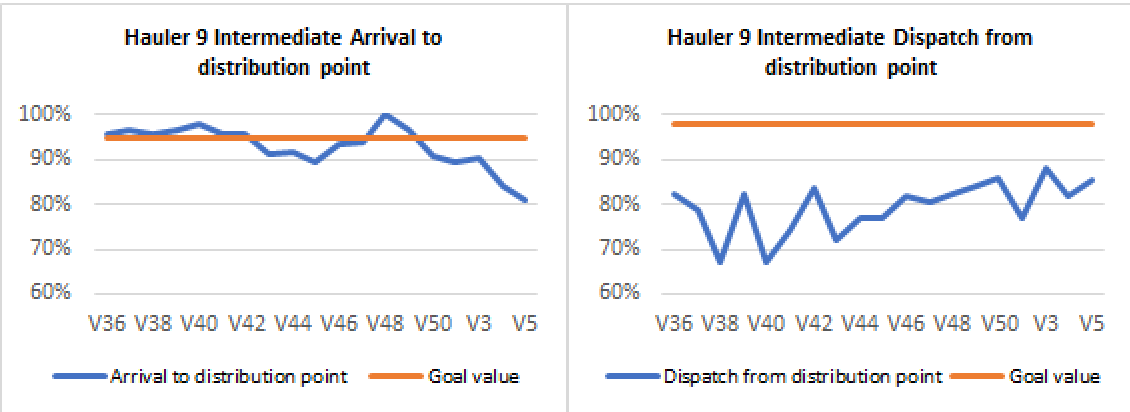


Graph 17: KPI statistics of Hauler 8 Frozen transportations Helsingborg

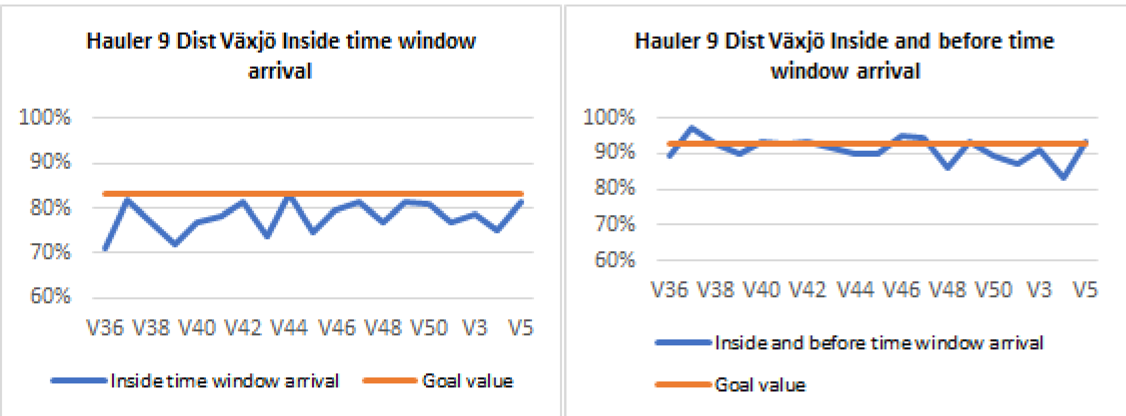


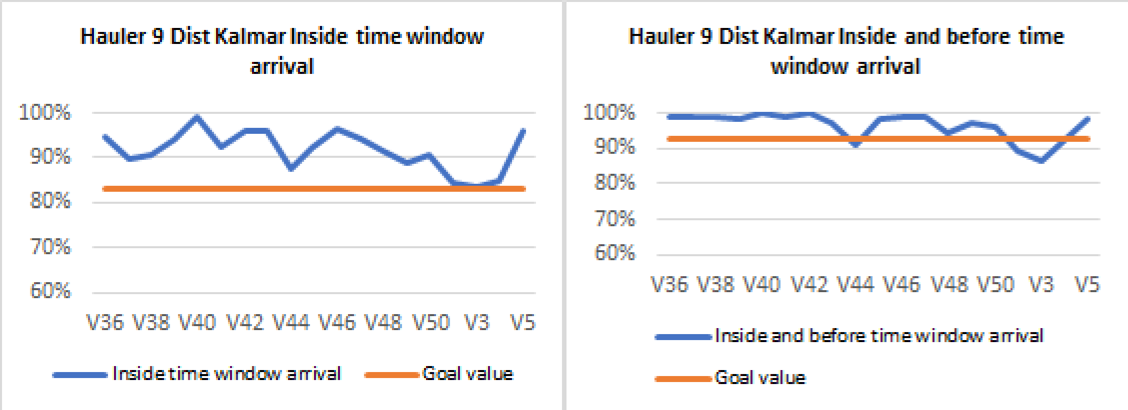
Graph 18: KPI statistics of Hauler 8 Intermediate transport Kungälv

As exemplified within Appendix 1, Hauler 8 is the main actor conducting frozen transportations within the Helsingborg region. Graph 17 illustrates a rather stable data output within the KPIs of arrival to distribution point and dispatch from distribution point, with some occasional deviations. At the same time, KPIs of time window arrival parades a more constant variability throughout the data period. Furthermore, Graph 18 shows how only the two KPIs of arrival to distribution point and dispatch from distribution point can be presented within the different intermediate transportation flows of ICA. As discussed, and clarified within both Appendix 1 and Appendix 3, intermediate transportations only conduct distribution between two transhipment centres or warehouses. Inevitably, the intermediate transportation does not distribute to any stores, which makes the presentation of time window analysis irrelevant.

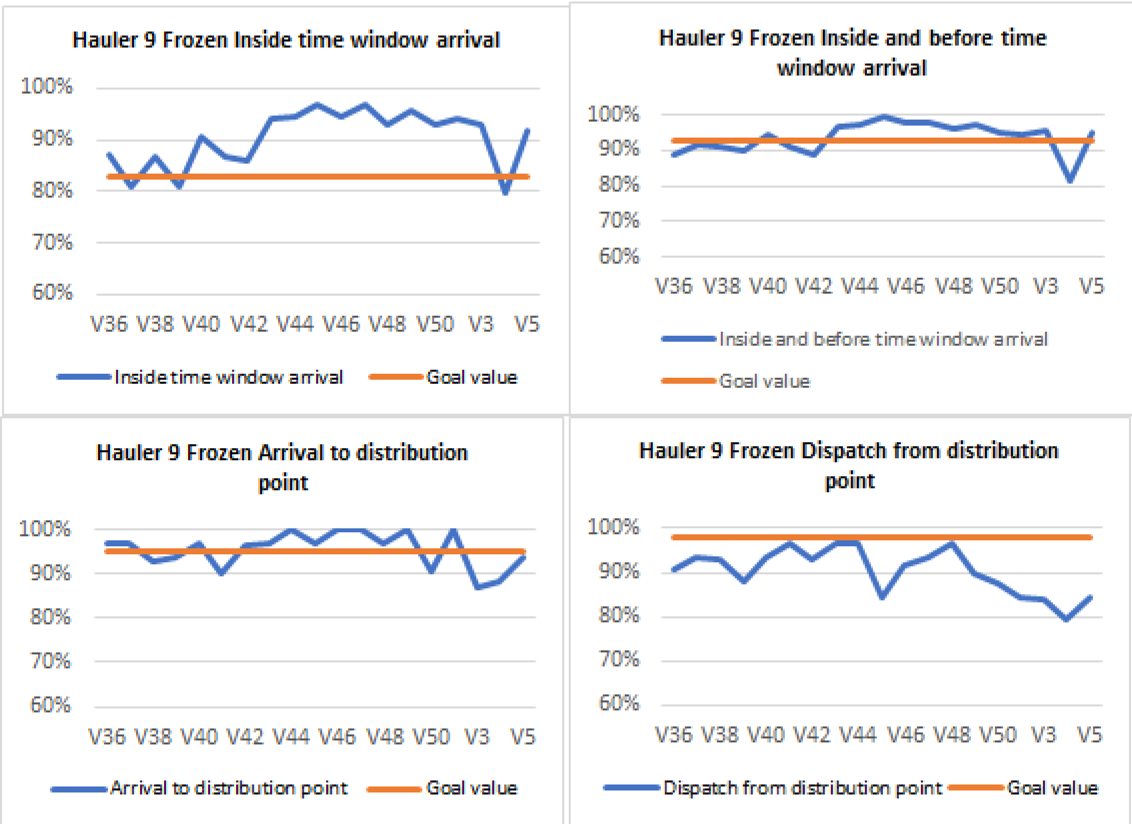


Graph 19: KPI statistics of Hauler 9 Intermediate transports Växjö and Kalmar



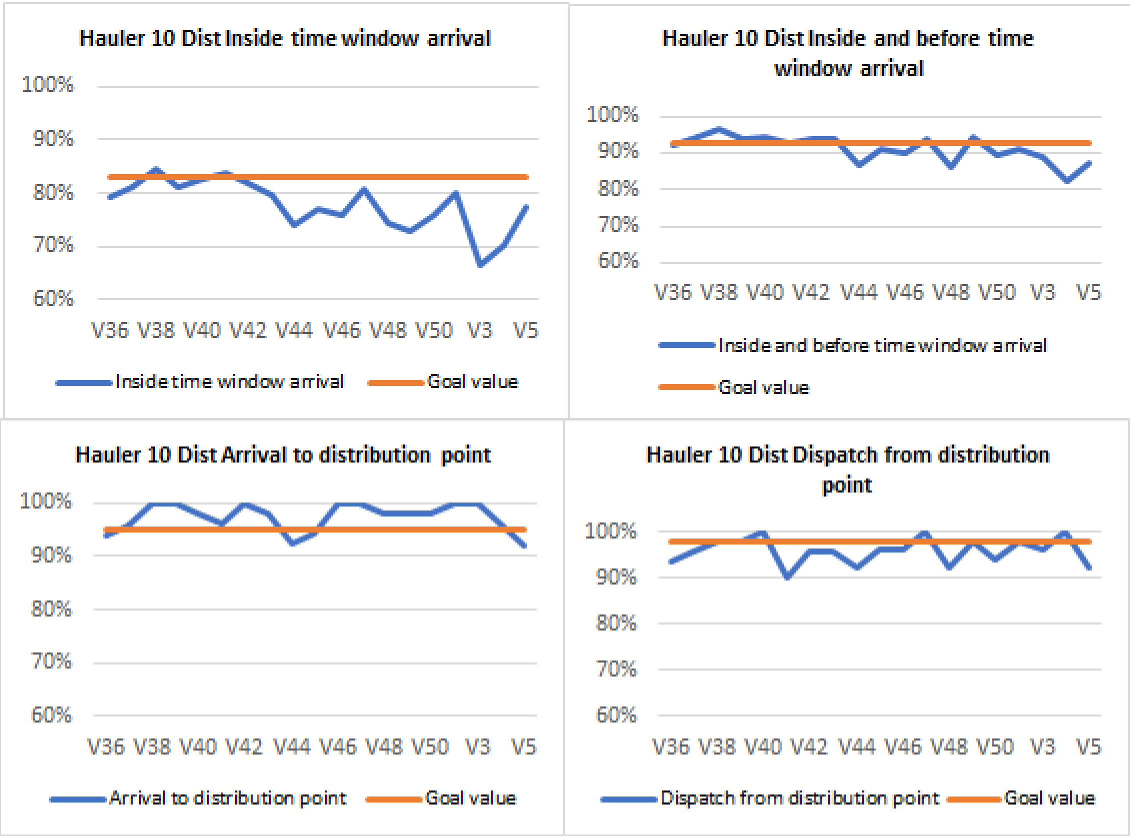


Graph 20: KPI statistics of Hauler 9 Distribution Växjö and Kalmar

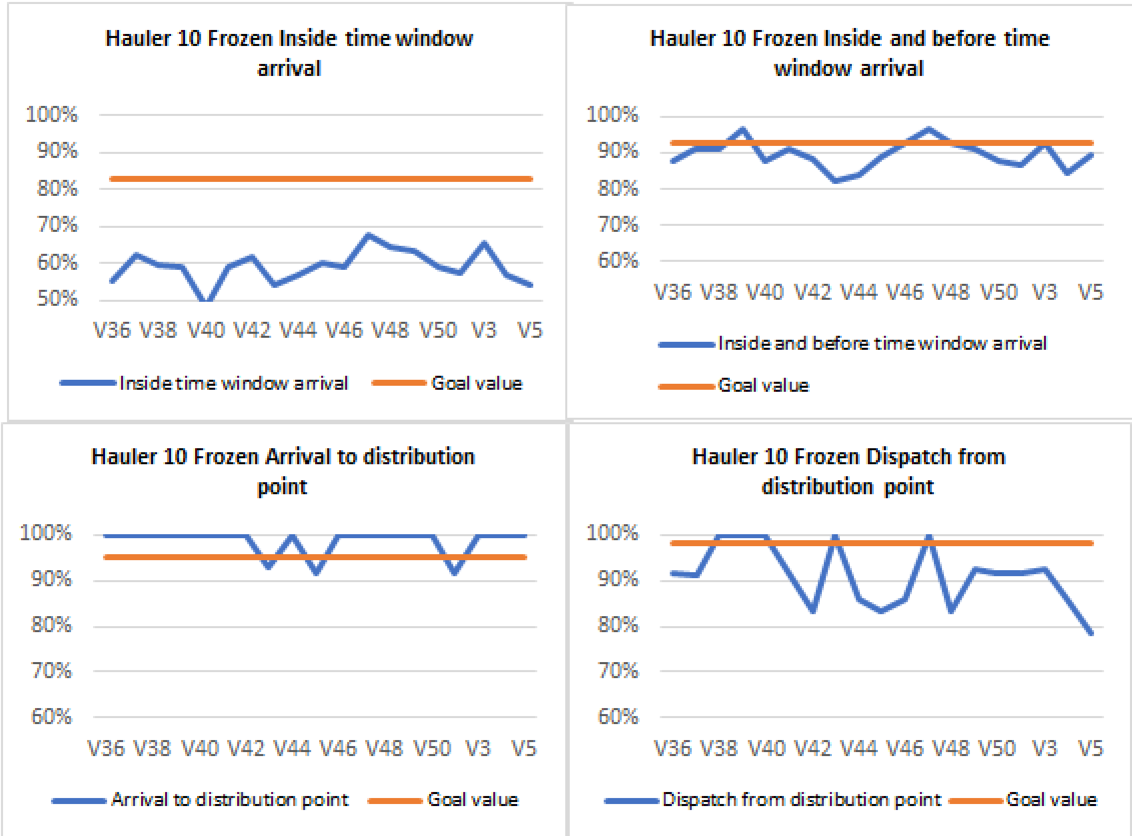


Graph 21: KPI statistics of Hauler 9 Frozen transportations Växjö and Kalmar

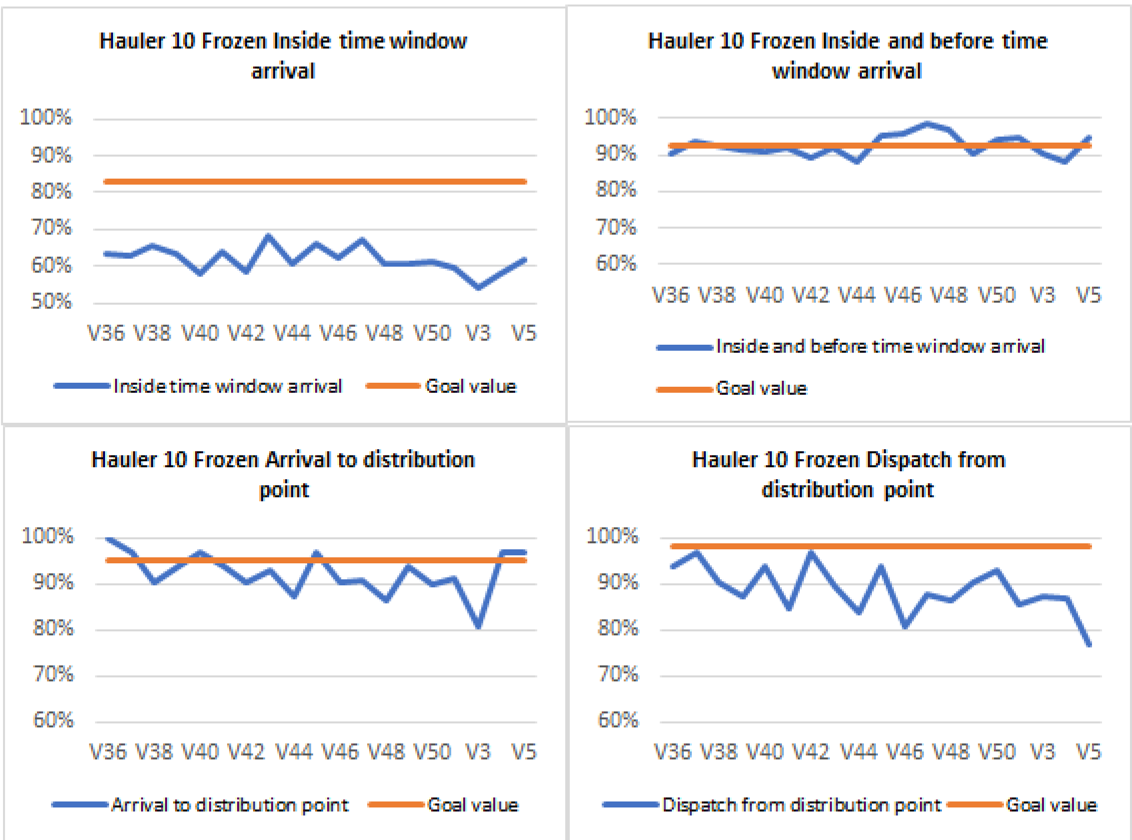
Hauler 9s intermediate transportations to Kalmar and Växjö within Graph 19 neither have any direct affiliation with ICA stores, making time window analyses unnecessary. Additionally, the current transportation enterprise system of ICA S-W yields some difficulties with gathering information with regards to the performance of the transportation flows to and in Kalmar and Växjö. Accordingly, and as mentioned in both Appendix 1 and 3, the distribution flows of Kalmar and Växjö shown in Graph 20 have no data output within the KPIs of arrival to distribution point and dispatch from distribution point. Similarly, due to difficulties with separating the intermediate transportation data, the output of the intermediate transportations to Växjö and Kalmar showed in Graph 19 had to be included and illustrated in the same graph.



Graph 22: KPI statistics of Hauler 10 Distribution Jönköping

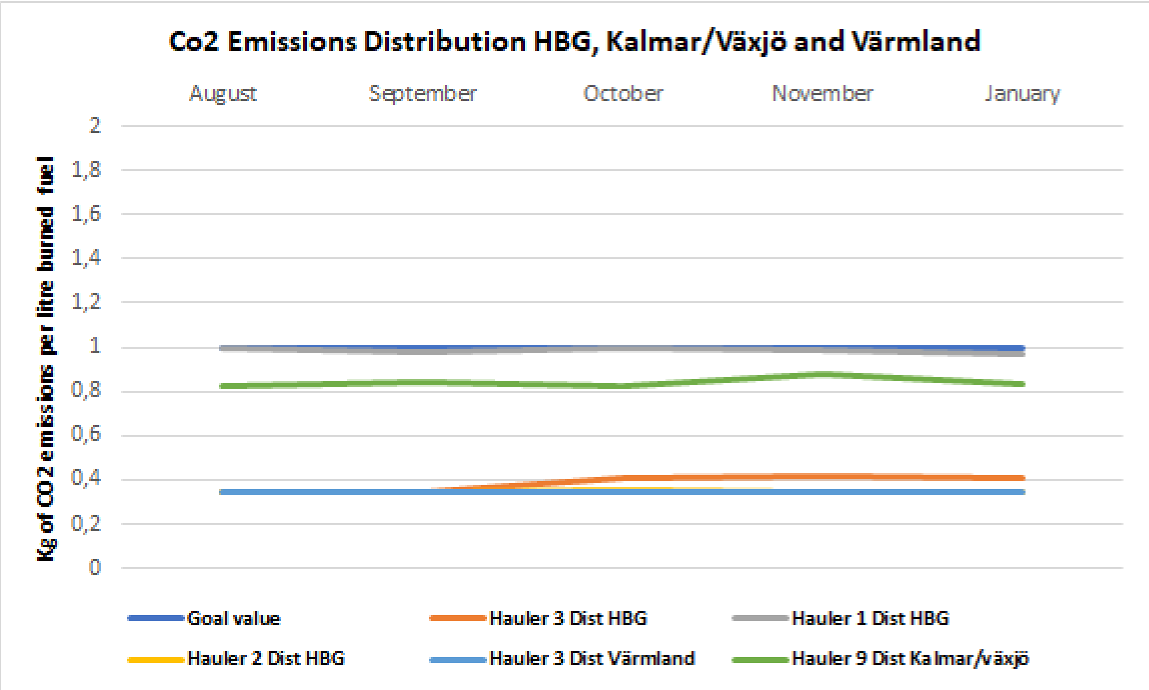


Graph 23: KPI statistics of Hauler 10 Frozen transportations Jönköping

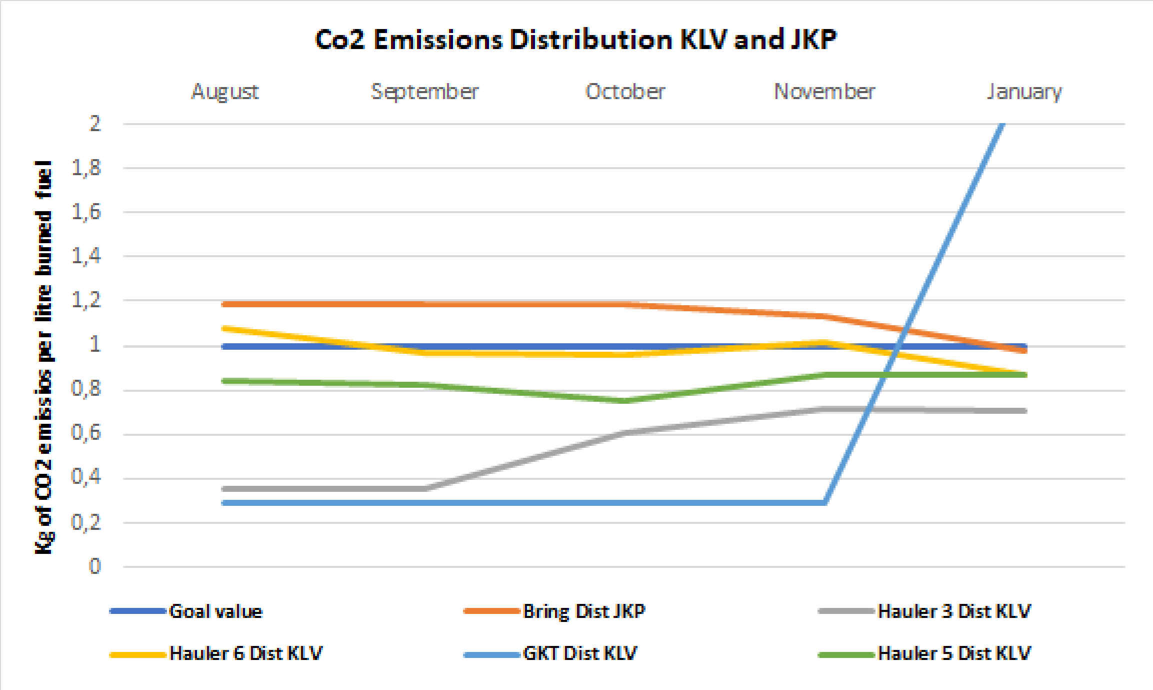


Graph 24: KPI statistics of Hauler 10 Frozen transportations Linköping

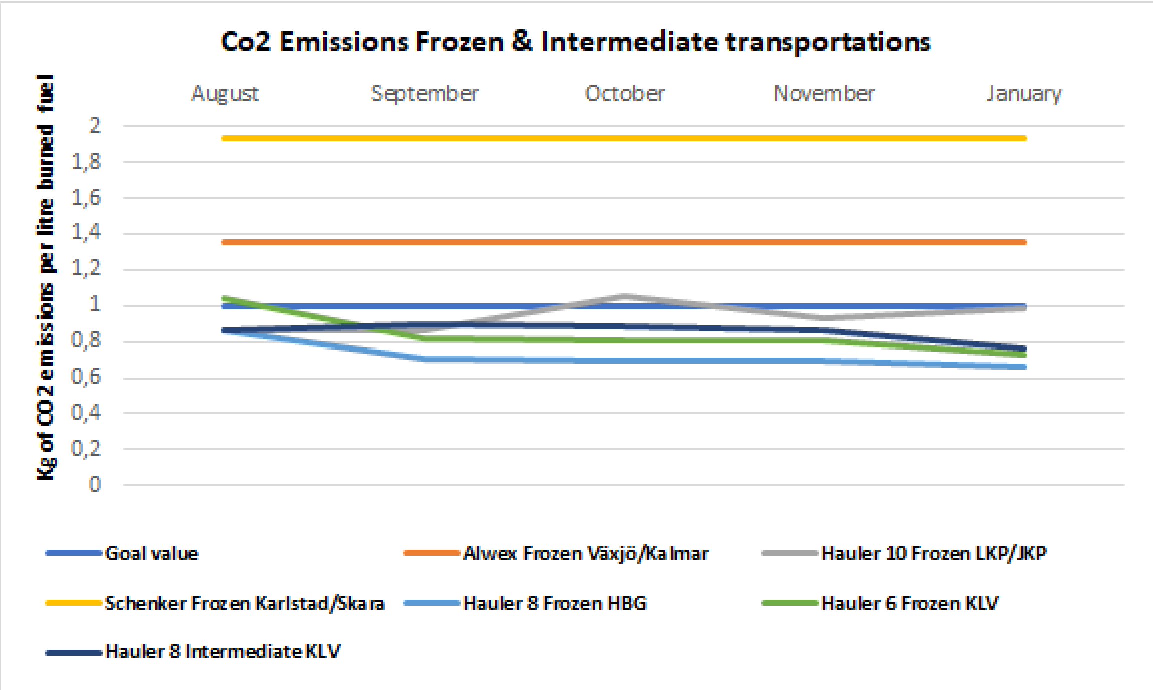
ICA S-Ws transportation flows to and within Jönköping are mainly operated by hauler 10. As illustrated in Graph 22 and 23, there is some variation within each of the KPIs, where some of the KPIs vary in output during specific sequences of the observed data period. In addition, hauler 10 conducts frozen transportations to Linköping. In this context, KPIs of both arrival to distribution point and dispatch from distribution point have a high variability of the data output. Like frozen transportations distributed to Skara and Karlstad by Hauler 7, the total number of frozen transportations to Linköping conducted by Hauler 10 is lower than average.



Graph 25: CO2 emission statistics of haulers conducting Distribution in Helsingborg, Kalmar, Växjö and Värmland



Graph 26: CO2 emission statistics of haulers conducting distribution in Kungälv and Jönköping



Graph 27: CO2 emission statistics of haulers conducting overall Frozen and intermediate transportations

The CO2 emissions of the different haulers have been divided into Graph 25, 26 and 27. The graphs are separated between different flows that are quite similar in terms of transportation characteristics or geographical transportation areas. An explanation of the abbreviations used for some of the geographical areas can be identified in Appendix 3. Furthermore, an important note can be made on Graph 25. Due to almost identical output in the CO2 emissions of “Hauler 2 Dist HBG” and “Hauler 3 Dist Värmland”, the yellow line of Hauler 2 is covered by the blue line of Hauler 3. However, both outputs are still included within the graph. Other details to consider within these graphs are the lack of lines of CO2 emission statistics for direct distribution transportations. The direct distribution flows are integrated into the different types of contracts used when withdrawing CO2 emissions for the different haulers. To exemplify this, Hauler 3 can be used. Hauler 3 facilitates transportations within four different transportation flows: distribution Helsingborg, distribution Värmland, distribution Kungälv and direct distribution Kungälv. However, the haulers have three main contracts for their transportations: Helsingborg, Kungälv and Värmland. The transportations of the direct distribution flow are therefore divided between the different contracts and included within the lines of Hauler 3 CO2 emission statistics of these graphs. Similarly, the CO2 emission statistics for direct distribution transportations facilitated by other haulers are integrated and included into the different CO2 output lines of the haulers presented within these three graphs. Beyond this, the intermediate transportation flow to Växjö and Kalmar is missing data for CO2 emissions during this period and therefore not included in Graph 27.

5. Analysis and discussion of empirical findings

The following section will analyse the main findings presented in part four of this paper. Here, further connections will be made between the empirical findings and the theoretical literature used in this study.

5.1 proposed improvements to existing measures and routines for assessing transportation performance

The empirical findings illustrate how ICA S-W operates with different measurements, goals, and routines for assessing transportation performance. ICA S-W has similar to what Forslund (2009) discusses about transportation performance assessment, together with their contractual hauler partners developed specific goal targets for transportation assessment, to ensure certain levels of transportation performance. This means that the transportation performance is dependent on how well a TSP or transportation flow performs in relation to formulated goals (Gunasekaran, 2001). The goal targets can further be connected to the approach of measurement subjectivity elaborated by Forslund (2007), where the goal targets are aimed at aiding the transportation performance measuring of a specific transportation flow conducted by ICA S-W and the haulers. This includes harvesting the benefits of transportation assessment mentioned by Fawcett & Cooper (1998), where ICA S-Ws goal targets give greater knowledge about the company's transportation performance and therefore support for decision making. Just like Krasnyanskiy & Penshin (2016) discusses about measuring transportation, ICA S-Ws goal targets have been divided between different measurement areas with the purpose of creating a common performance picture of the transportation flows. From this perspective, ICA S-W currently operates with a transportation performance assessment approach like the ones discussed by Gunasekaran (2001), where the company avoids over measuring by instead focusing on some main strong measurements and goal areas.

As manifested in Table 2 and mentioned throughout part 4, ICA S-W is prone to evaluate measures related to time. ICA S-W has developed both goals and routines for assessing timely transportation performance of dispatch from distribution point as well as arrival to distribution point and the ICA stores. ICA S-Ws current measurements related to time gives important performance information about the different steps of their transportation chain.

These measurements connect with discussions about assessing transportation performance made by Chae (2009), where specific measures within different steps of a transportation chain are being made and compared with formulated goals. Just like Forslund (2007) connects time and service quality measurements in transportation assessment, ICA S-W utilize time to evaluate overall service quality. The service quality can be interpreted as the level of delivery accuracy (Fawcett & Cooper, 1998), where ICA S-W uses timely measurements to assess how well the planned delivery promises are being fulfilled. Consequently, ICA S-Ws overall service quality of a specific transportation flow is in a way a result of many parameters, like the way Simkova et al (2015) discusses service quality as a mix of multiple measurements.

Beyond this, section 4.1 shows how ICA S-W conducts transportation performance assessment related to environmental impacts. Just like McKinnon & Piecyk (2009) and Sanchez-Rodrigues et al (2010), ICA S-W mainly includes measures of carbon dioxide emissions from the perspective of fuel efficiency, where the different transportation flows separated between each hauler are being evaluated. ICA S-Ws principle of using emission factors to calculate emission levels, somewhat connects to discussions made by Liu et al (2010) regarding portable emission measurement systems, where emissions of different types of vehicles with separated fuels can be compared. At the same time, as presented in Table 2, ICA S-W currently has one main transportation assessment goal related to environmental impact of transportation operations. Goal and routine developments such as emissions standards of transportation distance, cargo volumes and fill rates could therefore be of further interest for evaluating the environmental impacts of ICA S-W transportation operations. Accordingly, parallels between these potential goals and measurements could be connected to operational decisions regarding route planning and how these impact emissions of transportations (Tang et al, 2018).

Furthermore, as shown in Table 2, ICA S-W have developed performance related goals with regards to some aspects concerning both deviations of transportation operations, as well as incidents that occur during transportation. Through handling and documentation of deviations, section 4.2 displays how ICA S-W emphasizes the importance of being aware of different deviations of the original transportation plan that take place during transportation operations. ICA S-W classify deviations in a similar manner as Sanchez-Rodrigues et al (2013) and Fowke et al (2004), where certain occurrences that take place during transportation, will impact, and delay the original transportation plan. Beyond this, part 4.2 shows how ICA S-W also works with penalties for substandard transportation performance. In accordance with what Forslund (2009) discusses about contractual penalties for substandard performance, both ICA S-W and the haulers are obliged to compensate each other whenever one of the two fail to perform according to the planned transportation schedule.

However, as discussed throughout part 4.2 and 4.3, ICA S-W currently have limited routines regarding follow up of these deviations. It is being acknowledged how the separation of deviations that are within or outside the reach of an organisation discussed by Woxenius (2012), might be hard for ICA S-W to accomplish. Consequently, ICA S-W could benefit from developing procedures to filter different types of deviations, but also formulate separate performance goals that are anchored within the differentiation of deviations. Deviation data generated from GPS discussed by Woxenius (2012), could also potentially be used for identifying deviations with ICA S-W. The deviations would thereby be directly created within the GPS system when occurring and transferred to a common database shared by ICA S-W and their haulers. Yet, this potential solution has some flaws, where such a system most likely would register every step outside the programmed route system as a deviation (Woxenius, 2012). Other potential issues could be the trustworthiness of the GPS data provided and used by one actor, but also challenges with general data protection, where sensitive information regarding drivers work patterns are shared and exposed.

Similarly, within safety and risk performance, part 4.2 presents how ICA S-W handles and discusses the relevance of different cases related to accidents and incidents, but how the company lacks routines and goals for following up performance in these areas. ICA S-W problematizes the effects of accidents like Tubis & Werbińska-Wojciechowska (2017), where the company must handle the actual accident as well as finding new ways of delivery when these types of situations occur. Accordingly, ICA S-W acknowledge the need for greater registration, documentation and follow up of different safety - and risk cases such as damaged and crushed goods. Added measurements for evaluating risk and safety could yield greater information regarding losses and damages of goods over time, which would enhance incitements for catering a higher transportation quality (Krasnyanskiy & Penshin, 2016).

Moreover, as depicted in Table 2 and as mentioned in part 4.1, similar to Sanchez-Rodrigues et al (2010), ICA S-W has formulated some performance goals related to internal operational efficiency. Concurrently, as displayed in part 4.2 and 4.3, there is right now a scarcity in routines for measuring and following up these goals. ICA S-W needs to involve the right actors for these types of performance assessment endeavours, to receive correct information on how to develop routines for these measurements. Furthermore, a continuous documentation and practice for long term evaluation in relation to these formulated performance goals must be established. Beyond this, ICA S-W could consider follow up of other operational measures discussed by Sanchez-Rodrigues et al (2010) and Simkova et al (2015) in their studies about transportation measurements, such as fill rate and empty load running. This could give ICA S-W greater insight into how their route planning impacts the performance of these measurements. However, these suggestions do not necessarily mean that ICA S-W is not acknowledging fill rate and empty load running as important for their transportation operations, but rather highlighting the potential to develop more goal targets and routines for having a continuous performance assessment of these measurements. Like other potential operational measurement improvement areas previously discussed, ICA S-W must involve the right employees and transportation data collection to facilitate these suggested measurements.

To summarize, part 4.1 to 4.3 illustrate how ICA S-W currently has developed goals within different types of metric areas relevant for measuring transportation performance. The performance goals are illustrated as customer expectations of transportation operations, where ICA S-W, the ICA stores and the haulers operate in a similar triad type of customer - and TSP relationships as the ones discussed by Forslund (2007). This includes a high focus on timely follow ups, such as on time delivery (Fawcett & Cooper, 1998), where evaluations are taken to minimize poor performance and to avoid reducing or losing customer relationships (Simkova et al, 2015). Just like Forslund (2007) describe transportation assessment, the process of transportation performance evaluation of ICA S-W is complex, where many parameters are needed to both develop routines for measuring certain metrics areas as well as to follow up specific transportation performance goals. As a result, ICA S-W recognizes the need to increase visibility of transportation performance by developing additional routines and goals for transportation assessment. Through this, ICA S-W can decrease or avoid the risks with under measuring performance discussed by Fawcett & Cooper (1998), such as reduced process quality and customer satisfaction.

5.2 Current transportation performance with suggested areas for operational improvement

Distribution flows

As exemplified throughout section 4.4, ICA S-W transportation flows give different performance outputs compared to the performance goals formulated by the company. Initially, Graph 1, 3 and 5 with distribution in Helsingborg show an overall decent performance in relation to the goal targets. However, the higher performance of the KPI of arrival inside and before time window arrival in relation to the performance of the KPI related to arrival inside time window arrival indicates that many transportations arrive before their time window.

Additionally, Graph 8, 9, 11 and 13 as well as Graphs 7 and 22 show a quite similar pattern as distribution transportations in Helsingborg, where many of distribution transportations in Kungälv, Värmland and Jönköping arrive early to the stores. However, the overall performance of time window arrival before and within the time window is significantly higher in Värmland and Kungälv than in Jönköping. The main expectation of this performance pattern of the distribution flows is distribution within Kalmar illustrated in Graph 20. This graph illustrates how arrival to stores before and within the time window as well as only within the time window manage to reach the goal value during most of the observed weeks.

Beyond this, as illuminated in the graphs previously mentioned, most of the distribution flows except distribution Värmland seem to have a significant difference of performance between the KPIs of arrival to distribution point and dispatch from distribution point. The two KPIs are closely interlinked, which indicates some potential challenges or problems taking place after arrival to the distribution point. This means that the trucks of these flows arrive on time to the distribution point but are then being delayed before departure in relation to the planned departure time.

Direct distribution flows

The transportation flows associated with direct distribution within graph 2,4, 6, 10 and 12 highlights a transportation performance with high variability. This means that the performance throughout the different weeks of the observation period yields outputs both above and well below goal targets. The main exception to this is direct distribution conducted by Hauler 3, presented in Graph 6. Graph 6 shows a lower performance variability in some of the KPIs. However, as discussed in part 4.4, it is important to notice that the data output is greatly influenced by the number of transportations that operate within the direct distribution flow. As mentioned in part 4.4, Graph 6 illustrate a direct distribution flow with a significant larger number of transportations compared to the other direct distribution flows. Whenever a delay or disturbance to the remaining direct distribution transportation flow occurs, the performance output is being more impacted than the transport flow of Graph 6. Therefore, it might be difficult to say if weekly performance delay depends on random occurrences or because of overall deficiencies in performance. In this regard, except for Graph 6, it can thus be challenging to identify any essential areas of improvement or draw transportation performance related conclusions based on the data output from the direct distribution flows.

Frozen and intermediate transportation flows

The different frozen transportations that originate from the distribution centre in Helsingborg seem to perform differently throughout the data period. Just like some of the different distribution transportation flows, Graph 14 and 15 show how frozen transportations around the Kungälv area perform well within the KPI goal of arrival inside and before time window arrival. However, the goal related to arrival within the time window underperforms. Like before, this indicates that a high number of transportations arrives prior to schedule. Furthermore, the same graphs indicate how the goal for arrival to the distribution point is being met during most of the observed weeks, but how the performance related to dispatch from distribution point is lacking. For the frozen transportations to Skara, this flow mainly has a shortage of performance through the perspective of dispatch from the distribution point. Beyond this, Graph 17 shows how frozen transportations within Helsingborg perform somewhat decently throughout the data period, but how the arrival within the time windows underperform.

The frozen transportations to Jönköping illustrated in Graph 23 exhibit how the transportation flow performs well from the aspect of arrival to distribution point, but how the other KPIs are lacking compared to the goal targets. In comparison, the frozen transportations to Linköping showed in Graph 24 embodies how the transportation flow is performing relatively well within the KPI of arrival inside and before the time window, but how the remaining KPIs are highly underperforming. In addition, as presented in Graph 21, the dispatch of distribution points in Helsingborg seems to be the main issue for the frozen transportations going to the stores in Kalmar and Växjö. The frozen transportation flows of Växjö and Kalmar perform well in relation to the goals of time window arrival and arrival to distribution point.

Furthermore, the two main intermediate transportation flows of this dataset, presented in Graphs 18 and 19 show a generally low performance in relation to the goal of arrival to the distribution point. Similarly, to other flows, there is also an identified difference between performance in arrival to distribution point and dispatch from distribution point. However, within the intermediate transportations, the overall performance of dispatch from distribution point is highly underperforming.

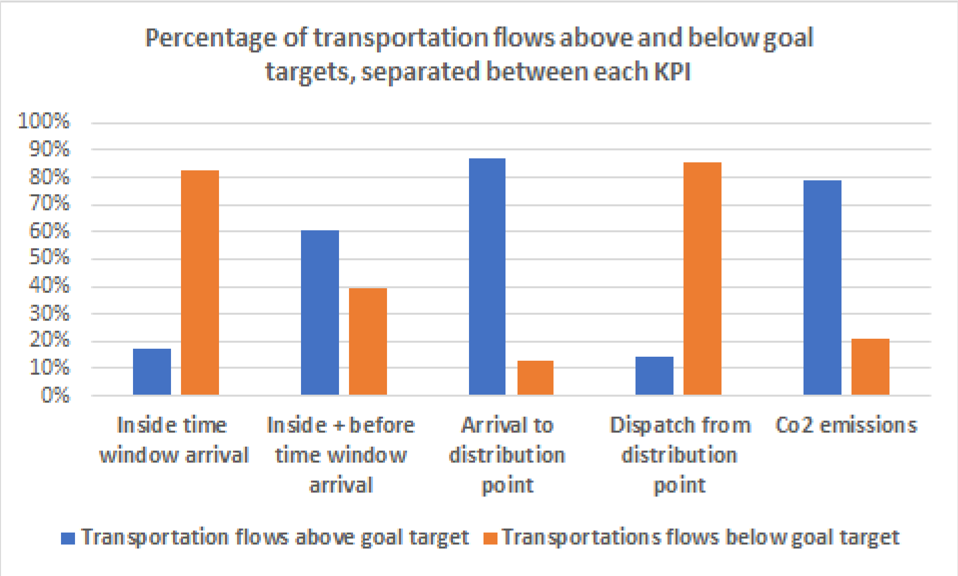
Environmental aspect

Within the context of environmental transportation performance, separate levels of CO_2 emissions are identified for the different transportation flows of ICA S-W. Initially, Graph 25 illuminates a high performance of the different haulers conducting distribution within the Helsingborg, Kalmar, Växjö and Värmland areas. In this regard, every hauler within these transportation flows is reaching the goal of releasing less than one kg of CO_2 per litre burned fuel throughout the observation period.

At the same time, Graphs 26 and 27 exemplify more differentiated performance, where the transportation flows are having high as well as low emission levels in relation to goal target. As identified in Graph 26, distribution within Jönköping is the main flow that is somewhat underperforming throughout most of the observed period but manages to increase the performance during the last weeks. Another highlight in Graph 26 is the large increase of emissions within the distribution flow of Hauler 4 Kungälv, where the two last months of the observed period underperformed. As presented in Graph 27, the frozen transportation flows to Skara, Karlstad, Växjö and Kalmar is consistently underperforming throughout the data period.

Regardless of the CO_2 emission performance within each of the transportation flows and individual performance deviations, most of the output is at the same time staying relatively constant throughout the data period. In this regard, it can be assumed how the different haulers conduct somewhat similar transportation operations and routes over the time period. Furthermore, as the procurement of lorries is a high capital investment, it also seems reasonable to estimate that the haulers operate with slightly identical vehicles throughout the time period. Whenever an occasional or continuous change to the emission levels occur, it can be expected how the hauler has made some adjustments to their vehicle fleet or received a different type of transportation route system.

Summary with theoretical connections



Graph 28: Overview of the number of transportation flows performing above or below goal targets, separated between each KPI

To summarize, the transportation data analysis gives interesting output with connections to how Chae (2009) discusses benefits of transportation performance assessment, where information regarding the transportation performance of ICA S-W is given at different stages of the transport chain. In this regard, Graph 28 gives an overview of how the overall transportation flows perform within the five KPIs. Complementary, Appendix 3 allows a deeper summary of how the specific transportation flows perform on average within the five KPIs. Within Appendix 3, the illustration of a green cell shall be interpreted as a performance above the goal target, while the orange colour shows the opposite.

Through the different sections of this analysis, certain areas of underperformance have been problematised and highlighted for ICA S-W transportation operations. Initially, as illustrated in Graph 28 and as previously discussed, there is generally a performance difference among all transportation flows between the KPI related to arrival within time window and the KPI of arrival within and before time window. It can therefore be acknowledged how many of ICA

S-Ws transportations show up to the different stores earlier than expected. Although it can be assumed that an early arrival might be better than a late arrival, many of the transportations are still outside the planned delivery schedule, lowering overall on time delivery rate (Fawcett & Cooper, 1998) as well as creating potential challenges for consigning stores, unloading goods in the transport chain (Lai et al, 2002). In this context, increased communication between stores and transportation planners, where the transportation route planning is more frequently being updated could be a potential suggestion for this issue.

In addition, it has been identified how some transportation flows show a significant variation within their performance throughout the data period. Therefore, when comparing the average output of the KPIs presented in Graph 28 and Appendix 3 with the different graphs throughout section 4.4, some separated interpretations can be drawn. This means that some transportation flows have a high overall average of the KPI performances, while at the same time have a high fluctuation of performance. Some of the direct distribution flows are a good example of this phenomena, where the flows illustrate high variation of output as well as high averages. Nonetheless, as previously discussed, the performance of the direct distribution flows is linked with that transportation data in itself.

However, other types of transportation flows with larger total number of transportations such as the frozen and intermediate transportation flows reveal similar issues with performance variability in relation to performance averages. Within the frozen transportation flows, the KPIs of arrival to distribution point and arrival within and before time window are the ones with highest concern. For the intermediate transportation flows, this is mostly the case for the KPI of arrival to distribution point. Consequently, high variability within transportation performance can manifest overall uncertainty among operations (Lai et al, 2002) and issues with operational control (Ploos van Amstel & D'Hert, 1996). As a result, these transportation flows within ICA S-W indicate further need to investigate and identify the origins of the performance defects. Through this, further separation between internal, external, and structural deficiencies can be made, to take operational actions where it is needed (Woxenius, 2012).

Furthermore, the CO_2 emissions earlier discussed in this section is just like Sanchez-Rodrigues et al (2010) and McKinnon & Piecyk, (2009) mention in their studies, highly dependent on the type of vehicle, fuel or cargo type that is being transported. Here, ICA S-W could, beyond the pure alternative of selecting haulers based on emissions, follow suggestions for increased transportation performance discussed by Kleinsorge (1991) and set regular higher contractual goals of reduced emissions related to vehicles and fuels for the haulers. Through this, the hauler companies would receive time to continuously improve their truck fleet with more environmentally friendly vehicles and fuel types, which in the long run would decrease emissions (Jeon et al, 2013). Additionally, this could include a separation of the actual emission goal, where the standard emission level is more specific and anchored in the type of transportation that takes place. An example of this would be a lower emissions standard for frozen transportations, where the low temperature demands a generally higher energy consumption. This proposal further connects to the discussions made by McKinnon & Piecyk (2009) regarding how emission goal targets should be anchored in the type of cargo that is being transported.

Beyond this, the measurements of arrival to distribution point and dispatch from distribution point yield interesting information regarding the transportation performance of ICA S-W, from the perspective of the handling factor discussed by Sanchez-Rodrigues et al (2010). It can be determined how ICA S-Ws transportation flows generally underperform from the perspective of dispatch from distribution point, where most of the transportation flows perform lower than the goal target throughout the data period. The intermediate transportation flows and some of the frozen transportation flows are the ones with lowest performance. For the frozen transportation flows, this creates a type of inter-conflicting relationship between some of the KPIs, where the late dispatches still arrive earlier than planned to the ICA stores. From this point, it can be assumed that the frozen transportations manage to catch up on their lost time from the delays, but also that the planned time window arrivals give room for delivery errors.

Beyond this, many transportation flows within ICA S-W which underperform from the perspective of dispatch from distribution point, perform well within the KPI of arrival to distribution point. Generally, it can be assumed that vehicles which arrive late to a planned loading time, most likely will dispatch later than planned as well. Similarly, a vehicle which arrives on time gives the best prerequisites for the vehicle to also dispatch on time. With that said, this shows how ICA S-W currently has challenges with their transportation chain, similar to the transportation issues discussed by Ploos van Amstel & D'Hert (1996) and Lai et al (2002), where there are problems with synchronizing the different transportation activities and making the transportation function operate as a common chain.

At the same time, as illustrated in Table 2, there is a difference of three percentage within the two goal targets of arrival to distribution point and dispatch from distribution point. Some of the transportation data which indicate a slight underperformance within the KPI of dispatch from distribution point, when compared to the KPI of arrival to distribution point could be the marginal of these three percent. The existing late arrivals could therefore be the reason for the lack of performance within the dispatch from the distribution point. Additionally, the differences in goal targets could also illustrate a skew performance picture between the two measurements, where the performance of the dispatches at first sight seems very low.

However, regardless of these percentage margins, the dispatch from distribution point performance at ICA S-W is still problematic when compared to elaborations made by Lai et al (2002) regarding transportation chains. Lai et al (2002) argues how delays within one part of a transport chain can create initial problems for the remaining transportation process. Additionally, a transport function of loading and dispatch is dependent upon both internal and external actors and processes, making the potential for delays multilateral (Krasnyanskiy & Penshin, 2016). ICA S-W would therefore benefit from deeper performance analysis on the different sources of delays that take place within their distribution points. Similar to what Lai et al (2002) discusses, additional ways of filtering data to separate between different origins of delay within distribution points can create operational value by giving better clarity of the specific performance of the loading and dispatch processes. In the case of ICA S-W, this could be done by further utilizing and filter the current information regarding the transportation processes which are being logged in the company's TMS. Through these measures, ICA S-W could receive better visibility of the handling factor discussed by Sanchez-Rodrigues et al, (2010) and therefore identify inefficiencies within the separate parts of their transportation chain. Like what Fawcett & Cooper (1998) mention as benefits with measuring transportation performance, this could also support the company in making further operational decisions and to take necessary actions when needed.

5.3 Evaluation of conceptual model

As exemplified throughout section 4 - 4.4, the empirical and transport data findings of this study show different relevant metric areas for measuring transportation performance within ICA S-W. Initially, the findings of this study relate to discussions made by Forslund (2007), where measuring of time can be acknowledged as a central aspect of ensuring both transportation process and service quality, where the aim is to coordinate and deliver as many transportations as possible within the planned transportation schedule. Additionally, with connections to Woxenius (2012), the aspect of deviations within transportation has also been identified as a central topic for ICA S-W, where there is a recognized need to differentiate between recurring and random deviations. Furthermore, the findings enumerate several other important metric areas for measuring transportation performance, where the company has either, or together, developed routines for conducting performance assessment and formulated goal targets for the metric areas. Potential improvements or changes to the current routines and goals for assessing transportation performance within the company have been discussed throughout section 5.1 and somewhat in 5.2.

As previously demonstrated throughout part 4.1 - 4.3 and discussed in section 5.1, all the following metric areas within the developed conceptual model of this study are directly or indirectly relevant for measuring transportation performance within ICA S-W. As illustrated, timely measurements are for example used to measure service quality. Therefore, just like Forslund (2007), Krasnyanskiy & Penshin (2016) and Woxenius (2012) discusses within their studies, this study also illustrates how measurements and metric areas for assessing transportation performance are not always absolute and straightforward but rather a blend, where the metric areas somewhat cross pass each other and are occasionally being differently prioritised.

Beyond this, the findings show potential adding to the current conceptual model. The aspect of assessing empty load carrier collections discussed in section 4.1 and 4.3 highlights the relevance of the reverse transportation flow perspective as an area for measurement. This study can therefore complement previous literature on reverse transportation assessment, which has mostly been focusing on evaluating return management as a measurement for service quality (Genchev et al, 2011) as well as empty running of vehicles due to backhauling as an operational measurement (Sanchez-Rodrigues et al, 2010).

The concept of empty load carrier collections could be interpreted as an antidote to the challenges associated with empty backhauling, where the trucks would transport empty load carriers back to the distribution point after delivering the goods. This would increase the fill rate of the trucks throughout the total run time (Sanchez-Rodrigues et al, 2010). As mentioned in Table 2 and discussed in part 5.1, the perspective of empty load carrier collections could therefore be assumed to be included within the metric area of measurements for operational efficiency. However, this assumption and operational benefit could mainly be harvested under the circumstances that the trucks always have time and space to organise and load the empty load carriers during their original transportation route.

Concurrently, as discussed within both part 4.1 and 4.3 as well as by Genchev et al (2011) and Huang (2010), a reverse transportation flow typically has its own transportation plan, including many different parameters and components. The aspect of evaluating the empty load carrier collection plan therefore further highlights the reverse transportation flow as a separate important metric area for measuring. Like other metric areas, the reverse transportation flow aspect could consist of many different measurements, such as returns (Genchev et al, 2011) and empty backhauling (Sanchez-Rodrigues et al, 2010), besides the empty load carrier collections. Aligned with other metric areas and with what has previously been discussed throughout part 5.3, development of the reverse transportation flow metric would most likely both impact and be dependent on other metric areas for measuring. Accordingly, the different aspects related to the reverse transportation flow brought by both the empirical findings of this study as well as previous literature, confirms the relevance of the reverse flow as a suggested metric area for overall transportation performance assessment. As a result, the following revised model with metric areas for measuring transportation performance is being presented in Figure 4.

Figure 4: Revised model with metric areas for measuring transportation performance

6. Conclusions

The sequent section will present the conclusive remarks of this research. The conclusions are divided into three parts, separated between each research question of this study.

Q1: ***What metric areas are important to consider when evaluating transportation performance?***

Measuring and assessing transportation performance continues to be central parts of operational evaluations and business management. This study shows the importance of acknowledging different metric areas for evaluating transportation performance, where focus is put on a few main measurements. The measurements shall be anchored in the transportation assessment context, where output is used to create value and drive decision making. The study further connects to some main theoretical implications: the importance of separating internal and external operational deviations: the measuring of time as an essential component for assessing and ensuring delivery precision as well as service quality: the aspect of potential risks with both over- and under measuring performance: how the measuring of both different metric areas and KPIs are more connected than separated from each other.

Moreover, this study's results both align with and add to the conceptual model of this research. The study's findings recognize every aspect of the conceptual model illustrated in Figure 3 as relevant areas for measuring transportation performance. At the same time, the aspect of the reverse transportation flow creates an additional important metric area for measuring transportation performance. This metric area considers all measurements related to reverse transportations such as returns, empty load carrier collections and empty back haulage. As a result, the study concludes how the revised conceptual model presented in Figure 4 contributes and works well as metric area guidelines for transportation performance assessment management.

Q2: ***How does the transportation flows of ICA S-W perform in relation to the goals formulated by the company?***

For this study, five KPIs within ICA S-W have been analysed and compared to formulated goal targets for transportation performance assessment. The findings conclude how there is a performance difference between the five separated KPIs distributed among all transportation flows, as well as a performance divergence between the different types of flows. Initially, the study shows how many transportations arrive earlier than planned to the different stores. This is especially true for the frozen transportation flows, where the output in some cases falls short of more than 20 percentage points. At the same time, it has been determined how more or less all transportations flows perform well from the perspective of time window arrival before and within the time window. The study therefore concludes how a low number of transportations in relation to the goal target arrive later than planned to the different stores.

Furthermore, the study concludes an overall performance difference between the KPIs of arrival to distribution point and dispatch from distribution point. The different intermediate and frozen transportation flows are identified as the flows with lowest performance concerning arrival to distribution point. The intermediate and frozen transportation flows are also the flows where the difference in performance regarding the KPIs of arrival to distribution point and dispatch from distribution point are the highest. Beyond this, the study acknowledges that most of the transportation flows perform well from the perspective of CO2 emissions, but how some flows such as the frozen transportation flows underperforms. Overall, this study concludes how ICA S-W performs well within the three out of the five KPIs used to measure transportation performance.

At the same time, the study identifies issues with the data output. The study shows how the intermediate transportation flows have a large data output variability within the KPI of arrival to distribution point throughout the observed period. Similarly, the study illustrates a high data output variability for the frozen transportation flows within the KPIs of arrival to distribution point and arrival within and before the time window. The study therefore concludes how these average outputs which are considered as good performance, could be interpreted as the opposite.

Q3: ***What operational areas of improvement exist?***

The main determined areas of operational improvement for ICA S-W are divided between procedures related to measuring and assessing transportation performance, as well as more physical operational areas that need to be highlighted. These areas are separated between three main sections: development of transportation performance assessment goals, suggestions for transportation performance evaluation routines, and improvement of transportation operations. The study highlights the requisite to develop performance measurement routines for the remaining existing goal metric areas within ICA S-W that are currently not being evaluated on a regular basis. This includes evaluation of different types of transportation deviations, provision of transportation capacity, measures of damaged goods and incidents as well as follow up of empty load carrier collections. Furthermore, the study concludes potential development of routines and goals associated with follow up of vehicle utilization and CO2 emissions related to transportation volumes and cargo type.

Beyond this, operational measures must be taken to reduce the performance defects taking place within ICA S-Ws dispatches from distribution points. The study illustrates the need to separate and analyse the origins of the performance issues at these sites and suggests more utilization and filtration of the information within ICA S-Ws TMS to identify and deal with these issues. The study also concludes how procedures must be taken towards reducing the number of transportations that arrives early to a planned delivery. In this regard, the study advocates how observations regarding recurring early arrivals could be tracked, to accustom the route planning schedule to these times.

To conclude, it can be determined that ICA S-W should continue with developing their routines for assessing transportation performance, where a solid and stable evaluation framework would give important performance information to keep control, monitor and make changes within the transportation operations when needed.

7. Limitations of study results

This research has further enumerated some limitations to the results of this study. The neat delimitations of the cost perspective displayed in part 1.4 has given a somewhat narrow empirical picture of how costs can be used to assess transportation performance. The cost aspect can in this study mainly be illustrated as an indirect metric area, affecting, and depending upon the performance taking place within other metric area measurements, as well as by operational decisions.

Furthermore, the used transportation data mentioned in part 2.3.2 leaves out any type of results concerning transportation performance during the holidays of Christmas and New Year’s Eve. Therefore, the results do not give any room for transportation performance comparisons between the operations during holidays and more normal operational circumstances. In addition, as mentioned in part 4.4 and illustrated in Appendix 3, the findings can acknowledge some lack of data within the transportation flows of both intermediate and distribution transportation to and within Växjö and Kalmar. Therefore, compared to other transportations flows, this study's results cannot portray a complete performance assessment of these specific transportation flows.

7.1 Future research

Additional research to the area of transportation performance assessment could bring more interesting perspectives of how to measure and assess the performance of transportation operations. This study includes different types of metric areas for measuring transportation performance, giving a wide framework for transportation performance assessment. In this context, the study therefore opens for further research, where the different metric areas could be investigated separately, focusing more on depth KPIs and measurements to be included within each metric area. As mentioned within the limitations of this study, the perspective of costs could potentially create a field for further research, where frameworks for dealing with cost management and evaluation within transportation could be studied.

Beyond this, the current revised model with metric areas for assessing transportation performance presented in Graph 4 could be applied and tested on other case studies than ICA S-W. This could give additional insights into the model as well as making the overall results easier to generalise and discuss within other types of context than ICA S-W. In the situation of ICA S-W, further longitudinal studies and comparable analyses could also be an area for future research, where the results of this case study are compared with the results of a similar case study done in a few years' time. This could for example also include a study assessment of different implementations for aiding transportation performance evaluations, such as an employment of shared GPS- systems for generating deviation data which has previously been discussed within part 5.1.

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Appendix 1: Overview of ICA S-Ws supply chain and transportation network

The following section will give a brief overview of the supply chain network of ICA S-W. The information within this appendix has been developed through consultation with the different interview respondents of ICA S-W as well as by the researchers own knowledge and experience of working within the company.

As discussed in part 2.2, for ICA S-W, most of the grocery volumes originate from the main distribution centre in Helsingborg. Beyond the distribution centre of Helsingborg, ICA S-W have different transhipment centres located around their business region. The biggest one is the warehouse in Kungälv, which is sometimes referred to as another of ICA Sweden's main distribution hubs. Other transhipment centres of ICA S-W are in Växjö, Kalmar and Linköping. The transhipment centres are warehouses which are utilized to consolidate goods more locally and efficiently, before transporting them to the stores connected to these areas. In this context, it is important to note that the transhipment centres mainly handle the redistribution of goods with a certain level of temperature resistance and therefore not frozen goods.

Furthermore, ICA S-W transportation flow consists of four different scattering points separating the transportation planning, administration of transportation orders as well as cooperating haulers for the transportations. The main scattering point of Helsingborg includes “distribution” (Dist) of goods to the stores located closest to the warehouse but also “direct distribution” (DD) to different stores located further north. On this matter, distribution transportations can be illustrated as transportations which are going between the warehouses of the four different scatter points directly to the stores connected to that scatter point. On the other hand, direct distribution transportations are only being loaded within the warehouse of Helsingborg but going directly to the stores within the Kungälv area, without the process of unloading and consolidating at the transhipment centre in Kungälv. Accordingly, there is a difference between a distribution transportation and a direct distribution transportation. Both the distribution and direct distribution transportations handle common (non-refrigerated) goods, as well as refrigerated goods (not frozen). Additionally, ICA S-W has separate transportation flows for frozen goods. All these frozen transportations collect their goods from the warehouse in Helsingborg and deliver them directly to the stores around the south-west region. The scattering point of Helsingborg also includes intermediate transportation between the warehouse in Helsingborg and the different transhipment centres around the southwest region. The intermediate transportations are only moving goods between different warehouses and are therefore not involved within the process of delivering goods to any stores.

The second scattering point originates from the warehouse in Kungälv and is mainly concerned with distribution to different stores around this area. Subsequently, the transport loads have first arrived with an intermediate transportation from Helsingborg to Kungälv, then been handled and reconsolidated into other trucks before going out to the stores. In this context, the area of Värmland belongs to the Kungälv scattering point. The third and fourth scattering points are concerned with distribution from the Linköping respective Kalmar and Växjö transhipment centres. Similarly, within these transhipment centres, goods from the intermediate transportations from Helsingborg are being reconsolidated as new transportation orders and reloaded onto other trucks for delivery to the local stores. Accordingly, each of the transportation that operates from the second, third and fourth scatter point can be illustrated as "Distribution" transportations. The man exception to this system is distribution transportations to Jönköping. This transportation flow operates with transportations directly from the warehouse in Helsingborg out to the stores in the Jönköping area.

ICA S-W currently operates with eleven main hauler actors for their different transportation flows. However, as mentioned within the delimitation of part 1.4, the intermediate and distribution transportation flow of Linköping will not be covered in this study. Therefore, the specific hauler flows connected to these transportation flows will not be presented in this ongoing section. The ten remaining hauler actors are presented in the following table, separated between each flow that the haulers are conducting transportations in. Due to confidentiality, the different haulers will be illustrated with pseudo names.

Hauler company name	**Transportation flow**	**Type of transportation**
Hauler 1	Helsingborg (HBG)	Distribution
Hauler 1	Kungälv (KLV)	Direct distribution
Hauler 2	Helsingborg (HBG)	Distribution
Hauler 2	Kungälv (KLV)	Direct distribution
Hauler 3	Helsingborg (HBG)	Distribution
Hauler 3	Kungälv (KLV)	Direct distribution
Hauler 3	Värmland	Distribution
Hauler 3	Kungälv (KLV)	Distribution
Hauler 4	Kungälv (KLV)	Distribution
Hauler 4	Kungälv (KLV)	Direct distribution
Hauler 5	Kungälv (KLV)	Distribution
Hauler 5	Kungälv (KLV)	Direct distribution
Hauler 6	Kungälv (KLV)	Distribution
Hauler 6	Kungälv (KLV)	Frozen transportation
Hauler 7	Karlstad	Frozen transportation
Hauler 7	Skara	Frozen transportation
Hauler 8	Helsingborg (HBG)	Frozen transportation
Hauler 8	Kungälv (KLV)	Intermediate transportation
Hauler 9	Växjö	Distribution
Hauler 9	Kalmar	Distribution
Hauler 9	Växjö	Intermediate transportation
Hauler 9	Kalmar	Intermediate transportation
Hauler 9	Växjö	Frozen transportation
Hauler 9	Kalmar	Frozen transportation
Hauler 10	Jönköping (JKP)	Distribution
Hauler 10	Jönköping (JKP)	Frozen transportation
Hauler 10	Linköping (LKP)	Frozen transportation

Appendix 2: Interview guide

The interview starts with a description of the purpose of the research and the interview. The respondent is then being asked permission to publish their name and work title together with the empirical findings in the research paper. The interview continues with some general questions regarding the respondent position and work at ICA before the main questions of the interview are being asked.

Main questions:

Purpose of measuring transportation performance:

What is your general experience and knowledge with conducting any type of evaluation concerning ICAs transportation operations?
What main areas of transportation performance is ICA currently conducting evaluations on that you are aware of?
What do you think about the concept of measuring transportation performance?
How does ICA utilize the measurements of performance and for what purpose?

Routines for measuring transportation performance:

What type of routines are you aware of that ICA use to measure transportation performance? (separated from measuring areas, more detailed)
How do you think these routines illustrate an evaluation of transportation performance?
How many of these routines are you involved with, and can you explain them?
How do you conduct these routines?
What data do you use to facilitate these routines?
Could you explain how and where you extract this data?
What do you think about the specific routines that you are involved with?

Goal targets for transportation assessment:

What type of goal targets does ICA have when measuring transportation performance?
Where can these goal targets be located?
What do you think about the goals?
How are ICAs transportations operating in relation to the formulated goals?
What operational areas could be improved?

How is ICA following up the goals?

Areas for measurement:

What areas do you believe are the most important when evaluating transportation performance?
Do you believe that ICA could work more with evaluating transportation performance, and how?
Why are these important areas to measure?
What is impeding these evaluations or the development of such routines?
How could these evaluations be measured and with what data?
Where can this data be located and how?
What procedures could be taken to improve the performance evaluation process?

Appendix 3: Summary of transport data findings

Contracting hauler party	Inside time window arrival	Inside + before time window arrival	Arrival to distribution point	Dispatch from distribution point	Co2 emissions
Hauler 1 Disttribution Helsingborg	66%	92%	99%	94%	0,9875
Hauler 1 Direct distribution Kungälv	67%	97%	100%	97%	Missing data
Hauler 2 Distribution Helsingborg	75%	91%	99%	93%	0,342
Hauler 2 Direct distribution Kungälv	77%	91%	98%	93%	Missing data
Hauler 3 Distribution Kungälv	76%	89%	98%	94%	0,548
Hauler 3 Direct distribution Kungälv	83%	89%	99%	97%	Missing data
Hauler 3 Distribution Helsingborg	78%	96%	100%	98%	0,384
Hauler 3 Disttribution Värmland	75%	96%	100%	99%	0,34
Hauler 4 Distribution Kungälv	66%	95%	100%	98%	0,676
Hauler 4 Direct distribution Kungälv	52%	73%	97%	95%	Missing data
Hauler 5 Distribution Kungälv	65%	97%	99%	99%	0,83
Hauler 5 Direct distribution Kungälv	56%	100%	97%	84%	Missing data
Hauler 6 Distribution Kungälv	67%	95%	100%	99%	0,978
Hauler 6 Cold transportation Kungälv	58%	92%	100%	95%	0,842
Hauler 7 Cold transportation Karlstad	62%	92%	98%	89%	1,94
Hauler 7 Cold transportation Skara	83%	94%	97%	92%	1,94
Hauler 8 Intermediate transport Kungälv	No store impact	No store impact	92%	83%	0,845
Hauler 8 Cold transportation Helsingborg	60%	90%	96%	96%	0,73
Hauler 9 Distribution Växjö	78%	91%	Missing data	Missing data	0,838
Hauler 9 Distribution Kalmar	92%	96%	Missing data	Missing data	0,838
Hauler 9 Cold transport Växjö/Kalmar	90%	94%	95%	90%	1,35
Hauler 9 Intermediate transport Växjö & Kalmar	No store impact	No store impact	93%	79%	Missing data
Hauler 10 Distribution Jönköping	78%	91%	97%	96%	1,136
Hauler 10 Cold transportation Jönköping	59%	90%	99%	91%	0,936
Hauler 10 Cold transportation Linköping	62%	93%	92%	89%	0,936