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Empty container management in depots before and after outsourcing of container inspection

A flow and cost related comparison

Bachelor´s thesis in Shipping and Logistics

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Cover:

[Image illustrates a reach stacker lifting a container on a chassis inside a depot area (Photography). Available from: https://www.maxpixel.net/Construction-Site-Container-Pier-Crane-1156575 (CC0) https://creativecommons.org/publicdomain/zero/1.0/deed.en]

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Abstract

The purpose of this study is to assess the effects on the process of returning empty containers to depots in regards of if the inspection is performed in-house or outsourced to third-party actor located near the depot. This report is based on a case study that includes review of relevant literature, semi-structured interviews and a time study. Three semi-structured interviews have been conducted with representatives from key actors involved in the process of empty container returns to the depot, and a time study was carried out at the depot and container inspection site. Time measurements were carried out with a scientific proof smartphone application called Star Driver that record measurements made by the researchers. The measurements were then collected in an Excel sheet by Star Driver.

The studied depot operator's first arrangement consisted of an inspection of empty containers and administration at the gate to the depot. The in-house inspection meant longer turnaround time since the administration and inspection was performed by the same actor, which also led to a lower quality of the inspection. Turnaround time refers to the time from arrival at the gate of the depot until the truck exits the depot. The depot operator then introduced a new arrangement which meant that containers were inspected at a different location near the depot. As a result, from outsourcing, personnel with special training carry out the inspection that leads to both decreased inspection time and higher quality of the inspection.

The results demonstrate that an outsourced inspection could lead to shorter turnaround times and more efficient flows can be obtained. Additionally, an increased efficiency is achieved in the gate of the depot and for the inspection activity.

Key words: empty container management, empty container return, drayage, container inspection, road haulier operation, depot operation, disturbance cost, queuing time

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1 Introduction

The first chapter of the study contains relevant information with corresponding problematization. Section 1.1 describes the background and relevant terminology. Section 1.2 introduces the problem area under the scope of this study and some historical aspects of containers and containerization. Section 1.3 presents the purpose as well as the research questions to assess. Section 1.4 describes delimitations in regards of geographical area, resources for qualitative and quantitative data and parts assessed in the processes. Section 1.5 describes the outline of the remaining parts of the report´s structure.

1.1 Background

According to the Oxford English Dictionary (2018), transport is an organised operation of conveying persons or things from one location to another. Empty container management is a part of maritime transport, which carries the majority of transported cargo annually (Divall, 2012) and is considered the cheapest mode for transport of large quantities with a relatively short transit time (Bosneagu, 2016). Goods can be carried it a variety of goods carrier, e.g. a container. (Lumsden, 2012).

Since 1950, containers have been a venture to increase port efficiency in the aspects of time for loading and discharging operations in addition to decrease queuing for trucks delivering cargo to ports (Stopford, 2009). The venture was successful, and containerization of supply chains started to develop on a global scale (Stopford, 2009). The container plays a vital part in developing the global economy and creating global supply chains were production and distribution in different geographical areas became less of an obstacle (Notteboom & Rodrigue, 2008). Global supply chains meant production could be outsourced to areas closer to the raw materials or with lower production costs (Notteboom & Rodrigue, 2008). Furthermore, the industrial actors adapted dimensions on cargo, packaging and wrapping after the dimensions of the container to maximize utilization and transportability of cargo (Notteboom & Rodrigue, 2009)

Intermodal transport or intermodal freight transportation refers to a combination of two or more modes of transport when moving containers between shippers and consignees (Lowe, 2005). A container is a standardized goods carrier used in global transportation networks (Lumsden, 2012). The standardized dimensions of the container enabled it to be transferred between different transport mode thus increasing the mobility and making it easier to transport goods to remote areas (Lumsden, 2012). Containers have strongly influenced the development of global trade since 1950, both on the sea and inland (Jacks & Pendakur, 2010). Transfer of containers between transport modes is performed using various types of lifts or cranes e.g. straddle carriers, reach stackers, toplifter cranes and gentry cranes (Lumsden, 2012; Branch, 1986).

The road transportation within intermodal transportation is often referred to as drayage (e.g. the movement from the terminal or port to the consignee or the return of the empty container to the depot or terminal from the shipper) (Zhang, Won Young, & Kopfer, 2015). While performing drayage in intermodal freight transportation, disturbances can affect the transport planning. These disturbances can be caused by e.g. snow or high tides (Van Riessen, Negenborn, Lodewijks, & Dekker, 2015). Additionally, it can be caused by congestion and delays at terminals and ports resulting in increased transit time for trucks moving both loaded and empty containers (Ishfaq & Sox, 2012). Moreover, the disturbances can also affect additional costs that may occur due to delays and queuing. These costs can be referred to as disturbance costs (Van Riessen, Negenborn, Lodewijks, & Dekker, 2015).

Empty container management refers to the movement of empty containers, in global and regional levels (Braekers, Janssens, & Caris, 2011). The empty container return activity is part of empty container management at regional level and involves the movement of an empty container from the consignee's premise to an empty container depot or port terminal for storage (Olivo, Di Francesco, & Zuddas, 2013).

Depot or container depot refers to an area used for storage of empty containers when not in use, in either a terminal area or an inland area (Do Ngoc & Moon, 2011). Additionally, depots can offer container repair services (Theofanis & Boile, 2009). Furthermore, when a container has been returned to a depot it must be inspected before being reused for an export shipment (Palacio, Adenso-díaz, Lozano, & Furió, 2016). Inspection of empty containers is carried out to categorize and asses the quality or cleanliness of the container. Containers can be either operational and ready for reuse or damaged and in need of repairs (Pascual, et al., 2016). This study considers inspection carried out by the depot personnel and inspection outsourced to a company outside the depot area. Outsourcing in this aspect refers to moving an activity completely to another actor (Smogavec & Peljhan, 2017).

Actors, resources and activities involved in the return of empty containers to empty container depots are in this paper described using the industrial network approach (Gadde, Huemer, & Håkansson, 2003). Actors can refer to depot operators, road hauliers, container shipping lines, etc. Examples of resources can be container, trucks, reach stackers etc. Activities can be returning empty containers, inspecting empty containers etc.

The interphase between truck and depot when returning a stripped container from the consignee is investigated. Therefore, this study focuses on the effects of different locations for container inspection when transportation is carried out by truck. Different locations of inspection refer to two types of depots; one with inspection carried out "in-house" and one with inspection outsourced to another actor at an area located near the gate of the depot.

1.2 Problem area

Empty container management is an issue that has risen to attention more in later years (Braekers, Janssens, & Caris, 2011). Since the levels of supply and demand seldom are equal, it causes trade imbalances in import and export. Consequently, causing an over or under supply of empty containers available for stuffing. Moreover, trade imbalance can be caused by different requirements on container types for different kinds of cargo (Olivo, Di Francesco, & Zuddas, 2013). Container shipping lines handles this issue by repositioning empty containers to areas with higher demand. Repositioning of this kind is referred to as empty container management on a global level. However, empty container management on regional level can refer to the movement of empty containers to shippers for stuffing of export cargo. It can also refer to returns of empty import containers to depots from consignees (Braekers, Janssens, & Caris, 2011).

Moving the container by truck provides flexibility which cannot be provided to the same extent by train, vessel or barge. Thus, truck transportation is vital in offering door-to-door services. Although, many issues arise using trucks for container transport e.g. high costs, CO^2 emission and road congestion causing delays further on in the chain (Zhang, Won Young, & Kopfer, 2015).

Empty container management on a regional level, specifically the return of empty import containers to depot from consignees is the movement addressed in this study. The main issue is regarding the inspection of empty containers, where the inspection is located and if this, depending of type of arrangement, causes any disturbance. At the studied depot, before outsourcing the empty container inspection, the inspection was carried out just after the gate inside the depot operator's area which is shown in Figure 1. The arrangement caused issues for the depot operator who chose to move the inspection from the depot area to a third-party actor located nearby the depot, also illustrated in Figure 1. The outsourcing of the inspection leads to complaints from road hauliers who introduced a fee for, according to them an extra stop in the process of returning empty containers. This is said by the road haulier to have caused longer turnaround times and therefore the extra fee was introduced.

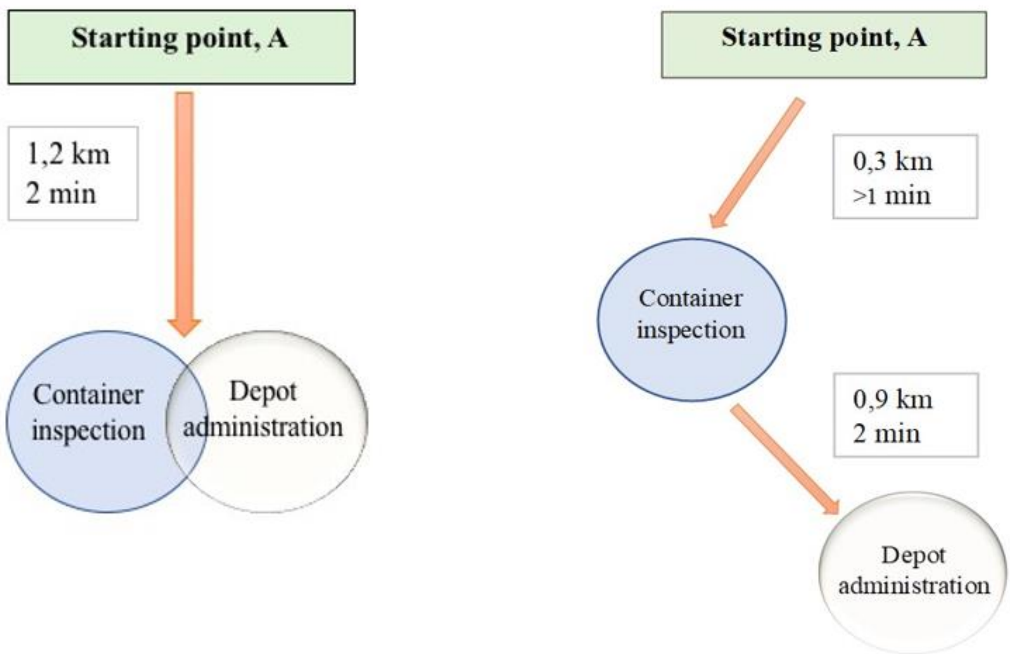

Figure 1 - illustrates previous (left) and current arrangement (right) of container inspection

1.3 Purpose and research questions

The purpose of this study is to assess the effects on the process of returning empty containers to depots in regards of if the inspection is performed in-house or outsourced to third-party actor located near the depot.

The study will identify the actors involved in the activity of returning empty containers at a depot and review which actors benefit and are disadvantaged from the different inspection solutions. Moreover, aspects motivating outsourcing of the inspection will be studied.

RQ 1: What actors and resources are involved in the empty container return activity before and after the outsourcing of the inspection?

After identifying the actors and resources involved in the empty container return activity, the effects from the outsourcing of inspection on the main actors will be assessed. Effects refer to impacts on costs and flows related to the actors that occur as a result of the inspection location. Location refers to if the inspection area is located on the depot area or at another actor´s area outside the depot to whom the inspection activity has been outsourced.

RQ 2: How are the actors affected by the location of the container inspection?

Moreover, an assessment will be made of if it is justifiable for road hauliers to charge a disturbance cost for returning at the depot with outsourced inspection performed outside the depots premise. If so, what amount is reasonable?

RQ 3: How can a disturbance cost for returning empty containers to the depot with outsourced inspection be justified?

1.4 Delimitations

The collection of qualitative and quantitative information from actors in this study has been limited to one depot, the container inspection company and one road haulier. Limitations of actors were made to enable comparing of different aspects and simplify the assessment in regards of the time frame of this project. Geographically, this study is limited to actors located by the same port. Hence, empty container returns are performed using the same routes and the basic freight is the same. Therefore, assessing cost and time of returning empty containers is more manageable.

Measured times retrieved during the time study are limited to individual activities in the inspection process and entering the gate of the depot. Individual moments inside the depot cannot be measured due to limited access to the area. Hence, depot activities will be presented with total turnaround times from entry to exit through the gate.

Furthermore, the study is limited to an assessment of the arrangement of outsourcing to a third party and the effect on flows, time and each actor involved. Hence, the arrangement will not be assessed as a preparatory measure for future projects and rebuilding of the depot or terminal.

1.5 Structure of report

Chapter 1 provides background for the report with an introduction to empty container management, problem area and the research questions.

Chapter 2 describes the methods and actors interviewed for the qualitative study and methods to describe the time study. Moreover, chapter 2 describes costs related to operating a truck and truck driver.

Relevant literature and prior research for understanding the findings in this study can be found in chapter 3. Information regarding how empty container management works together with a presentation of the Industrial Network Approach and Key Performance Indicators are found in chapter 3.

Results from the time study, semi-structured interviews and personal observations from the time study are presented and discussed in chapter 4. The results and discussion consider how empty container returns were performed before the outsourcing of inspection and how empty container returns are performed now. Moreover, the measured times are presented and compared to the cost allocation.

Chapter 6 presents the conclusion and answers to the research questions. Additionally, suggestions to future research are given.

2 Research design

This chapter describes the participating actors and the methods used to gather and analyse data. Section 2.1 describes the participants by using the industrial network approach. Section 2.2 describes what methods and applications that have been used for the time study. Section 2.3 describes the research quality of this study.

2.1 Participants

The participants in this study include one road haulier, one depot operator and one container inspector. In Table 1, all participants (i.e. the actors) are described by using the industrial network approach and named Road Haulier, Depot Operator and Container Inspector. The resources for each actor include personnel, major- and smaller handling equipment or trucks. The activities describe what type of work each actor performs.

Table 1 - Illustrate the actors, resources and activities in this research work.

Actors	Resources	Activities
Road Haulier	Employees, Trucks, Chassis	Container transport
Depot Operator	Employees, Reach Stackers	Container storage, reparation
Container Inspector	Employees, Reach Stackers	Container inspection, reparation

Note: (Jacobsson, Arnäs, & Stefansson, 2017) *Adapted with permission.*

The Depot Operator was selected as their routine for container inspection changed which (according to road hauliers) led to longer queues and handling time. Additionally, the Depot Operator is the largest depot operator near the selected port. The Container Inspector is linked with the Depot Operator and is therefore a crucial actor within the study. No other container inspector exists near the studied port. The Road Haulier was selected based on their size and regular traffic at the selected Depot Operator and Container Inspector. The Depot Operator also provided statistical data of turnaround time of all road hauliers entering the depot. The Depot Operator also serves as a major terminal operator for the same port.

2.2 Methods

This report is based on a case study and includes both quantitative and qualitative research. Case studies are primarily used to conduct small but detailed research and allow for the researcher to use several resources and methods (Denscombe, 2009). When using more than one research method for a study, this is referred to as triangulation (Denscombe, 2009). Using triangulation allows the researcher to compare results from different methods and if the results are similar, it strengthens the results. (Denscombe, 2009). Triangulation *within* methods is primarily used to analyse qualitative data and is useful to strengthen one method’s result if another similar method displays the same results. Triangulation *outside* methods is primarily used to confirm or question results by applying a different method and compare to the first result. Triangulation gives the researcher another perspective of the results and strengthens the understanding (Denscombe, 2009).

The report’s research work was carried out in the following order: literature study, semi-structured interviews and empirical studies. In the literature study, four major areas are presented: Intermodal Freight Transportation, Empty Container Management, Industrial Network Approach and Cost and Time performance as Key Performance Indicators (KPI). To obtain literature material, different databases where searched such as Google Scholar, CHALMERS Lib and ProQuest. Main keywords used to find relevant articles were “empty container management”, “drayage”, “Container Depot”, “Disturbance costs” and “terminal container management”.

Interviews are semi-structured which implies that the interview is based on a structured list of predetermined questions and subjects (Denscombe, 2009). Also, it means that the interviewer is adaptable in regards of line of questioning and allows the interviewer to develop their own ideas regarding the subject (Denscombe, 2009).

The empirical studies consist of both qualitative and quantitative data. The qualitative data consists of three semi-structured interviews (One with the Road Haulier, one with the Depot Operator and one with the Container Inspector). The interviews were made with each actor to establish a wider perspective and ensure an independent status of the report. Interview questions can be found in Appendix I, Appendix II and Appendix III. The quantitative data consists of time measurements and observations made by the researcher during the time study. Time measurements were conducted both at the Container Inspector and Depot Operator. To perform the time study, a scientific based smartphone application named Star Driver developed by Prockl and Sternberg was used (2015). At the Container Inspector, measurements of possible queue time and inspection time were conducted, while at the Depot Operator, queue time and administration time was measured. Data was collected for Excel with the smartphone application and then analysed and summarized. Time measurements were conducted during one work week (Monday – Friday) by two researchers between 09:00 – 17:00 divided into shifts of one hour on each point (e.g. 09:00 – 10:00 at Container Inspector, 10:00 – 11:00 at the Depot Operator). Participant observations were made at the time of conducting the time study at the different actors.

2.3 Research quality

By using multiple methods, triangulation of the results is possible and that gives the authors the possibility to compare and analyse the results from different angles. Therefore, this report uses literature studies, semi-structured interviews and empirical studies to justify the results. Due to the wide range of used methods the report´s reliability and validity increases. Although using multiple methods do not guarantee that there might be errors and incorrectness. All sources are revived and assessed regarding authenticity, reliability, representativeness and content before considering them in the report. In some cases, sources need to be included even though there are lacks objectivity e.g. the time measurements provided by the Depot Operator. Those exceptions are limited as far as possible and sources that lacks too much reliability or objectivity is to be put away even if they were considered to be important for the report.

The same procedure is implemented in regards of the interviews. Conducted interviews are reviewed in terms of reliability and plausibility and are then followed up by personal observations for confirmation. When the conducted interviews with the Depot Operator, Container Inspector and Road Haulier are followed up by observations at the study location, the general perception is that interviews are in a large extent correct. As a result, the interviews can be considered to be reliable and comprehensive.

As mentioned earlier, one issue was to perceive multiple trucks simultaneously during time measurements. The inability to measure more than two trucks might affect the results and by allowing for time measurement of all the participating trucks during the selected period, this could lead to more accurate results. Another issue is when comparing the provided data from the Depot Operator with the measured data. Data from Depot Operator is based on the full opening hours (06:00 – 21:00) while the time measurements were conducted during part of the day (09:00 – 17:00). The different time frames were considered to have little or no effect on the results as both personnel at Container Inspector and interviews indicates busiest hours between 08:00 – 18:00.

3 Review of relevant literature

This chapter presents relevant background information and terminology about intermodal freight transportation and empty container management. Furthermore, the industrial network approach is described and how it can be used to describe the actors, resources and activities that are involved in intermodal freight transportation.

3.1 Intermodal freight transportation

Intermodal freight transportation occurs when an intermodal transport unit (ITU) is transported from location A to location B using different transportation modes. Different transportation modes can be container vessels, railways, barges, aircrafts and trucks depending on where the transport is requested (Jonsson & Mattsson, 2011). When two or more transportation modes are used, ITU´s are crucial to maintain the effectiveness of the system. Therefore, the container as an ITU is considered a suitable option as it is easy to transfer between transportation modes and provide a good protection for the cargo (Jonsson & Mattsson, 2011). Specific cargo handling gear is needed to load and discharge containers between different transportations modes. Special handling gear of this kind is located at cargo terminals where the shifting between transport modes occurs, e.g. container depots and railway- and sea-traffic terminals (Jonsson & Mattsson, 2011).

3.1.1 Containers

Intermodal transport units, which include containers, is important for the intermodal transport network to maintain effectiveness and competitiveness against other transportation alternatives (Viorela-Georgiana & Cristian, 2016). Common container types which are subject to this study are twenty-foot and forty-foot containers. One twenty-foot container equals one twenty-foot equivalent unit (TEU) and one forty-foot container equal one forty-foot equivalent unit (FEU) or two TEU. The forty-foot container also includes high-cube versions which have an increased height compared to the original FEU (Rajendran, 2014). Containers are the most commonly used ITU and due to its effectiveness, different types of containers have been developed over time (Viorela-Georgiana & Cristian, 2016). Therefore, this work focuses only on the flows of containers (and not other types of ITUs).

3.1.2 Container truck transportation

To cover the transportation of both loaded and empty containers, trucks are often required to perform the first and last part of the transport chain due to its ability to reach destinations located in remote areas (Lumsden, 2012). Truck transportation of containers is carried out in different ways depending on size and weight of the transported containers. Local and regional road restrictions, loaded or unloaded containers and type of container are examples that affects the choice of chassis. Facilities at loading and discharging destination also affect the type of container chassis chosen (Lumsden, 2012). To be precise, there are three types of chassis or interconnectors to transport containers by truck:

- Regular chassis. Transports 1 FEU or 2 TEU (Vanhool, 2018)

Figure 2 - 2 TEU (Tech. Sgt. Eric Petosky)

Figure 3 - 1 FEU (Lee Bristol)

- Link chassis: Transports 1 FEU + 1 TEU or 3 TEU (PNO, 2018)

Figure 4 - 2 TEU (Teppo Lainio)

- Self-loading trailer (SIMA): 1 FEU, 1 TEU or 2 TEU (HAMMAR, 2018)

Figure 5 - SIMA (Sludge G)

3.2 Empty container management

Empty container management refers to the handling of empty containers on different levels. Levels refer to global or regional (Braekers, Janssens, & Caris, 2011). In addition to empty container management on a global or regional level, it can also be referred to as maritime repositioning (global level) and inland repositioning (regional level) (Olivo, Di Francesco, & Zuddas, 2013). These two different levels are further described in the two sub-sections below.

3.2.1 Empty container management – global level

Global empty container management is applied due to imbalances in supply and demand of containers or demands of different types of containers e.g. size, purpose or quality. The movements of empty containers to counter imbalance represents 20% of the global container movements (Braekers, Janssens, & Caris, 2011). Reasons for imbalances can for example be that areas export more than what is imported (Pérez-Rodríguez & Holguín-Veras, 2014), or areas import commodities more suitable for 20-foot containers and export commodities more suitable for 40-foot containers (Braekers, Janssens, & Caris, 2011). From a container shipping line’s perspective empty container management generates no revenue and is instead movement of container to areas closer to shippers and potential revenue. Therefore, container shipping lines intend to minimize the empty container handling to reduce the re-positioning cost (Braekers, Janssens, & Caris, 2011). Repositioning on a global level is performed using container vessels, where empty containers are loaded together with full containers. Thus, empty containers use slots that could have been used for paying containers (Di Francesco, Crainic, & Zuddas, 2009). The most complex activity in global empty container management is planning and forecasting. Predicting future demand of containers is difficult and could result in over-supply causing extra storage costs at terminals and depots or under-supply resulting in not being able to fulfil customer demand (Di Francesco, Crainic, & Zuddas, 2009).

3.2.2 Empty container management – regional level

Regional empty container management often refers to the last movement in intermodal freight transportation of containers in door-to-door shipments, where empty containers are returned to depots or moved to shippers for exportation (Olivo, Di Francesco, & Zuddas, 2013). Moreover, containers can either be returned to a depot for storage in the hinterland of a port or directly to the port depot for global repositioning (Braekers, Janssens, & Caris, 2011). Furthermore, regional empty container management can refer to repositioning of empty containers between inland depots, port depots or port terminals to decrease empty container imbalance (Braekers, Janssens, & Caris, 2011). Imbalance of empty containers at a regional level is often the result of trade imbalances in export and import among businesses and industries in the region. For example, if an area is high in import and low in export, the area can be assumed that there will be a surplus of empty containers in the depots in that area (Olivo, Di Francesco, & Zuddas, 2013).

According to existing research, it can be assumed that the majority of regional empty container management is carried out via trucks (Braekers, Janssens, & Caris, 2011). The average distance of regional repositioning has increased (Mittal, Boile, Baveja, & Theofanis, 2012). Historically businesses and industries have been located close to the port, but lately businesses and industries have been located further into the hinterland due to spatial issues and land cost increases in areas near the ports and depots (Mittal, Boile, Baveja, & Theofanis, 2012).

3.2.3 Depot

Depot refers to a storage facility for empty containers, where the company operating the depot can offer services such as cleaning, repairs and inspection of the empty containers for the owners/leasers of the containers. (Zhang & Wirth, 2012; Theofanis & Boile, 2009). An important aspect of the depot is the location. Depots can be located in the close area of the port or in the hinterlands which is known as an inland depot (Mittal, Boile, Baveja, & Theofanis, 2012). In the aspect of empty container management, there can be different reasons for the location of the depot. Inland depots can be located closer to the consignees to decrease the distance for empty container returns. However, an inland depot can also be located near potential shippers to increase accessibility of empty containers. Disadvantages of inland depots are imbalances in supply and demand of empty container. Such imbalances cause the need for repositioning that is geographically more demanding than repositioning empty containers from a depot near the port (Braekers, Janssens, & Caris, 2011)

Inside the depot, the depot operators face different challenges such as planning of container stack regarding customers and container type; movability for reach stackers and trucks; area of repairs and container types that are in need of special equipment (e.g. refrigerated containers that require electrical supply) (Pascual, et al., 2016).

3.2.4 Interphase between truck and depot when returning empty containers

The interface between truck and depot refers to when a truck returns an empty container from the importing consignee to the empty container depot. The depot is where the container shipping line store their containers until the next shipper pick up a container for exportation, or the container shipping line decides to reposition the container (Palacio, Adenso-díaz, Lozano, & Furió, 2016). The process for road hauliers when returning empty containers can differ between various empty container depots. For example, Pascual, et al., (2016) performed a case study of an empty container depot in Valparaiso and identified the following activities in the process.

- Trucks arrive at the gate to be cleared for entrance to the depot area.
- After clearance the truck stops at the inspection zone, where toplifter cranes lift off the empty containers from the truck chassis.
- After the container has been lifted off, it is inspected and categorized as operational or damaged depending on its state.
- Toplifter cranes move operational containers depending on their status. If the containers are ready to be reused they will be stacked and if the containers are damaged they will be moved to the maintenance area for repairing.
- Trucks leave the premise, after the container has been lifted of, either empty or with an empty container to be delivered to a shipper.
- After repairs of a damaged container, the toplifter crane is used to move the repaired container to the stacks of container ready for reuse

Moreover, the lift off in the interphase between truck and depot can in addition to the toplifter cranes be performed using a reach stacker that has a similar area of usage compared to the toplifter crane (Branch, 1986). Furthermore, both toplifter cranes and reach stackers are categorized as fork lift trucks with an attachment to lift the containers from the corner castings. Attachment refers to the utility mounted on the mast e.g. forks or similar utilities. The main difference between toplifter cranes and reach stackers is that the toplifter crane has a fixed vertical mast for the attachment and the reach stacker has a horizontal telescopic mast for the attachment (Branch, 1986).

3.3 Industrial Network Approach

The industrial network approach can describe a system as a network with three different states: actors, resources and activities. The network consists of interconnections between different business relationships, either relations which constitutes over a long period of time or more spontaneous relations (Gadde, Huemer, & Håkansson, 2003). Business relations can be sorted into two categories: Business in theory and business in practice. Business in theory mainly describes independent companies that operates as individuals and driven by competitors. While business in practice comprises interactions with others. (Jacobsson, Arnäs, & Stefansson, 2017). Below actors, resources and activities are briefly described:

- Actors are people or organisations within the network whose purpose is to increase the control of the network (Håkansson, 1987).
- Resources are owned by actors and used in the network (Håkansson & Snehota, 2006). Resources can be trucks, drivers or equipment (Jacobsson, Arnäs, & Stefansson, 2017).
- Activities refer to operations performed by actors in the network, using resources in some way (Jacobsson, Arnäs, & Stefansson, 2017).

The industrial network approach can be used to describe intermodal freight transportation and other logistical systems. The approach has the advantage of handling the exchange of products and services between two organisations and how they organise their information and goods flow. Due to its competitive description of relationships between organisations in a network, the approach can help to identify sources that both produce and collect information (Jacobsson, Arnäs, & Stefansson, 2017). Therefore, the industrial network approach is used in this work to describe involved actors, resources and activities in returns of empty containers at empty container depots.

3.4 Outsourcing

The term outsourcing is generally used to describe an actor who seeks services currently performed in-house to be provided by other external actors (Brcic-Stipcevic, Renko, & Renko, 2006). Outsourcing can also mean to transfer certain activities to specialised actors in a certain segment to improve quality of the activity. This has been part of a trend towards outsourcing non-core activities to external actors (Logozar, 2008).

Outsourcing non-core activities is a proven business strategy to enable resources to focus on core activities and internal processes. It also spreads risk and enables the company to achieve a higher quality and service toward their customers (Logozar, 2008). Outsourcing activities to a third-party actor comes with both advantages and disadvantages.

Advantages can be less capital bound in resources; instead the third-party actor suffers the capital bindings (Razzaque & Sheng, 1998). Moreover, if the payment terms between the outsourcing actor and the third-party actor are on variable cost basis the outsourcing actor avoids fixed costs in resources and may better adapt to market fluctuation e.g. if demand is lower the outsourcing actors pays less to the external actor (Razzaque & Sheng, 1998). Furthermore, outsourcing activities can reduce or re-locate resources to enable better turnaround times and easier coordination of remaining activities (Razzaque & Sheng, 1998).

Disadvantages with outsourcing might occur in form of less control over the activity resulting in e.g. lowered quality. Causes for lowered quality can be caused by insufficient experience in the third-party actor employees or sub-standard contractors employed by the third-party actor (Razzaque & Sheng, 1998).

3.5 Cost and times as key performance indicators

The report uses two main factors as key performance indicators (KPI), namely time and cost. This section describes what time and cost refer to what KPI´s, respectively, and how time and cost are used in the time study and assessment of activities.

3.5.1 Time

Time as a key performance indicator for empty container management on a regional level can be used for the turnaround time and the time of individual actives in the return process (Ishfaq & Sox, 2012). Turnaround time, also known as total shipment time, is the sum of the transit times and hub time (Ishfaq & Sox, 2012). Transit time refers to the time that elapses when containers are moved between depots or terminals (Ishfaq & Sox, 2012). Hub time refers to the handling or storage time in terminals or depots (Ishfaq & Sox, 2012). Studying the time for performance of various activities enables an overlook of where in the chain optimization is necessary to decrease the turnaround times (Ishfaq & Sox, 2012).
The time study performed for this report will assess the turnaround time consisting of queuing at inspection gate, queuing to the depot gate, inspection time and administration in the depot gate.

3.5.2 Cost

Costs refer to additional cost that occurs due to disturbances (i.e. disturbance costs). Disturbance costs are costs that might occur from events that are not under the actor’s control (Van Riessen, Negenborn, Lodewijks, & Dekker, 2015). Disturbance costs are therefore additional fees for freight payers and are not agreed on before the haulage commence. Disturbance costs can be influenced by weather, congestion or queuing (Van Riessen, Negenborn, Lodewijks, & Dekker, 2015).

Costs considered in this study were disturbance costs caused by queuing and the location change for the inspection.

3.6 Cost allocation for trucks

To be able to compare and analyse potential queuing time and the cost for the time, the cost allocation for one individual truck needs to be examined. The Swedish government ordered in 2014 a report regarding the cost allocation for trucks that perform service in Sweden (WSP Sverige AB, 2014). As there are many different nationalities performing transportation services in Sweden, the most reoccurring nationalities are selected in the report. The report only addresses trucks that can connect trailers in different set-ups such as regular chassis, SIMA and link chassis (WSP Sverige AB, 2014). Both fixed- and variable costs are examined and summarized in Table 2.

Table 2 - Describes costs for trucks in four countries. (WSP Sverige AB, 2014)

Truck costs	**Sweden**	**Poland**	**Estonia**	**Czech Republic**	**Cost**
1. Vehicle costs					
1.1 Fixed costs	**141 267**	**118 557**	**99 914**	**124 403**	**SEK/year**
Depreciation	30 631	23 685	23 685	23 685	SEK/year
Interest	22 804	24 427	17 647	17 647	SEK/year
Vehicle fees	9 991	6 676	6 055	7 594	SEK/year
Road fees	10 591	10 591	10 591	10 591	SEK/year
Insurance	30 000	35 451	21 936	13 738	SEK/year
Other costs	37 250	17 726	20 000	51 147	SEK/year
1.2 Variable costs	**51,72**	**41,27**	**43,71**	**45,48**	**SEK/10 km**
Depreciation	7,07	5,47	5,47	5,47	SEK /10 km
Tires	2,89	1,90	2,01	2,01	SEK /10 km
Service and reparation	5,70	2,05	3,71	3,13	SEK /10 km
Gas	36,07	28,66	32,53	30,57	SEK /10 km
Other costs	0,00	3,19	0,00	4,29	SEK /10 km
2. Driver costs	**625 098**	**359 836**	**244 241**	**216 706**	**SEK/year**
Wages and compensations	456 749	310 969	163 372	155 904	SEK/year
Social fees	168 350	48 867	80 869	60 802	SEK/year
3. Summary	**Sweden**	**Poland**	**Estonia**	**Czech Republic**	**Cost**
1. Vehicle costs	**813 687**	**655 015**	**668 183**	**715 627**	SEK/year
1.1 Fixed costs	141 267	118 557	99 914	124 403	SEK/year
1.2 Variable costs	672 420	536 458	568 269	591 224	SEK/year
2. Driver costs	**625 098**	**359 836**	**244 241**	**216 706**	SEK/year
Total costs /year	**1 438 785**	**1 014 851**	**912 423**	**932 333**	**SEK/year**

To be able to calculate cost per minute for one single truck, costs per year have been converted to costs per minute. According to the Swedish Agency for Governmental employees, the total number of working hours in 2018 is 1975, 5 hours (Huhtamaa, 2017). 1975, 5 hours is based on a regular full-time office job with an average of 8 hours per working day. It is likely that truck drivers work different hours than the calculation is based on, but the total number of hours worked should not differ according to Transportstyrelsen (2018). Those numbers, together with the combined costs in Table 2 results in a cost distribution per minute presented in Table 3. The average cost per minute to run a truck including driver, gas and other costs is 9,1 SEK and based on the most reoccurring driver nationalities in Sweden.

Table 3 - *Describes costs for trucks operating in Sweden. Data retrieved from table 2.*

Working hours in Sweden 2018 - 1975,5			
Country	**Total cost**	**Cost/h**	**Cost/min**
Sweden	1 438 785	728,3	12,1
Poland	1 014 851	513,7	8,6
Estonia	912 423	461,9	7,7
Czech Republic	932 333	471,9	7,9
Total	**1 074 598**	**544,0**	**9,1**

4 Results and discussion

This section presents and describes the collection and analysis of gathered data from both the time study, interviews and participant observations. In section 4.1, RQ 1 is answered and discussed in the perspective of Industrial Network Approach. Section 4.2 address RQ 2 including time measurements and section 4.3 address RQ 3 which covers possible justification of disturbance fee.

4.1 RQ 1: What actors and resources are involved in the empty container return activity before and after the outsourcing of the inspection?

This section presents the findings for RQ1 by showing actors, resources and activities before and after the Depot Operator outsourced the inspection.

4.1.1 Prior outsourcing of inspection

Actors

The empty container returns mainly revolved around two actors, namely the Depot Operator and the Road Haulier.

All actors are located within a 5 km radius around the port area. The site is a typical port with associated business such as storage, road hauliers and depots. Figure 6 illustrates the previous arrangement with the container inspection at the same site as the container depot. Therefore, the figure only demonstrates the range from measuring point A which has been used as starting point.

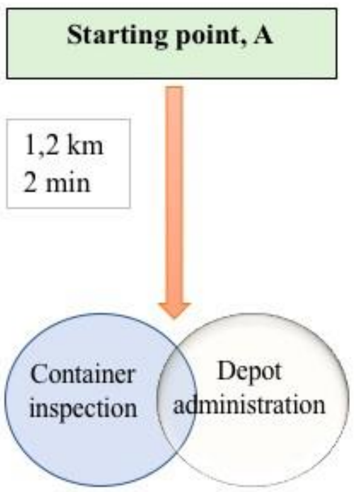

Figure 6 - Site description prior outsourcing.

Resources

Resources of the Depot Operator (used for the return activity) were the gate function and its personnel, inspection utilities, inspection personnel, reach stackers and its drivers. Further resources of the depot operation were reparation utilities and reparation personnel handling damage containers, other lifts and trucks used to move container within the depot and administrative personnel like dispatchers and supervisors.

The road haulier's most relevant resources involved in the activity were trucks, trailers and the truck drivers. These resources are physically involved in the return activity. Moreover, the Road Haulier used mainly traffic planners and sales personnel, whose function are to arrange haulage and obtain future haulage/business.

Activities

When a truck arrives at the depot with an empty container, the first step is to gate-in. Prior to passing through the gate waiting time often occurs due to queues. When arriving to the gate, the truck driver parks the truck and enters the depot administration where the truck driver's ID and the owner of the empty container are checked. Then, the Depot Operator determines what stack the container shall be placed in. Prior arrival, the Road Haulier must send a pre-arrival notification to the Depot Operator in order to get approval for gate-in. After completing the control, the truck driver receives a ticket/card used to pass through the gate at entry and departure.

Directly after the gate, the inspection area is located. At the inspection area, the truck driver parks the truck and waits for the inspection. Queues are common during rush hours that in turn also affect the gate-in process and causes queues outside the gate. The reason behind the queues is due to the small parking and waiting area at the inspection site. The inspection is performed by depot personnel, who commonly have other duties with the depot operations (e.g. reach stackers or reparation). Hence, high work load with reach stacks can cause personnel shortages at the inspection and vice versa. The quality of the inspection varies therefore depending on different factors (e.g. weather, work load and experience of the inspector). The inspection is sometimes an ocular assessment of the outside of the container, or an ocular assessment of the outside and an inspection of the inside using a flashlight. Depending on the outcome of the inspection, the truck driver is informed where the discharge is to be performed. For example, operational containers are to move to the stacking areas and the damaged ones to the reparation areas.

The next step in the return activity is the discharge of containers at the container storage area. Trucks are queueing in different lanes depending on where the container is destined. High workload on the reach stack drivers can cause long waiting time for truck drivers before being discharged. The reach stack driver discharges the container and places it in the container owner's designated stack. Moreover, before commencing the next discharge, the reach stack driver commonly needs to pick up another empty container that the discharged truck driver is loading for his/her next haulage.

The final step in the return activity is gate-out from the depot. The process of gate-out is similar to the gate-in. If the truck driver gates-out without a loaded empty container he/she needs to pass through by using the card/ticket received before entering the depot. If the truck driver gates-out with an empty container, he/she is obligated to park the truck at the gate and then to enter the depot administration where the loaded empty container is registered in order to inform the container shipping line that their container has left the depot.

For different trailer types, the return activity differs slightly. The return of chassis is performed previously described. The return of empty containers follows not the same extent due to difficulties of entering the container for inspection. The reason behind these difficulties is due to blocking doors. The return activity of containers using SIMA is that the containers are not inspected due to the cranes arms that block the door to the container. Furthermore, since SIMA is equipped with cranes, it enables truck drivers to discharge inside the depot without assistance from a reach stack. Truck drivers using SIMA are therefore using a separate lane at the gate and inside the depot to avoid waiting time.

4.1.2 After outsourcing of inspection

Actors

The new arrangement meant that a new main actor was introduced to the network, compared to the old arrangement for empty container returns, namely the Container Inspector.

Inspection prior to outsourcing to a third party was considered insufficient and of varying quality according to the Depot Operator. The aim of the new inspection solution is to continuingly deliver high quality inspection. The Container Inspector is operated as a joint venture between two companies with experience of empty container repairs and cleaning. Moreover, the Container Inspector is well-equipped with utilities for inspection and small repairs of the empty containers. Thorough inspection prior to entering the depot mean that the truck drivers are prepared for where to go and the gate personnel can direct them to the designated areas for either operational or damaged empty containers. Thus, eliminating unnecessary reach stack lifts inside the depot as well as moving around the empty container inside the depot. Moreover, the small repairs and services offered by the Container Inspector decreased the number of rejected empty containers since the Container Inspector can fix damages and odours. Thus, increasing the number of empty containers ready for instant loading and decreasing idle time spent for waiting on repairs and cleaning inside the Depot Operator. More thoroughly inspected empty containers are beneficial for the Depot Operator since empty containers are categorized as operational or damaged thus reducing moving and lifts of containers. Moreover, the Depot Operator can release empty containers to truck drivers sooner after the container arrived than before. The Road Haulier benefits from well-inspected container since the truck drivers often are asked to inspect containers upon release since some customers request special grades of cleanliness due to cargo sensibility. Hence, the Road Haulier is less exposed to the risk of customers rejecting containers upon delivery after loading at the depot.

Repairs and services performed by the Container Inspector other than the primary activity to inspect the empty containers may be questioned. Since the Container Inspector approve or rejects empty containers it gives concern whether the inspection is performed impartially. Instead, the personnel performing the inspection have the possibility of finding faults which otherwise might not be considered as damaged to increase revenue from repairs performed. Furthermore, the Container Inspector only documents repairs, services and measures taken to fix the issue in writing. Damages, litter and other issues are not documented with photos at this moment. Therefore, it is difficult to prove that actual damages in need of measures were found if the owner of the container request evidence or grounds before paying the invoice. Photos were taken for one container shipping line, for compensation at the time of the time study. However, it should be considered that all repairs and services should be documented using photos as grounds for invoice and as proof in case of claims against the Container Inspector.

Resources

As a result of outsourcing the inspection, the Depot Operator's resources designated for inspection were re-assigned to other activities related to depot and terminal operations.

Resources used by the Container Inspector are inspection personnel, one reach stack, ladders, inspection utilities and reparation utilities.

Resources of the Road Haulier are the same as before the inspection was outsourced. However, the return activity has been changed which resulted in an added disturbance cost by the Road Haulier for the transport buyer. Below, Figure 7 illustrates the current arrangement with outsourced inspection.

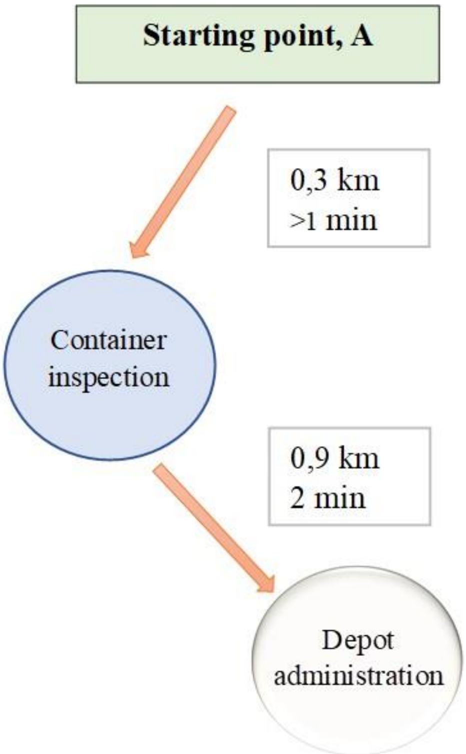

Figure 7 - Site description after outsourcing.

Activities

Before returning to the depot the truck driver must pass through the Container Inspector to inspect the empty container. No pre-arrival notice is necessary to the Container Inspector and the truck driver may drive through the open gate and park at the inspection area or wait in queue if other trucks are being inspected. The inspection area is divided into three lanes, two for inspection of chassis and one for inspection where lifting off and on the empty container is required. After parking in the designated lane, the truck driver exits the truck and the inspection commence.

Chassis loaded with one empty container are inspected using ladders with wheels. The inspector climbs up the ladder and opens the container doors. The inspector enters the container and inspects the inside for damage, litter, odours and nails. Then the doors are closed to see if there are holes in the container letting in light. Afterwards, the outside is inspected for dents and hazardous cargo labels not removed. Furthermore, the door hinges are checked for damage. If door hinges are not locking properly it must be repaired, otherwise the container cannot be shipped via rail since the high speed and shaking can unlock the doors during transport.

SIMA, link and chassis loaded with two 20-foot containers require a lift by reach stack since the container cannot be inspected. After the container is lifted and is in reachable height, the same procedure as for chassis is commenced. When the container is inspected the reach stack is used to lift on the container again.

When a container passes inspection, it is sealed using an orange seal and the truck driver receives a green stamp on a paper form to be shown at the Depot Operator gate. If the container doesn't pass the inspection due to damage or odour the container is not sealed, and the truck driver receives a red stamp on the form to be shown at the Depot Operator gate.

The Container Inspector offers an additional service for the owners of the container for quick repairs of damages on the container. Quick repairs services are provided to quickly repair damages that cause the container not to pass the inspection. Examples of quick repairs are dent removal, odour removal, door hinge repairs and sweeping the inside of the container. As a result, the container shipping lines can avoid additional charges for lifts and repairs from the Depot Operator since the container passed the inspection. The additional charge from the Container Inspector is less than what would have been charged by the Depot Operator since no additional lifts of the container is required.

When the inspection is completed, the truck driver continues to the gate of the depot. The process is similar to before the outsourcing of the inspection was performed. Firstly, if there are trucks being administrated before, the truck driver must queue. When arriving at the gate, the truck driver exits the truck and enters the depot administration for clearance. Prior administration the Road Haulier must have sent pre-arrival notice to the Depot Operator for the truck driver to be approved gate-in. However, in addition to former controls in the depot administration (e.g. ID-check and issuing tickets), the inspection form is checked. There are two reasons for checking the inspection: firstly, to confirm that the empty container has been inspected. Secondly, to refer the truck driver to the correct area for this container depending on if the container is operational or damaged.

After passing through the gate the truck driver continues to the designated area depending on where the container is being stored. Queuing might occur depending on how many trucks are being discharged or loaded at the depot. When a reach stacker has discharged the container, it is moved either to the container owners designated stack or the reparation area depending on if the container passed the inspection. Trucks with SIMA discharge by own machinery at a designated area like before. When the container is discharged the truck driver either loads an empty container for the next haulage or continues directly to the depot administration for gate-out.

Gate-out is carried out as before the inspection was outsourced. For trucks without empty containers the ticket is shown at the gate and passes through. Trucks loaded with another empty container must exit the truck and register the loaded empty container in order for the

Depot Operator to inform the container owner that the container has been loaded and left the depot.

4.2 RQ 2: How are the actors affected by the location of the container inspection?

This section aims to show how actors involved in the study are affected by the location of the container inspection. Also, it provides information regarding common issues causing delays, reasons for outsourcing the inspection and results of time study.

4.2.1 Common issues causing delays

Interviews with the Depot Operator and Road Haulier identified several common issues causing delays in the empty returns. The different actors view on the largest issues varies.

The Depot Operator identified the most common cause of issues at the gate and inside the depot area as truck drivers with a lack of language skills in Swedish and English. Not being able to explain and refer the truck driver to the correct area or explain that they must pass through the inspection area before entering the depot causes delays in the gate and in the depot area. Furthermore, the Depot Operator explained the issues with containers owned by leasing companies that has been leased to a container shipping line. Leasing companies can lease containers to several different container shipping lines that in turn, complicates the work for the Depot Operator with identifying which stack the container should be stored in and who to bill for reparation work. The Road Haulier is responsible for informing the truck driver before whose container it is. Moreover, more uncommon issues identified are truck breakdowns in the depot, in the queue or inspection area as well as IT system breakdown at the Depot Operator making it difficult for the Road Haulier to send pre-arrival notice and for the truck drivers to gate-in.

According to the Road Haulier the most common cause of delays are queues at the gate and inside the depot. Many trucks arriving at the same time or low productivity by the Depot Operator cause congestions and queues for the truck drivers. The Road Haulier find it difficult to prove and justify queuing time when billing transport buyers for extra time. Furthermore, the Road Haulier explained that the new inspection solution causes increased total time due to the inspection being more thorough than before. Before the outsourcing the inspection was mainly an ocular control of the container and containers arriving on SIMA were not inspected at all. As a result of the outsourcing, all containers are inspected regardless of trailer type. Hence, an extra activity in the form of thorough inspection has been added according to the Road Haulier.

4.2.2 Reasons for outsourcing

According to the Depot Operator the main reason for outsourcing the inspection to a third-party actor was a preparatory measure for future implementation of automatic gates to the depot. Automatic gate mean that no personnel will be found at the gate instead it will be run by cameras and a computer with eight different languages to assist the truck driver upon arrival. Hence, inspection wouldn’t be possible since the gate is unmanned. Therefore, the Depot Operator chose to outsource the inspection

Furthermore, due to the number of claims from the container owners against the Depot Operator for insufficient inspection the Depot Operator found it necessary to outsource the inspection. Unlike the Depot Operator, the Container Inspector employs personnel whose main function is to inspect containers. The Container Inspector is certified for container inspection and provides a higher quality inspection than the Depot Operator did before. By outsourcing a non-core activity to a specialised third-party actor, the quality of the performed activities can increase. Moreover, claims for insufficient inspection have been re-directed to the Container Inspector instead of the Depot Operator. Outsourcing activities can also lead to decreased control of how the outsourced activities are performed. In this case, the Depot Operator still has partly control over the actor due to partnership which decreases the risk of losing control over the activity.

Additionally, the inspection was outsourced in an attempt to decrease congestion at the gate and inside the depot to increase efficiency and the flow for empty container returns and pick-up. By moving the inspection activity, the Depot Operator removed one area where congestion was common, namely the inspection area. Hence, more room was made for handling of trucks inside the depot area.

When queues are building up at the gate due to many trucks or if the Depot Operator has an IT system failure, the Depot Operator can communicate with the Container Inspector and order them to reduce or stop activity. Since there is a limited area to queue at the gate, the Container Inspector can stop inspections and let trucks queue at their premise to ease congestion on public roads and other traffic between the Container Inspector and the Depot Operator.

Complete outsourcing of the inspection was not performed instantly. Instead, a step-by-step outsourcing was performed. First the Container Inspector performed inspections at the Depot Operator’s premise (at the same area as before the outsourcing), as an introduction and test for the Road Haulier. After the test period the inspection was moved to the designated site and further testing was performed. As a starting point trucks using SIMA was not inspected at the Container Inspector. In lieu, they used the same procedure as before. However, after the test period inspection of empty containers loaded with SIMA was integrated in the process and therefore moved to the Container Inspector.

4.2.3 The impact on the actors regarding the two inspection solutions

When comparing the return process before and after the outsourcing of the inspection it might seem that the difference is quite large, since the whole inspection has moved 900 m outside the depot area and is being performed by third party actor. However, as shown before in Figure 6 and Figure 7 the actual driving distance is basically unchanged since the Container Inspection is located along the original route. The Road Haulier argued that an extra stop for the truck driver has occurred as consequence of the Depot Operator’s decision to outsource the inspection. However, with the previous arrangement the truck drivers were obligated to stop for inspection at an area adjacent to the gate of the depot. Therefore, the stop at the Container Inspector should not be considered an extra stop and instead considered as a moved stop in the return process. However, the Road Haulier and the Depot Operator confirmed that the past inspection process was insufficiently performed and sometimes not performed at all which meant decreased turnaround time for the truck drivers. Insufficiency or no inspection often occurred because of special circumstances e.g. bad weather or shift change. Therefore, it should be considered exceptional and not standard procedure.

Risk of queuing occurred at four separate activities in the return process before the inspection was outsourced, at the gate when entering the depot, in the inspection area, in the load and discharge area inside the depot and last at the gate when exiting the depot. Risk areas for the new return process are similar except for the queuing inside the inspection area which has relocated to the Container Inspector. There are some advantages of queues at the Container Inspector compared to inside the inspection area for the Depot Operator. Firstly, the Container Inspector area is larger than the past inspection area at the Depot Operator and has three lanes for queuing. Secondly, the past inspection area was located adjacent to the gate of the depot which meant that congestion in the inspection area had greater effect on the queues at the gate. Meanwhile, the new inspection solution has no direct effects on the queues at the gate, instead the Depot Operator can communicate with the Container Inspector and ask them to stop inspections to build queues at the Container Inspector to decrease queues at the Depot Operator. The new inspection solution has less effect on ordinary traffic since build-up of queues at the gate to the depot affect the public roads that is not the case at the Container Inspector since the area for queues is inside the Container Inspector.

4.2.4 Depot Operator point of view

Outsourcing of the inspection has also meant freed resources for the Depot Operator. Personnel and reach stacks used for inspection purposes can instead be used for other activities at the Depot Operator. Reach stacks can instead be operated for loading and discharging empty containers for trucks inside the depot. Thus, offering greater efficiency than prior the outsourcing. However, higher efficiency can only be reached if the resources are used optimally for the depot operations. During the interviews, it was not confirmed if the resources were used for the same amount of time as for when they were used for inspection. If not, the activities are carried in the same manner as before with the outsourcing having less effect on the efficiency inside the depot other than the reduced congestion.

In addition to freed resources, the move of the inspection area also freed more space inside the depot. The freed space can be used for several solutions depending on the intentions of the Depot Operator. The area can be used for extra storage of containers. Thus, increasing revenue as result from more rent income. Moreover, the free space can be used to further increase efficiency and movability inside the depot. Either the queuing area for trucks waiting for loading or discharged can be relocated or the area can be used for loading and discharging operations.

4.2.5 Road Haulier point of view

Assessing the outsourcing of the inspection, it could be considered that the Road Haulier has suffered the most changes both positive and negative. The change of routines was performed over a short period of time and the Road Haulier and its competitors were given short notice of the change. SIMA trailers were excluded from the change at the beginning during a trial period of the arrangement to ease the effects of the change. The change meant changes in routines and demanded more from the truck drivers since they need forms stamped to be accepted through the gate of the Depot Operator. Moreover, a large proportion of truck drivers performing empty container haulage in this area are citizens of states other than Sweden which complicates giving new instructions due to a change of routines for empty container returns. However, once the issues in the beginning were settled operations have run smoothly according to the Depot Operator and Road Haulier. However, with one exception of turnaround time inside the depot that according to the Road Haulier is the main issue of empty container returns at this moment. Waiting for reach stacks to load and discharge trucks and the overall efficiency have been argued as the main issue both before and after the outsourcing of the inspection.

As evidenced by the time study in below sub-section the Road Haulier's level of consequence is affected depending on the trailer type. These differences are more visible when studying the results from the Container Inspector. Regular chassis are least affected since the containers are accessible without the need of a reach stack lift. Hence, turnaround time is lesser. Trucks equipped with link are slower than chassis but more efficient than SIMA. Inspection of empty container loaded on link requires a reach stack since one container is not accessible for inspection using ladder. SIMA is the trailer type most affected by the new inspection set-up, especially when two containers are loaded on the same SIMA. SIMA is less efficient than link even though it often requires the same number of lifts that in turn is caused by the actual lifting of the empty container. SIMA's are equipped with hydraulic pipes and chains which are more exposed to damages if the empty container is not discharged with caution. Moreover, the crane arms on the SIMA give fewer margins for movement of the empty container during the lift. The reach stack driver must lift straight up without moving the reach stack when discharging and lower straight down without moving the reach stack when loading. Thus, inspections of empty containers loaded on SIMA are timelier than inspection of containers loaded on link or chassis.

As a result of the outsourcing of the inspection truck drivers using link and SIMA have suffered an increase of lifts compared to before the change. Before the only lift necessary for link was that inside the depot when discharging the empty container. SIMA had no lifts performed by other than those performed by the truck driver. Hence, both SIMA and link have had an increase of lifts due to the discharge and re-loading by the Container Inspector.

Comparing the whole empty container return process between the different trailer types, it is also evident that empty containers returned loaded on SIMA have had larger impact by the changes than other trailer types. Returns performed using SIMA were less thorough prior the change. The trucks using SIMA had an own lane for entering the gate and no inspection was performed since the doors of the container were inaccessible. Moreover, since the truck driver could discharge the empty container without the assistance from a reach stack less queuing occurred inside the depot. Now the returns are similar to the other trailer types but with timelier inspection and discharge of the empty container inside the depot using the SIMA crane arms. As a result, it can be argued that one stop has been added for SIMA since no stop for inspection was necessary prior the outsourcing of inspection.

4.2.6 Time study

Time measurements were made separately at the site of inspection and at the gate of the depot. At the Container Inspection, the time studied was from when the truck stopped either for queuing or for inspection. If there was no queue at that time, time measuring stopped when the truck started to drive towards the gate. The time measurements include queuing, inspection, repairs and administration (e.g. identifying the owner of the container).

Before arriving to the depot, the truck is driven 0,9 km to the gate of the depot, a route which is covered in approximately 2 minutes as shown previously in Figure 7. When the truck has stopped either for queuing at the gate or for passing through the gate or for administration at the gate if no queue, the time was measured until the truck started rolling through the gate.

Time measurements at the Container Inspection are summarized in Table 4, showing number of observations made during the week and how many measurements of total measured that included queuing. Median number for queueing is 00:00 due to more trucks that were not exposed to queuing than those who were exposed to queuing. Moreover, times are divided between the different types of trailers as well as time for inspection regardless of trailer type. The most commonly used trailer type during the time study was chassis, and chassis were also the most exposed in regards of queuing. Although, the mean queuing time for SIMA and link were longer. The actual inspection activity in regards of time to perform, it was highest for SIMA. The mean total time spent at the Container Inspection was 3min 32s during the week. Furthermore, for trucks using SIMA the total time at the Container Inspection was higher than chassis and link.

Table 4 - Summary of time measurements at the Container Inspector.

Type	Chassi	SIMA	Link	All
no. of observations	133	53	22	208
no. of observations with queuing time	37 (28%)	14 (26%)	5 (23%)	56 (27%)
Queuing (mm:ss)				
mean	00:24	00:54	01:07	00:36
median	00:00	00:00	00:00	00:00
st.dev	00:59	01:57	02:39	01:32
Inspection (mm:ss)				
mean	02:20	04:11	03:32	02:56
median	02:03	03:45	03:25	02:32
st.dev	01:05	02:03	01:08	01:37
Total time (mm:ss)				
mean	02:44	05:05	04:38	03:32
median	02:20	04:15	03:39	03:05
st.dev	01:22	02:25	00:24	02:06

Note: For detailed summary see appendix IV.

The time study performed at the gate of the Depot Operator is summarized in Table 5. Like Table 4, it shows number of observations performed and the number of observations where queuing occurred. Times measured are dived per trailer type as well as summarized in the "All"-column where trailer types are not taken to consideration. Unlike at the Container Inspection, queuing was most common for trucks using SIMA. Moreover, queuing occurred more frequently than at the Container Inspection. Time for administration at the gate (i.e. the time from when the truck driver exits the truck to be cleared at the gate until the truck starts rolling through the gate) is approximately the same regardless of trailer type. The total time from arriving at the Depot Operator until passing through the gate is similar for all trailer types, with a mean time of 3min and 19s.

Table 5 - Summary of time measurements at the Depot Operator.

Type	Chassi	SIMA	Link	All
no. Of observations	136	28	33	197
no. of observations with queuing time	50 (37%)	12 (43%)	12 (36%)	74 (38%)
Queuing (mm:ss)				
mean	01:02	01:29	01:33	01:11
median	00:00	00:00	00:00	00:00
st.dev	02:16	03:11	03:27	02:38
Gate-in (mm:ss)				
mean	02:05	02:24	02:10	02:09
median	01:53	02:07	01:54	01:55
st.dev	00:44	01:01	00:50	00:48
Total time (mm:ss)				
mean	03:07	03:53	03:43	03:19
median	02:19	02:45	02:18	02:24
st.dev	02:28	03:25	03:45	02:52

Note: For detailed summary see appendix V.

4.2.7 Depot turnaround time

The times presented in Table 6 are a summary of the times captured by the Depot Operator. The turnaround time are based on two times: the first, when the truck driver registers the ticket for passage through the gate: and the second, when the truck driver registers the ticket while exiting the depot. The times shown do not consider trailer type if the trucks are leaving or picking up empty container or if trucks that have discharged empty containers load a new empty container before leaving.

Table 6 shows turnaround time inside the depot for two separate weeks. First, a week prior to the outsourcing of the inspection, and second, a week after outsourcing. Time and number of trucks passed are summarized for each working day during the week. Furthermore, all trucks are summarized in a mean of the whole week. The results show that the mean turnaround time was lower after the inspection was outsourced, despite more trucks passed through the depot.

Table 6 - Depot Operator turnaround time before and after outsourcing Container Inspector of inspection.

Turnaround time inside depot before outsourcing inspection	Mon	Tue	Wed	Thu	Fri	mean
trucks	364	372	341	378	345	360
time (mm:ss)	23:54	25:01:00	24:46:00	19:24	19:15	22:28
Turnaround time inside depot after outsourcing inspection	Mon	Tue	Wed	Thu	Fri	mean
trucks	437	368	370	333	343	370
time (mm:ss)	19:43	13:01	14:24	13:13	14:11	14:54

Note: For detailed summary see appendix VI. Retrieved from depot operator. Adopted with permission.

4.3 RQ 3: How can a disturbance cost for returning empty containers to the depot with outsourced inspection be justified?'

As shown in Figure 6 and Figure 7, both arrangements involve about the same distance and driving time. Therefore, this element is not considered when performing below calculations.

The average cost for trucks in Sweden is multiplied with the total turnaround time for both arrangements. As the data for the arrangement with inspection and administration at the gate does not show any queuing time or administration time, this time has been assumed to be included in the total turnaround time provided. Queuing time to arrive at the depot administration has been assumed to be at least the same as with the current arrangement. Total costs for turnaround time for both arrangements are presented in Table 7.

Table 7 - Describes turnaround time and cost for one turnaround. Numbers are retrieved from Table 6,5,4,3 and 2

Actual costs	Pre-Insp. outsource	After Insp. Outsource
Administration	N/A	02:09
Queuing admin	01:11	01:11
Queuing inspection	N/A	00:36
Inspection	N/A	02:56
Total	**01:11**	**06:52**
Turnaround time	00:22:28	00:14:54
Total time	**23:39**	**21:46**
SEK/Min	9,10 SEK	9,10 SEK
Total costs (SEK)	**215,22 SEK**	**198,11 SEK**
Difference	**-1:53 min**	-17,11 SEK
Result		**198 SEK**

Table 7 presents a difference of 17,11 SEK between the both arrangements, and a cost of 215,22 SEK for the previous arrangement and 198,11 SEK for the current arrangement.

As the results displays, the average turnaround time has been decreased by about 2 minutes that indicates that a disturbance cost for this type of arrangement is difficult to justify. The difference between the turnaround times is greater than the average inspection time (that indicates the inspection time has decreased), although there are a few variables that potentially could influence the result. When calculating costs for a single truck there are several assumptions which must be made. The trucks in WSP Sverige AB (2014) analysis have an assumed driving range of 130000 km/year. The assumed driving range might vary for some of the trucks in this study which directly affect the costs for one turnaround time. Although this affects the cost, the fact that the current arrangement means shorter turnaround time, which allows for a general assumption, because the current arrangement is cheaper. Another aspect when calculating costs, is assumptions made regarding the price for the trucks which differs between different models and choice of additional equipment. Differences in truck prices are addressed and analysed in the report of WSP Sverige AB (2014) that shows the main differences between Swedish road hauliers and foreign road hauliers. The differences in cost allocations between Swedish and foreign road hauliers can been seen in Table 2. As the transport of empty containers is performed by trucks with different nationalities, the average cost for the four most common nationalities are used in this report that in turn provides a comparable result.

Regarding the queue and inspection time at Container Inspection and Depot Operator, and according to personnel at the Container Inspector, measurements were made during a period while the traffic was lower than normal. Lower traffic volumes are a parameter of importance as it has a potential impact on the result. To justify the data of this report, a comparison of the number of trucks measured during this period and a similar period before the outsourcing is carried out. The comparison shows that the number of trucks passing through Depot Operator was almost the same (360 vs 370). In this report, about 200 trucks have been measured which is lower than the number passing through the Depot Operator. Since the measurements only were made on trucks carrying containers to drop off at the Depot Operator, and not the trucks that only load empty containers, this could explain the lower number. From the participant observations, it is reasonable to assume that the total number of trucks (with and without container) passing through the Depot Operator is about the same as before outsourcing as after outsourcing. The assumption ratifies the measurements to be comparable to each other and therefore justifies our result. A potential increase in traffic could lead to longer queue time both at the Depot Operator and at the container inspection which needs to be considered.

While conducting the empirical studies, another issue regarding measurements of multiple trucks at the same time was faced. In the event of more than two trucks arriving at the Depot Operator or Container Inspector at the same time, the measurement equipment could only measure one truck at a time. Therefore, in some cases only measurements of two out of several trucks that were for example queuing were possible, an issue which was partly resolved by selecting trucks which potentially could be exposed to queuing before the ones who arrived first, although this is still a weakness in the report. With a scenario where all trucks could be measured a more accurate result would be achieved.

Furthermore, in the cost result part, a queuing time has been added to the Depot Operator before outsourcing. Queuing time was added since the turnaround time received from the Depot Operator only measures the time when the truck enters the Depot Operator, not the time the truck potentially queues before entering the depot. The queuing time used is the same as after outsourcing and is motivated because of the assumptions that the queuing should have been at least as long when they also performed inspection at the gate. It could be argued that the queue time at the container inspection should be added to the time at the Depot Operator and the total time used as queue time at the Depot Operator. In this case, it was decided to use only the queueing time at the Depot Operator as this assumption can more easily be argued for than adding both queue times.

5 Conclusions

This chapter states the main conclusions of the work and makes suggestions for future research. To solve the purpose and answer the research questions, a mix of information and methods have been used. Methods include review of relevant literature such as empty container management, drayage, industrial network approach and depot operations. Semi-structured interviews have been conducted with key actors within the study such as Depot Operator, Road Haulier and Container Inspector. Also, a time study has been performed on site to assess the current arrangement and to allow for comparison with previous arrangements.

Benefits for involved actors regarding the two inspection solutions

The empty container return activity involves three main actors: the Road Hauliers, the Depot Operator and the Container Inspector. All three actors operate independently as separate entities, but the Depot Operator outsources the inspection service from the Container Inspector.

Considering what actors benefit from the old solution (where the inspection was performed inside the depot by the Depot Operator), it is evident that the Road Haulier had the largest advantage when comparing the advantages between Road Haulier and Depot Operator. Specifically, truck drivers using SIMA benefitted from the old solution since it meant they had no lifts and no inspection. Benefits as a result performing their own discharge inside the depot as the crane arms block the doors of the empty container. Furthermore, SIMA had a separate lane to the gate of the depot that in turn lead to less queuing and lower turnaround time for empty container returns.

Considering the benefits from outsourcing the inspection to the Container Inspector it is clear that both the Depot Operator and Road Haulier are beneficial from the change. As a result of decreased turnaround time for the empty container returns, the Road Haulier saves time and the Depot Operator has increased efficiency inside the depot. Moreover, the higher quality of inspection from outsourcing reduces the number of lifts inside the depot and facilitates for the Road Haulier since it is often delegated to them to pick-up a clean and operational empty container.

Moreover, the Depot Operator has an increased control over the queues that can occur at the gate and inside the depot since the collaboration between the Depot Operator and Container Inspector enables communication regarding the number of trucks arriving for empty container returns. If the Depot Operator suffers congestion at the gate, notifications can be given to the Container Inspector to stop operations to reduce queues at the gate and instead build queues at the inspection area until congestion has eased at the gate.

Influence of the location of the container inspection when returning empty containers

The report addresses two different arrangements for empty container inspection. The first arrangement is a combined inspection and administration at the Depot Operator. The second arrangement has the inspection outsourced to a third party located nearby. In regards of the first arrangement, SIMA drivers were exempted inspection at the gate, which in turn leads to shorter queue times than other drivers. The old arrangement also meant fewer lifts as the container was inspected while still on the chassis. Therefore, chassis that carried 2x TEU and Link chassis were not fully inspected as the containers stand just next to each other. Compared to the current arrangement, the quality of container inspection has improved substantially as every container now is inspected, even if it needs to be discharged. Moreover, it is inspected by personnel who are specialised in the requirements for inspection.

Even though the current arrangement includes a moved stop to the Container Inspector and in many cases more lifts, the turnaround time has decreased. Due to higher efficiency at the Depot Operator and Container Inspector (where employees are specialised on their assignments), a better flow of containers is achieved as the inspection and administration is kept apart. When keeping the inspection and administration at different locations, it gives the opportunity to split up any queues that might occur at the Container Inspector and the Depot Operator. One disadvantage that the Road Haulier has is that drivers need to remember to go through the Container Inspector before arriving at the Depot Operator.

No justification of disturbance costs

To be able to justify a disturbance cost for the extra stop at the Container Inspector, the turnaround time needs to be longer than before the outsourcing of the container inspection. A longer turnaround time leads to higher costs as the drivers can load and/or drop fewer containers during a certain period which allows for a disturbance cost.

The results of the time measurements in this report indicate that the turnaround time has decreased by 1 min and 53 secs compared to previous retrieved data from the Depot Operator. One turnaround time including inspection, costs with the current arrangement 198 SEK compared to 215 SEK based on the cost allocation for one truck provided in **4.3 RQ 3: How can a disturbance cost for returning empty containers to the depot with outsourced inspection be justified?'**.

The results indicate that an additional fee cannot be justified basis on the change of arrangements regarding the container inspection. The one type of driver that was possible to be able to justify the fee, is drivers with SIMA chassis. Even though there are no indications, it is plausible to believe that those have been affected the most by the change due to added inspection.

Suggestions for future research

The time study for this report was carried out during one work week during regular work hours. Hence, it would be relevant to perform a more extensive time study during a longer period of time to better consider volume changes and season effects. This time study was performed during a period time of decreased volumes as a result from e.g. the Chinese New Year. Therefore, it would be suitable to measure times during higher pressure to assess whether the Container Inspector can handle an increase of volumes.

Since the outsourcing was a preparatory measure for implementation of automated gates it would be relevant to perform the same type of study to assess whether the implementation of automatic gates have had an impact on the flow, efficiency and turnaround time for empty container returns.

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Appendix I

Questions to the Depot Operator

Description of the activity from arrival at the gate of the depot until the truck exits the depot

1 What do you request from the road hauliers prior arrival?
2 Which activities are manned?
3 Which activities are the bottle necks?
4 Do you communicate with the Container Inspector?
5 Are times measurements performed?

Inspection

6 Where and how was the inspection of empty containers performed before?
7 How large was the workload? From a time and manning perspective

New vs. old inspection solution

8 What is the main difference for the you after the change regarding flow, costs and time?
9 Have there been any volume changes for the flow to and from the depot?
10 Can you name another depot/terminal with a similar inspection solution?

Road Hauliers perspective

11 What is your perception of the road hauliers view on the change of inspection?
12 What is your opinion on the additional feel for empty container returns at your depot?
13 Do you have perception of why an additional fee are charged?
14 Since the empty container are more thoroughly inspected, are pick-ups more efficient than before?

Automatic gate

15 When will the automatic gates be ready for use?
16 What will be the main differences?

Appendix II

Questions to the Container Inspector

Inspection

1. Explain the inspection process step-by-step.
2. How do you communicate with the road hauliers before the inspection?
3. What services do you provide for the Depot Operator?
4. How do you communicate with the Depot Operator after an inspection is complete?
5. What is your perception of the road hauliers view on the change?
6. Can you name another depot with a similar inspection concept?

Organisation

7. What is the Depot Operator's role in your organisation?
8. Are there any plans for an update of services provided to the depot operator?

Road Hauliers perspective

9. How does the "extra stop" affect the road hauliers? From a time and distance point-of-view.
10. What is your perception on what costs the additional fee are to cover?
11. What is your perception of why some road hauliers charge and an additional fee and some don´t?

Appendix III

Questions to the Road Haulier

1. What is the main difference from returning empty containers to the Depot Operator compared to “regular” depots?
2. Which part of the return process is timeliest and what are the most common issues?
3. What has the inspection outsourcing meant for your routines?
4. How long does it take to return an empty container for you now?
5. How has congestion at the gate been affected?
6. Have you noticed a change in empty container cleanliness since the change?
7. What is the transport buyers view on the change?
8. Do you encourage transport buyers to return empty container at other depots?
9. What is your opinion on the implementation of an automatic gate system?
10. What are your demands to abolish the additional fee?

Appendix IV

Summary of all measured times for inspection at the Container Inspector from the time study.

No.	Activity	Type	Lift (Y/N)	Weekday	Hour of the day	Queuing time (MM:SS)	Inspection time (MM:SS)	Total time (MM:SS)
1	Inspection	SIMA	Y	Monday	8:00 AM	00:54	03:05	03:59
2	Inspection	SIMA	Y	Monday	9:00 AM	00:00	03:32	03:32
3	Inspection	SIMA	Y	Monday	9:00 AM	00:00	05:46	05:46
4	Inspection	SIMA	Y	Monday	9:00 AM	00:00	01:07	01:07
5	Inspection	Chassi	N	Monday	9:00 AM	00:00	03:07	03:07
6	Inspection	SIMA	Y	Monday	9:00 AM	00:00	07:53	07:53
7	Inspection	SIMA	Y	Monday	9:00 AM	00:00	06:09	06:09
8	Inspection	Chassi	N	Monday	9:00 AM	00:00	03:47	03:47
9	Inspection	Chassi	N	Monday	9:00 AM	00:00	03:47	03:47
10	Inspection	Chassi	N	Monday	9:00 AM	01:11	01:59	03:10
11	Inspection	Chassi	N	Monday	9:00 AM	00:00	02:36	02:36
12	Inspection	Chassi	N	Monday	9:00 AM	00:00	01:55	01:55
13	Inspection	Chassi	N	Monday	10:00 AM	00:14	02:13	02:27
14	Inspection	Link	Y	Monday	10:00 AM	00:00	03:17	03:17
15	Inspection	Chassi	N	Monday	10:00 AM	00:00	01:33	01:33
16	Inspection	Chassi	N	Monday	10:00 AM	00:00	03:06	03:06
17	Inspection	Chassi	N	Monday	10:00 AM	00:00	01:53	01:53
18	Inspection	Chassi	N	Monday	10:00 AM	00:00	04:14	04:14
19	Inspection	Chassi	N	Monday	10:00 AM	00:00	02:13	02:13
20	Inspection	Chassi	N	Monday	10:00 AM	00:00	03:14	03:14
21	Inspection	SIMA	Y	Monday	11:00 AM	00:00	04:12	04:12
22	Inspection	Chassi	N	Monday	11:00 AM	00:16	03:29	03:45
23	Inspection	Chassi	N	Monday	11:00 AM	00:00	01:36	01:36
24	Inspection	Chassi	N	Monday	12:00 PM	00:00	03:38	03:38
25	Inspection	Chassi	N	Monday	12:00 PM	00:00	02:03	02:03
26	Inspection	Link	Y	Monday	12:00 PM	00:00	03:28	03:28
27	Inspection	Chassi	N	Monday	1:00 PM	00:00	02:10	02:10
28	Inspection	Chassi	N	Monday	1:00 PM	00:00	01:53	01:53
29	Inspection	Chassi	N	Monday	1:00 PM	00:00	01:44	01:44
30	Inspection	SIMA	N	Monday	1:00 PM	00:00	00:54	00:54
31	Inspection	SIMA	Y	Monday	1:00 PM	00:00	11:09	11:09
32	Inspection	Chassi	N	Monday	1:00 PM	00:00	01:55	01:55
33	Inspection	Chassi	N	Monday	2:00 PM	00:00	02:38	02:38
34	Inspection	Chassi	N	Monday	2:00 PM	01:55	03:21	05:16
35	Inspection	Chassi	N	Monday	2:00 PM	00:39	01:50	02:29
36	Inspection	Link	Y	Monday	2:00 PM	00:00	03:41	03:41
37	Inspection	Link	Y	Monday	2:00 PM	00:00	03:32	03:32
38	Inspection	Chassi	N	Monday	2:00 PM	00:00	02:14	02:14
39	Inspection	Chassi	N	Monday	3:00 PM	00:00	01:51	01:51
40	Inspection	Link	Y	Monday	3:00 PM	04:24	02:06	06:30
41	Inspection	Link	Y	Monday	3:00 PM	11:14	02:39	13:53

42	Inspection	Chassi	N	Monday	3:00 PM	00:21	01:52	02:13
43	Inspection	SIMA	Y	Monday	3:00 PM	02:24	04:18	06:42
44	Inspection	Chassi	N	Monday	3:00 PM	01:30	03:22	04:52
45	Inspection	Chassi	N	Monday	3:00 PM	00:00	03:16	03:16
46	Inspection	SIMA	Y	Monday	3:00 PM	00:00	05:17	05:17
47	Inspection	SIMA	Y	Monday	3:00 PM	08:34	03:56	12:30
48	Inspection	SIMA	Y	Monday	3:00 PM	08:29	02:24	10:53
49	Inspection	SIMA	Y	Tuesday	8:00 AM	00:00	03:12	03:12
50	Inspection	Link	Y	Tuesday	8:00 AM	02:30	03:05	05:35
51	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	03:58	03:58
52	Inspection	Chassi	N	Tuesday	9:00 AM	01:16	01:16	02:32
53	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	01:10	01:10
54	Inspection	SIMA	Y	Tuesday	9:00 AM	02:30	02:13	04:43
55	Inspection	SIMA	Y	Tuesday	9:00 AM	00:00	03:27	03:27
56	Inspection	SIMA	Y	Tuesday	9:00 AM	00:00	03:24	03:24
57	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	03:51	03:51
58	Inspection	SIMA	Y	Tuesday	9:00 AM	00:00	05:46	05:46
59	Inspection	Link	Y	Tuesday	9:00 AM	00:00	03:23	03:23
60	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	02:20	02:20
61	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	02:52	02:52
62	Inspection	Chassi	N	Tuesday	9:00 AM	00:00	02:20	02:20
63	Inspection	Chassi	N	Tuesday	11:00 AM	00:00	01:18	01:18
64	Inspection	Chassi	N	Tuesday	11:00 AM	00:00	03:00	03:00
65	Inspection	Link	N	Tuesday	11:00 AM	00:00	05:51	05:51
66	Inspection	Chassi	N	Tuesday	11:00 AM	00:00	01:36	01:36
67	Inspection	Chassi	N	Tuesday	11:00 AM	00:00	02:59	02:59
68	Inspection	Chassi	N	Tuesday	11:00 AM	00:00	02:32	02:32
69	Inspection	Link	Y	Tuesday	11:00 AM	00:00	04:17	04:17
70	Inspection	Link	Y	Tuesday	11:00 AM	00:00	02:58	02:58
71	Inspection	Chassi	N	Tuesday	12:00 PM	00:00	01:29	01:29
72	Inspection	Chassi	N	Tuesday	12:00 PM	00:42	01:31	02:13
73	Inspection	Chassi	N	Tuesday	12:00 PM	00:00	01:32	01:32
74	Inspection	Chassi	N	Tuesday	12:00 PM	00:00	02:20	02:20
75	Inspection	SIMA	Y	Tuesday	2:00 PM	00:00	03:07	03:07
76	Inspection	Chassi	N	Tuesday	2:00 PM	00:00	01:56	01:56
77	Inspection	Chassi	N	Tuesday	2:00 PM	04:52	03:09	08:01
78	Inspection	Chassi	N	Tuesday	2:00 PM	00:00	02:17	02:17
79	Inspection	Chassi	N	Tuesday	2:00 PM	06:22	02:02	08:24
80	Inspection	Link	Y	Tuesday	2:00 PM	04:16	01:46	06:02
81	Inspection	Chassi	N	Tuesday	2:00 PM	00:00	02:14	02:14
82	Inspection	Chassi	N	Tuesday	2:00 PM	00:00	01:24	01:24
83	Inspection	Chassi	N	Tuesday	2:00 PM	00:00	01:28	01:28
84	Inspection	SIMA	Y	Tuesday	2:00 PM	00:00	04:21	04:21
85	Inspection	Link	Y	Tuesday	4:00 PM	00:00	01:51	01:51
86	Inspection	Link	Y	Tuesday	4:00 PM	00:00	04:31	04:31
87	Inspection	SIMA	Y	Tuesday	4:00 PM	00:00	04:01	04:01

88	Inspection	Chassi	N	Tuesday	4:00 PM	00:00	01:44	01:44
89	Inspection	Chassi	N	Tuesday	4:00 PM	05:04	02:06	07:10
90	Inspection	Chassi	N	Tuesday	4:00 PM	00:00	01:17	01:17
91	Inspection	Chassi	N	Tuesday	4:00 PM	02:03	01:26	03:29
92	Inspection	Chassi	N	Tuesday	4:00 PM	00:00	02:41	02:41
93	Inspection	Link	Y	Tuesday	4:00 PM	00:00	03:20	03:20
94	Inspection	Link	Y	Tuesday	4:00 PM	00:00	03:26	03:26
95	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	03:32	03:32
96	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	02:30	02:30
97	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	01:39	01:39
98	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	01:43	01:43
99	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	02:23	02:23
100	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	02:25	02:25
101	Inspection	Chassi	N	Wednesday	9:00 AM	00:00	01:32	01:32
102	Inspection	SIMA	Y	Wednesday	9:00 AM	00:00	04:22	04:22
103	Inspection	SIMA	Y	Wednesday	11:00 AM	01:35	03:04	04:39
104	Inspection	SIMA	Y	Wednesday	11:00 AM	00:00	03:05	03:05
105	Inspection	Chassi	N	Wednesday	11:00 AM	00:00	02:05	02:05
106	Inspection	Link	Y	Wednesday	11:00 AM	00:00	04:52	04:52
107	Inspection	Chassi	N	Wednesday	11:00 AM	00:30	02:04	02:34
108	Inspection	Chassi	N	Wednesday	11:00 AM	00:26	01:31	01:57
109	Inspection	Chassi	N	Wednesday	11:00 AM	00:00	02:26	02:26
110	Inspection	Chassi	N	Wednesday	11:00 AM	00:18	02:05	02:23
111	Inspection	Chassi	N	Wednesday	11:00 AM	02:43	01:49	04:32
112	Inspection	Link	Y	Wednesday	11:00 AM	00:00	03:09	03:09
113	Inspection	Chassi	N	Wednesday	11:00 AM	00:00	02:16	02:16
114	Inspection	SIMA	Y	Wednesday	11:00 AM	02:14	03:11	05:25
115	Inspection	SIMA	Y	Wednesday	11:00 AM	02:16	02:59	05:15
116	Inspection	Chassi	N	Wednesday	11:00 AM	02:20	02:37	04:57
117	Inspection	SIMA	Y	Wednesday	11:00 AM	00:00	02:53	02:53
118	Inspection	Chassi	N	Wednesday	11:00 AM	00:00	01:54	01:54
119	Inspection	Chassi	N	Wednesday	11:00 AM	00:24	03:09	03:33
120	Inspection	Link	Y	Wednesday	12:00 PM	00:00	03:37	03:37
121	Inspection	Chassi	N	Wednesday	12:00 PM	00:00	02:10	02:10
122	Inspection	Chassi	N	Wednesday	12:00 PM	01:18	01:46	03:04
123	Inspection	SIMA	Y	Wednesday	1:00 PM	00:00	04:02	04:02
124	Inspection	Link	Y	Wednesday	1:00 PM	02:09	02:49	04:58
125	Inspection	SIMA	Y	Wednesday	1:00 PM	05:34	01:35	07:09
126	Inspection	Chassi	N	Wednesday	1:00 PM	00:00	01:53	01:53
127	Inspection	SIMA	Y	Wednesday	1:00 PM	03:25	02:33	05:58
128	Inspection	SIMA	Y	Wednesday	3:00 PM	00:00	03:53	03:53
129	Inspection	SIMA	Y	Wednesday	3:00 PM	00:00	03:48	03:48
130	Inspection	SIMA	Y	Wednesday	3:00 PM	02:56	03:23	06:19
131	Inspection	SIMA	Y	Wednesday	3:00 PM	00:00	04:08	04:08
132	Inspection	SIMA	Y	Wednesday	3:00 PM	00:57	03:16	04:13
133	Inspection	Chassi	N	Wednesday	3:00 PM	00:00	02:02	02:02

134	Inspection	Link	Y	Thursday	9:00 AM	00:00	06:21	06:21
135	Inspection	SIMA	Y	Thursday	9:00 AM	00:00	03:16	03:16
136	Inspection	SIMA	Y	Thursday	9:00 AM	02:54	03:23	06:17
137	Inspection	Chassi	N	Thursday	9:00 AM	00:00	01:59	01:59
138	Inspection	Chassi	N	Thursday	9:00 AM	00:00	01:59	01:59
139	Inspection	SIMA	Y	Thursday	9:00 AM	03:10	03:44	06:54
140	Inspection	SIMA	Y	Thursday	9:00 AM	00:00	04:20	04:20
141	Inspection	SIMA	Y	Thursday	10:00 AM	00:00	03:46	03:46
142	Inspection	SIMA	Y	Thursday	11:00 AM	00:00	07:26	07:26
143	Inspection	Chassi	N	Thursday	11:00 AM	00:00	01:28	01:28
144	Inspection	Chassi	N	Thursday	11:00 AM	00:00	02:24	02:24
145	Inspection	SIMA	Y	Thursday	11:00 AM	00:00	03:45	03:45
146	Inspection	Chassi	N	Thursday	11:00 AM	00:00	02:07	02:07
147	Inspection	Chassi	N	Thursday	11:00 AM	00:00	01:42	01:42
148	Inspection	Chassi	N	Thursday	11:00 AM	00:00	01:55	01:55
149	Inspection	Chassi	N	Thursday	11:00 AM	01:17	00:54	02:11
150	Inspection	Chassi	N	Thursday	11:00 AM	02:42	01:53	04:35
151	Inspection	Chassi	N	Thursday	11:00 AM	00:23	04:22	04:45
152	Inspection	Chassi	N	Thursday	11:00 AM	00:00	03:23	03:23
153	Inspection	Chassi	N	Thursday	11:00 AM	00:26	01:57	02:23
154	Inspection	SIMA	Y	Thursday	1:00 PM	00:00	09:36	09:36
155	Inspection	Chassi	N	Thursday	1:00 PM	00:00	02:02	02:02
156	Inspection	Chassi	N	Thursday	1:00 PM	00:26	02:00	02:26
157	Inspection	Chassi	N	Thursday	1:00 PM	00:00	02:35	02:35
158	Inspection	Chassi	N	Thursday	1:00 PM	00:00	01:54	01:54
159	Inspection	Chassi	N	Thursday	1:00 PM	00:00	01:24	01:24
160	Inspection	Chassi	N	Thursday	1:00 PM	00:00	01:40	01:40
161	Inspection	SIMA	Y	Thursday	1:00 PM	00:00	03:00	03:00
162	Inspection	Chassi	N	Thursday	1:00 PM	00:00	03:51	03:51
163	Inspection	Chassi	N	Thursday	1:00 PM	00:00	01:56	01:56
164	Inspection	Chassi	N	Thursday	1:00 PM	01:25	00:45	02:10
165	Inspection	Chassi	N	Thursday	3:00 PM	00:00	02:01	02:01
166	Inspection	SIMA	Y	Thursday	3:00 PM	00:00	03:57	03:57
167	Inspection	Chassi	N	Thursday	3:00 PM	00:00	02:07	02:07
168	Inspection	SIMA	Y	Friday	9:00 AM	00:00	11:14	11:14
169	Inspection	Link	Y	Friday	9:00 AM	00:00	03:34	03:34
170	Inspection	Chassi	N	Friday	9:00 AM	02:20	00:39	02:59
171	Inspection	Chassi	N	Friday	9:00 AM	00:00	03:48	03:48
172	Inspection	Chassi	N	Friday	9:00 AM	00:00	02:03	02:03
173	Inspection	Chassi	N	Friday	9:00 AM	00:00	01:32	01:32
174	Inspection	Chassi	N	Friday	9:00 AM	00:17	02:12	02:29
175	Inspection	Chassi	N	Friday	9:00 AM	00:00	05:33	05:33
176	Inspection	Chassi	N	Friday	9:00 AM	00:00	02:52	02:52
177	Inspection	Chassi	N	Friday	9:00 AM	00:30	01:59	02:29
178	Inspection	Chassi	N	Friday	9:00 AM	00:00	02:43	02:43
179	Inspection	Chassi	N	Friday	11:00 AM	00:00	02:00	02:00

180	Inspection	Chassi	N	Friday	11:00 AM	00:00	02:10	02:10
181	Inspection	Chassi	N	Friday	11:00 AM	00:00	03:11	03:11
182	Inspection	Chassi	N	Friday	11:00 AM	00:23	00:46	01:09
183	Inspection	Chassi	N	Friday	11:00 AM	00:00	01:52	01:52
184	Inspection	Chassi	N	Friday	11:00 AM	00:00	01:45	01:45
185	Inspection	SIMA	Y	Friday	11:00 AM	00:00	04:15	04:15
186	Inspection	Chassi	N	Friday	11:00 AM	00:00	03:53	03:53
187	Inspection	Chassi	N	Friday	11:00 AM	00:00	01:32	01:32
188	Inspection	Chassi	N	Friday	11:00 AM	00:00	06:47	06:47
189	Inspection	SIMA	Y	Friday	11:00 AM	00:00	04:28	04:28
190	Inspection	Chassi	N	Friday	1:00 PM	00:58	01:50	02:48
191	Inspection	Chassi	N	Friday	1:00 PM	01:58	01:45	03:43
192	Inspection	Chassi	N	Friday	1:00 PM	00:00	03:00	03:00
193	Inspection	Chassi	N	Friday	1:00 PM	00:35	00:49	01:24
194	Inspection	Chassi	N	Friday	1:00 PM	00:00	02:08	02:08
195	Inspection	Chassi	N	Friday	1:00 PM	00:57	01:03	02:00
196	Inspection	Chassi	N	Friday	1:00 PM	00:00	02:23	02:23
197	Inspection	SIMA	Y	Friday	1:00 PM	00:00	03:38	03:38
198	Inspection	Chassi	N	Friday	1:00 PM	00:00	01:32	01:32
199	Inspection	SIMA	N	Friday	1:00 PM	00:00	03:56	03:56
200	Inspection	SIMA	Y	Friday	1:00 PM	00:00	03:05	03:05
201	Inspection	Chassi	Y	Friday	1:00 PM	00:00	01:38	01:38
202	Inspection	Chassi	N	Friday	2:00 PM	01:55	01:51	03:46
203	Inspection	Chassi	N	Friday	3:00 PM	00:16	05:08	05:24
204	Inspection	SIMA	Y	Friday	3:00 PM	00:00	03:28	03:28
205	Inspection	Chassi	N	Friday	3:00 PM	00:00	02:18	02:18
206	Inspection	SIMA	Y	Friday	3:00 PM	00:00	05:46	05:46
207	Inspection	Chassi	N	Friday	3:00 PM	02:03	01:11	03:14
208	Inspection	Chassi	N	Friday	3:00 PM	00:00	08:21	08:21

Note: Authors own copyright.

Appendix V

Summary of all measured times for gate-in to the depot from the time study.

No.	Activity	Type	Weekday	Hour of the day	Queuing time (MM:SS)	Gate-in time (MM:SS)	Total time (MM:SS)
1	Gate-in	SIMA	Monday	9:00 AM	03:22	01:23	04:45
2	Gate-in	Chassi	Monday	9:00 AM	00:00	02:26	02:26
3	Gate-in	Chassi	Monday	9:00 AM	00:00	01:56	01:56
4	Gate-in	Chassi	Monday	9:00 AM	00:00	02:56	02:56
5	Gate-in	Chassi	Monday	9:00 AM	00:00	01:27	01:27
6	Gate-in	Chassi	Monday	9:00 AM	00:00	01:23	01:23
7	Gate-in	SIMA	Monday	9:00 AM	00:00	01:44	01:44
8	Gate-in	Chassi	Monday	9:00 AM	00:00	01:58	01:58
9	Gate-in	Chassi	Monday	9:00 AM	00:00	03:50	03:50
10	Gate-in	Chassi	Monday	10:00 AM	00:00	01:27	01:27
11	Gate-in	Chassi	Monday	10:00 AM	01:19	01:27	02:46
12	Gate-in	Chassi	Monday	10:00 AM	00:00	01:46	01:46
13	Gate-in	Link	Monday	10:00 AM	00:00	01:55	01:55
14	Gate-in	Link	Monday	10:00 AM	00:00	01:34	01:34
15	Gate-in	Chassi	Monday	10:00 AM	00:00	02:27	02:27
16	Gate-in	SIMA	Monday	10:00 AM	00:19	01:41	02:00
17	Gate-in	Chassi	Monday	10:00 AM	02:47	01:35	04:22
18	Gate-in	Chassi	Monday	10:00 AM	01:16	02:46	04:02
19	Gate-in	Chassi	Monday	10:00 AM	00:00	02:16	02:16
20	Gate-in	SIMA	Monday	11:00 AM	00:43	02:10	02:53
21	Gate-in	SIMA	Monday	11:00 AM	09:31	01:47	11:18
22	Gate-in	Chassi	Monday	11:00 AM	11:56	05:10	17:06
23	Gate-in	Chassi	Monday	12:00 PM	06:35	02:02	08:37
24	Gate-in	Chassi	Monday	1:00 PM	00:00	01:25	01:25
25	Gate-in	Link	Monday	1:00 PM	00:53	02:08	03:01
26	Gate-in	Chassi	Monday	1:00 PM	01:23	03:03	04:26
27	Gate-in	SIMA	Monday	1:00 PM	00:00	02:00	02:00
28	Gate-in	Chassi	Monday	1:00 PM	01:09	01:27	02:36
29	Gate-in	Link	Monday	1:00 PM	00:00	03:15	03:15
30	Gate-in	Chassi	Monday	1:00 PM	00:29	02:18	02:47
31	Gate-in	Chassi	Monday	1:00 PM	05:06	01:40	06:46
32	Gate-in	Link	Monday	2:00 PM	00:54	01:35	02:29
33	Gate-in	Link	Monday	2:00 PM	04:27	02:22	06:49
34	Gate-in	Chassi	Monday	2:00 PM	02:13	02:06	04:19
35	Gate-in	Chassi	Monday	2:00 PM	00:00	02:13	02:13
36	Gate-in	Chassi	Monday	2:00 PM	04:52	01:31	06:23
37	Gate-in	Link	Monday	2:00 PM	02:09	01:43	03:52
38	Gate-in	Link	Monday	2:00 PM	03:44	01:23	05:07
39	Gate-in	SIMA	Monday	2:00 PM	01:30	02:15	03:45
40	Gate-in	Chassi	Monday	2:00 PM	04:14	01:55	06:09
41	Gate-in	Link	Monday	4:00 PM	01:41	04:58	06:39

42	Gate-in	Chassi	Monday	4:00 PM	00:00	02:12	02:12
43	Gate-in	Chassi	Monday	4:00 PM	00:00	02:33	02:33
44	Gate-in	SIMA	Monday	4:00 PM	00:00	02:29	02:29
45	Gate-in	Chassi	Monday	4:00 PM	00:00	02:20	02:20
46	Gate-in	Link	Monday	4:00 PM	01:32	03:42	05:14
47	Gate-in	Chassi	Monday	4:00 PM	00:00	01:22	01:22
48	Gate-in	Link	Monday	4:00 PM	00:00	02:16	02:16
49	Gate-in	Chassi	Monday	4:00 PM	00:00	01:59	01:59
50	Gate-in	Link	Monday	4:00 PM	00:00	02:18	02:18
51	Gate-in	Chassi	Tuesday	10:00 AM	00:00	01:32	01:32
52	Gate-in	Chassi	Tuesday	10:00 AM	00:00	02:10	02:10
53	Gate-in	Chassi	Tuesday	10:00 AM	00:00	01:26	01:26
54	Gate-in	Link	Tuesday	10:00 AM	00:00	01:35	01:35
55	Gate-in	Chassi	Tuesday	10:00 AM	00:00	01:36	01:36
56	Gate-in	SIMA	Tuesday	10:00 AM	00:00	02:18	02:18
57	Gate-in	SIMA	Tuesday	10:00 AM	00:00	02:24	02:24
58	Gate-in	Chassi	Tuesday	10:00 AM	00:00	02:07	02:07
59	Gate-in	SIMA	Tuesday	10:00 AM	01:05	01:39	02:44
60	Gate-in	Chassi	Tuesday	10:00 AM	01:44	02:24	04:08
61	Gate-in	Chassi	Tuesday	10:00 AM	00:00	01:40	01:40
62	Gate-in	SIMA	Tuesday	10:00 AM	03:49	01:25	05:14
63	Gate-in	Chassi	Tuesday	10:00 AM	00:00	01:18	01:18
64	Gate-in	Chassi	Tuesday	10:00 AM	00:10	01:40	01:50
65	Gate-in	Link	Tuesday	10:00 AM	00:00	01:20	01:20
66	Gate-in	SIMA	Tuesday	10:00 AM	00:00	03:34	03:34
67	Gate-in	Chassi	Tuesday	10:00 AM	00:00	02:13	02:13
68	Gate-in	SIMA	Tuesday	10:00 AM	00:51	01:35	02:26
69	Gate-in	Chassi	Tuesday	10:00 AM	00:49	01:57	02:46
70	Gate-in	Chassi	Tuesday	12:00 PM	02:02	01:33	03:35
71	Gate-in	Link	Tuesday	12:00 PM	00:00	01:51	01:51
72	Gate-in	Chassi	Tuesday	12:00 PM	00:00	02:01	02:01
73	Gate-in	Chassi	Tuesday	12:00 PM	00:00	01:43	01:43
74	Gate-in	Chassi	Tuesday	12:00 PM	01:19	01:41	03:00
75	Gate-in	Chassi	Tuesday	12:00 PM	02:15	01:33	03:48
76	Gate-in	Chassi	Tuesday	12:00 PM	00:41	01:57	02:38
77	Gate-in	Chassi	Tuesday	12:00 PM	00:00	01:18	01:18
78	Gate-in	SIMA	Tuesday	12:00 PM	00:00	01:15	01:15
79	Gate-in	Link	Tuesday	1:00 PM	00:00	01:52	01:52
80	Gate-in	Chassi	Tuesday	1:00 PM	01:55	02:36	04:31
81	Gate-in	Chassi	Tuesday	1:00 PM	00:24	01:35	01:59
82	Gate-in	Link	Tuesday	1:00 PM	00:45	01:37	02:22
83	Gate-in	Chassi	Tuesday	1:00 PM	01:09	01:42	02:51
84	Gate-in	Link	Tuesday	1:00 PM	00:00	01:21	01:21
85	Gate-in	Chassi	Tuesday	1:00 PM	00:00	01:32	01:32
86	Gate-in	Chassi	Tuesday	1:00 PM	00:00	01:52	01:52
87	Gate-in	Chassi	Tuesday	1:00 PM	00:00	02:09	02:09

88	Gate-in	Chassi	Tuesday	1:00 PM	01:32	01:20	02:52
89	Gate-in	Chassi	Tuesday	1:00 PM	01:09	01:35	02:44
90	Gate-in	Chassi	Tuesday	1:00 PM	00:27	02:21	02:48
91	Gate-in	Chassi	Tuesday	1:00 PM	01:09	01:15	02:24
92	Gate-in	Chassi	Tuesday	1:00 PM	00:00	01:14	01:14
93	Gate-in	Chassi	Tuesday	1:00 PM	00:00	01:37	01:37
94	Gate-in	SIMA	Tuesday	1:00 PM	00:27	02:00	02:27
95	Gate-in	SIMA	Tuesday	1:00 PM	00:00	02:16	02:16
96	Gate-in	Chassi	Tuesday	3:00 PM	01:29	02:41	04:10
97	Gate-in	Chassi	Tuesday	3:00 PM	00:00	01:20	01:20
98	Gate-in	Chassi	Tuesday	3:00 PM	00:00	01:56	01:56
99	Gate-in	Chassi	Tuesday	3:00 PM	00:00	01:25	01:25
100	Gate-in	Chassi	Tuesday	3:00 PM	00:00	02:23	02:23
101	Gate-in	SIMA	Tuesday	3:00 PM	01:32	01:43	03:15
102	Gate-in	Link	Tuesday	3:00 PM	00:00	02:41	02:41
103	Gate-in	Chassi	Tuesday	3:00 PM	00:00	02:17	02:17
104	Gate-in	Chassi	Tuesday	3:00 PM	00:00	01:31	01:31
105	Gate-in	Chassi	Tuesday	3:00 PM	01:08	01:51	02:59
106	Gate-in	Chassi	Tuesday	3:00 PM	00:00	03:40	03:40
107	Gate-in	Chassi	Wednesday	10:00 AM	00:00	01:34	01:34
108	Gate-in	Chassi	Wednesday	10:00 AM	00:00	01:34	01:34
109	Gate-in	Chassi	Wednesday	10:00 AM	00:00	03:45	03:45
110	Gate-in	Link	Wednesday	10:00 AM	00:00	02:41	02:41
111	Gate-in	Chassi	Wednesday	10:00 AM	00:00	02:01	02:01
112	Gate-in	Chassi	Wednesday	10:00 AM	00:00	02:57	02:57
113	Gate-in	Chassi	Wednesday	10:00 AM	00:00	02:25	02:25
114	Gate-in	Chassi	Wednesday	10:00 AM	00:00	01:36	01:36
115	Gate-in	Chassi	Wednesday	10:00 AM	00:00	01:38	01:38
116	Gate-in	Chassi	Wednesday	10:00 AM	00:00	02:03	02:03
117	Gate-in	Chassi	Wednesday	10:00 AM	00:00	01:13	01:13
118	Gate-in	Chassi	Wednesday	10:00 AM	00:27	03:51	04:18
119	Gate-in	Chassi	Wednesday	12:00 PM	00:00	02:04	02:04
120	Gate-in	Link	Wednesday	12:00 PM	00:00	01:54	01:54
121	Gate-in	Link	Wednesday	12:00 PM	00:00	03:16	03:16
122	Gate-in	Chassi	Wednesday	12:00 PM	00:00	01:37	01:37
123	Gate-in	Chassi	Wednesday	12:00 PM	00:00	01:38	01:38
124	Gate-in	Chassi	Wednesday	12:00 PM	00:00	02:14	02:14
125	Gate-in	Chassi	Wednesday	12:00 PM	00:00	01:26	01:26
126	Gate-in	Chassi	Wednesday	12:00 PM	00:00	01:52	01:52
127	Gate-in	Chassi	Wednesday	12:00 PM	00:00	01:51	01:51
128	Gate-in	Chassi	Wednesday	1:00 PM	02:41	01:25	04:06
129	Gate-in	Chassi	Wednesday	1:00 PM	05:55	03:54	09:49
130	Gate-in	SIMA	Wednesday	2:00 PM	00:00	03:55	03:55
131	Gate-in	Chassi	Wednesday	2:00 PM	03:44	03:10	06:54
132	Gate-in	Chassi	Wednesday	2:00 PM	00:00	01:48	01:48
133	Gate-in	Chassi	Wednesday	2:00 PM	01:50	02:16	04:06

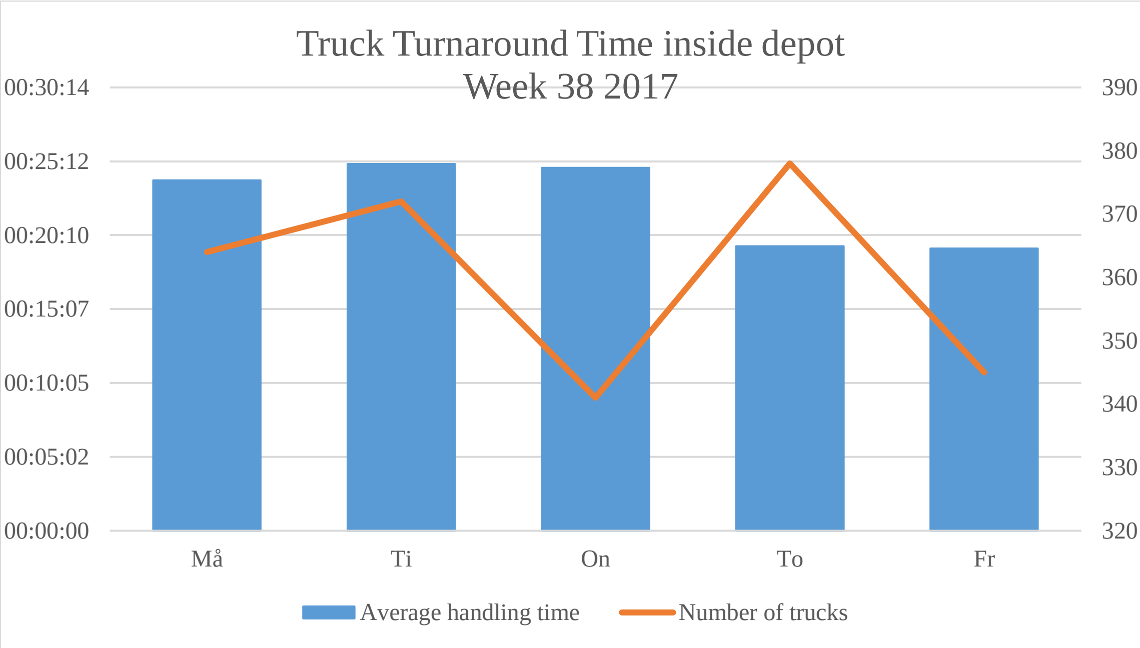
134	Gate-in	Chassi	Wednesday	2:00 PM	00:00	03:09	03:09
135	Gate-in	Chassi	Wednesday	3:00 PM	04:26	01:48	06:14
136	Gate-in	Link	Wednesday	4:00 PM	09:20	03:46	13:06
137	Gate-in	Chassi	Wednesday	4:00 PM	10:35	02:41	13:16
138	Gate-in	Link	Wednesday	4:00 PM	08:08	02:38	10:46
139	Gate-in	Chassi	Wednesday	4:00 PM	09:07	02:17	11:24
140	Gate-in	Link	Wednesday	4:00 PM	16:06	02:21	18:27
141	Gate-in	SIMA	Wednesday	4:00 PM	13:52	03:50	17:42
142	Gate-in	SIMA	Thursday	10:00 AM	00:00	01:43	01:43
143	Gate-in	SIMA	Thursday	10:00 AM	00:00	05:56	05:56
144	Gate-in	Chassi	Thursday	10:00 AM	00:54	01:36	02:30
145	Gate-in	Chassi	Thursday	10:00 AM	00:00	02:40	02:40
146	Gate-in	Chassi	Thursday	10:00 AM	01:19	02:01	03:20
147	Gate-in	Chassi	Thursday	10:00 AM	00:00	02:17	02:17
148	Gate-in	Chassi	Thursday	10:00 AM	02:11	01:41	03:52
149	Gate-in	Chassi	Thursday	10:00 AM	00:32	01:22	01:54
150	Gate-in	SIMA	Thursday	10:00 AM	00:00	01:52	01:52
151	Gate-in	Chassi	Thursday	11:00 AM	00:00	01:37	01:37
152	Gate-in	Link	Thursday	12:00 PM	00:00	01:41	01:41
153	Gate-in	SIMA	Thursday	12:00 PM	00:00	02:45	02:45
154	Gate-in	Link	Thursday	12:00 PM	00:00	01:27	01:27
155	Gate-in	Chassi	Thursday	12:00 PM	00:00	01:52	01:52
156	Gate-in	Chassi	Thursday	12:00 PM	00:00	01:53	01:53
157	Gate-in	Chassi	Thursday	2:00 PM	00:00	01:40	01:40
158	Gate-in	Link	Thursday	2:00 PM	00:00	01:12	01:12
159	Gate-in	SIMA	Thursday	2:00 PM	00:00	02:04	02:04
160	Gate-in	Chassi	Thursday	2:00 PM	00:00	01:30	01:30
161	Gate-in	Chassi	Thursday	2:00 PM	00:00	03:11	03:11
162	Gate-in	SIMA	Thursday	2:00 PM	04:27	03:06	07:33
163	Gate-in	Chassi	Thursday	2:00 PM	06:19	01:43	08:02
164	Gate-in	Chassi	Thursday	4:00 PM	00:00	01:51	01:51
165	Gate-in	Chassi	Thursday	4:00 PM	00:00	01:05	01:05
166	Gate-in	Chassi	Thursday	4:00 PM	00:53	01:49	02:42
167	Gate-in	Chassi	Thursday	4:00 PM	00:00	01:48	01:48
168	Gate-in	Chassi	Thursday	4:00 PM	00:00	02:14	02:14
169	Gate-in	Chassi	Friday	10:00 AM	02:23	01:40	04:03
170	Gate-in	Link	Friday	10:00 AM	00:00	01:54	01:54
171	Gate-in	Chassi	Friday	10:00 AM	00:00	04:05	04:05
172	Gate-in	Chassi	Friday	10:00 AM	00:00	02:52	02:52
173	Gate-in	SIMA	Friday	10:00 AM	00:00	03:28	03:28
174	Gate-in	Chassi	Friday	10:00 AM	00:00	02:58	02:58
175	Gate-in	Chassi	Friday	10:00 AM	00:00	01:46	01:46
176	Gate-in	Chassi	Friday	10:00 AM	00:00	02:27	02:27
177	Gate-in	Chassi	Friday	12:00 PM	00:00	02:35	02:35
178	Gate-in	Link	Friday	12:00 PM	01:14	01:46	03:00
179	Gate-in	Chassi	Friday	12:00 PM	00:31	01:32	02:03

180	Gate-in	Chassi	Friday	12:00 PM	00:50	01:28	02:18
181	Gate-in	Chassi	Friday	12:00 PM	00:00	02:14	02:14
182	Gate-in	Link	Friday	12:00 PM	00:00	01:45	01:45
183	Gate-in	Chassi	Friday	12:00 PM	00:00	04:00	04:00
184	Gate-in	SIMA	Friday	12:00 PM	00:00	02:51	02:51
185	Gate-in	Chassi	Friday	2:00 PM	00:00	04:55	04:55
186	Gate-in	Link	Friday	2:00 PM	00:00	01:52	01:52
187	Gate-in	Link	Friday	2:00 PM	00:00	01:57	01:57
188	Gate-in	Chassi	Friday	2:00 PM	00:00	02:20	02:20
189	Gate-in	Chassi	Friday	2:00 PM	00:00	03:08	03:08
190	Gate-in	Chassi	Friday	2:00 PM	00:00	01:51	01:51
191	Gate-in	Chassi	Friday	2:00 PM	01:26	02:12	03:38
192	Gate-in	Chassi	Friday	2:00 PM	00:00	01:56	01:56
193	Gate-in	Chassi	Friday	4:00 PM	05:22	02:28	07:50
194	Gate-in	Chassi	Friday	4:00 PM	12:59	01:09	14:08
195	Gate-in	Chassi	Friday	4:00 PM	02:14	01:50	04:04
196	Gate-in	Chassi	Friday	4:00 PM	00:00	01:47	01:47
197	Gate-in	Chassi	Friday	4:00 PM	00:51	02:06	02:57

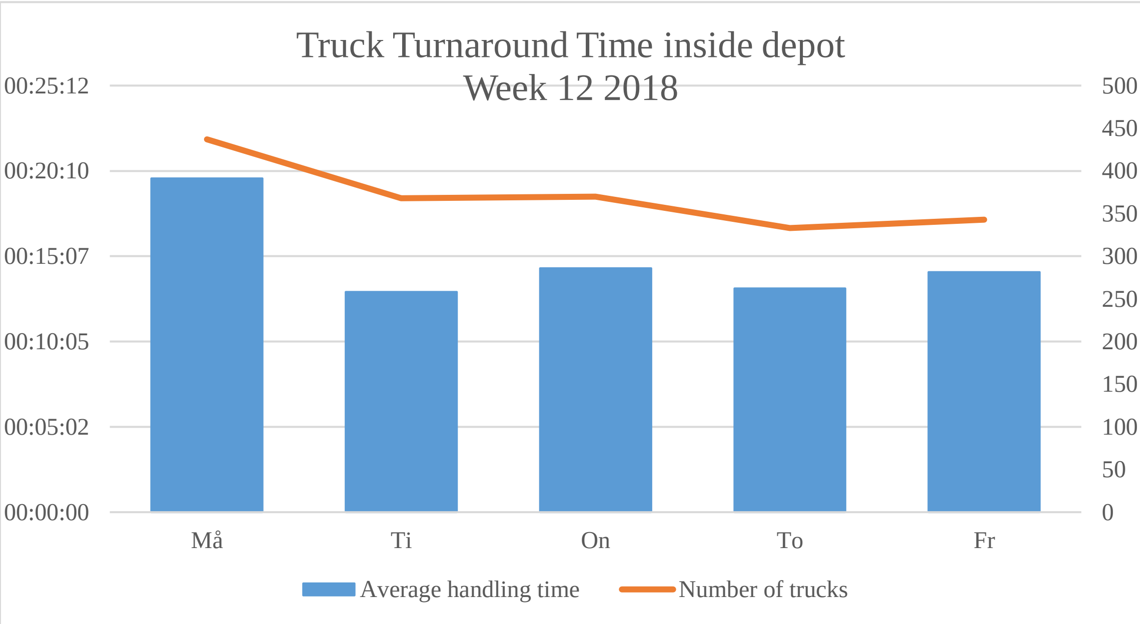
Note: Authors own copyright.

Appendix VI

Depot turnaround time provided by the Depot Operator. Charts are anonymized and formatted to minutes instead of days with permission.



Note: Retrieved from depot operator. Adopted with permission



Note: Retrieved from depot operator. Adopted with permission