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A FRAMEWORK FOR HOW LOGISTICS SERVICE PROVIDERS SHOULD HANDLE RETURNS AS A WAREHOUSE OPERATION FOR PURE E-COMMERCE COMPANIES

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Abstract

Title: A framework for how logistics service providers should handle returns as a warehouse operation for pure e-commerce companies

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Problem description: Managing the reverse logistics process in a warehouse is a central part of the activities for companies operating in e-commerce. Companies can outsource the return handling to a Logistics Service Provider (LSP) in order to focus on their core competences. The theory of today is based on the assumption that a physical point of contact is included in the chain. Therefore, there is a need to extend the theory into the context of e-commerce.

Purpose: The purpose of this thesis is to create a framework for how LSPs should handle returns in the warehouse, from the point of receiving until put back in storage, for customers in the e-commerce business.

Research questions: How should a LSP handle returns in the warehouse for customers of e-commerce? What are the barriers of the return handling in a warehouse and how can LSPs overcome these? How do the different characteristics of products and customers of a LSP change the handling of returns? How can the return handling in a warehouse of a LSP contribute to greater value for the customers acting in the e-commerce business?

Methodology: A flexible design methodology has been used in this thesis together with a multiple case study based on two cases at PostNord TPL´s facility in Helsingborg. Interviews, observations, and historical data have been collected and analysed in an intra case analysis and a cross-case analysis in order to answer the research questions and modify the reverse logistics framework to the context of e-commerce.

Conclusions: A framework for how LSPs should handle returns in a warehouse is extended based on theory to the context of e-commerce. Several barriers of the return handling for LSPs have been identified. These are: limited sharing of forecasts, limited visibility, customer requirements, heterogenous decision making, and the changing business of e-commerce. It can be concluded that the product and customer characteristics impact the handling of returns to a large extent. To be able to contribute to greater value for the customers, the LSP should offer a fast, efficient, and less costly reverse logistics process than if they would perform it in-house.

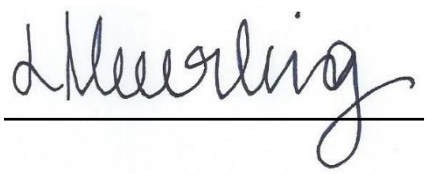
Keywords: Warehouse activities, inbound logistics, reverse logistics process, returns, return handling, e-commerce, logistics service provider

Preface

The research of this thesis was conducted during the spring in 2017 as a part of our engineering studies within the field of Supply Chain Management at the Faculty of Engineering of Lund University. By conducting the project our skills of performing a larger project in a structured way have been improved. In addition, we have learnt how to ensure the quality of a research and how to overcome unexpected obstacles along the process. Finally, the thesis has given us the opportunity to understand the relation between theory and practice.

The project was initiated by our collaborating partner PostNord TPL AB. It would not have been possible to execute the thesis and achieve the results without their help and support. Therefore, we would like to thank PostNord TPL AB for the opportunity to execute this thesis and all the employees that have been involved in this research. We are especially grateful to Henrik Strandberg, our supervisor at PostNord TPL AB, for his support, help, and happy mind. Finally, we would like to thank Joakim Kembro, our supervisor at Lund University, for the support and help with the academical aspects.

Lund, June 2017



Louise Meurling Matilda Sturesson

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Abbreviations

E-commerce	Electronic Commerce
ERP	Enterprise Resource Planning
FIFO	First In First Out
IT	Information Technology
KPI	Key Performance Indicator
LSP	Logistics Service Provider
RFID	Radio-Frequency Identification
SKU	Stock Keeping Unit
WMS	Warehouse Management System

1 Introduction

The introducing chapter will brief the background that developed this research and the purpose of its execution. The chapter also discusses the research questions, information about the collaborative partner, and the delimitations. The end of the chapter gives the reader information about the structure of the remaining report.

1.1 Background

Warehouse activities includes handling of the inbound and the outbound flow of goods. The outbound flow is the activities of order-picking, checking, packing, and shipping (Bartholdi and Hackman, 2016, Gu et al., 2007a). The inbound flow handles the receiving and put-way of new products but also the reverse logistics flow of returns (Bartholdi and Hackman, 2016, de Koster et al., 2007, Gu et al., 2007a). Reverse logistics is the process of planning, implementing, and controlling the efficient and cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin. The purpose of this process is to recapture value or proper disposal for the return (Rogers, 1998). Reverse logistics is and has been a growing field for some time, due to the high costs associated with product returns (Hsiao, 2010, Lee and Chan, 2009). Industry and researchers have realized the need for more research in the field to be able to stay sustainable competitive (Hsiao, 2010, Lee and Chan, 2009). Reverse logistics is one of the key competences in modern supply chains due to growing environmental awareness, corporate social responsibility, legislation and sustainable competitiveness (Wang, 2015). Researchers have spent a lot of effort studying how reverse logistics can reduce cost and how to establish an effective and efficient reverse logistics structure (Chan et al., 2010).

The reverse logistics process usually starts by consumers needing authorisation from the company to be able to return the product and then the screening will take place (de Leeuw et al., 2016). The screening determines which products to allow in the reverse logistics process (Beh et al., 2016). The aim is to control and reduce the number of returns without damaging consumer satisfaction (Rogers et al., 2002). The two initial steps of the reverse logistics process are usually performed at a physical point in the chain, such as a store. Conventional retailers can use the store for handling some of the returns and therefore lower the costs (Lee and Chan, 2009). The research of how to handle returns up to today is based on the assumption that a physical point of contact with the consumer is included in the chain (de Leeuw et al., 2016, Lambert et al., 2011, Rogers et al., 2002, Stuart et al., 2005).

For companies operating through pure e-commerce channels there are no physical point for screening, which means that a larger amount of returns is let into the reverse logistics flow. Higher costs are also associated with no screening due to the large amount of unwanted returns that need to be processed at the warehouse instead of stopped at the store (Asdecker, 2015, de Leeuw et al., 2016). The volume of returns and the handling cost in reverse logistics is one of the biggest challenges for a logistics service provider (LSP) handling returns for customers in

the e-commerce business (Mollenkopf et al., 2007). A LSP that faces this challenge is PostNord TPL AB, from now on PostNord TPL. PostNord TPL can tailor and offer custom made solutions within, for example, storage, receiving, and distribution (PostNordTPL, 2016). One of their largest customer segments is represented by companies operating in e-commerce. These customers value fast and efficient handling of returns to increase their consumers satisfaction (Brusch and Stüber, 2013). PostNord TPL struggles with returns, since their return management is very costly and does not add value to the products. The reverse logistics flow for PostNord TPL starts when the return is received in the warehouse and ends when the return is put back in storage. The return needs to be inspected and stored in the warehouse as fast and efficient as possible and the consumer needs to be refunded as early as possible (PostNordAB). The lack of a structured process of return handling is causing unnecessary high costs for the warehouse activity. Therefore, PostNord TPL would like to achieve a structured return handling.

To the knowledge of the researchers, the research and practice of how to handle returns in the warehouse are limited and a framework for how to handle returns in pure e-commerce channels is missing (Agatz et al., 2008, Rao et al., 2014). It can be concluded that there is a gap in the research. With growing e-commerce in both the Swedish market and other global markets, like the Chinese market (Ecommerce-Europe, 2016), it is important to fill the gap. A framework for how to handle returns in warehouses would be of great interest both for companies and for research. It could help PostNord TPL as well as many other companies, who are struggling with returns, to handle returns more efficient and cost effective.

1.2 Purpose

The purpose of this research is to create a framework for how PostNord TPL should handle returns in the warehouse, from the point of receiving until the return is put back in storage, for current and new customers in the e-commerce business.

1.3 Research questions

Research questions have been created to address the purpose. Figure 1 shows the questions in the research context. The research questions are:
RQ1: How should a LSP handle returns in the warehouse for customers of e-commerce?
RQ2: What are the barriers of the return handling in a warehouse and how can LSPs overcome these?
RQ3: How do different product and customer characteristics of a LSP change the handling of returns?
RQ4: How can the return handling in a warehouse of a LSP contribute to greater value for the customers acting in the e-commerce business?

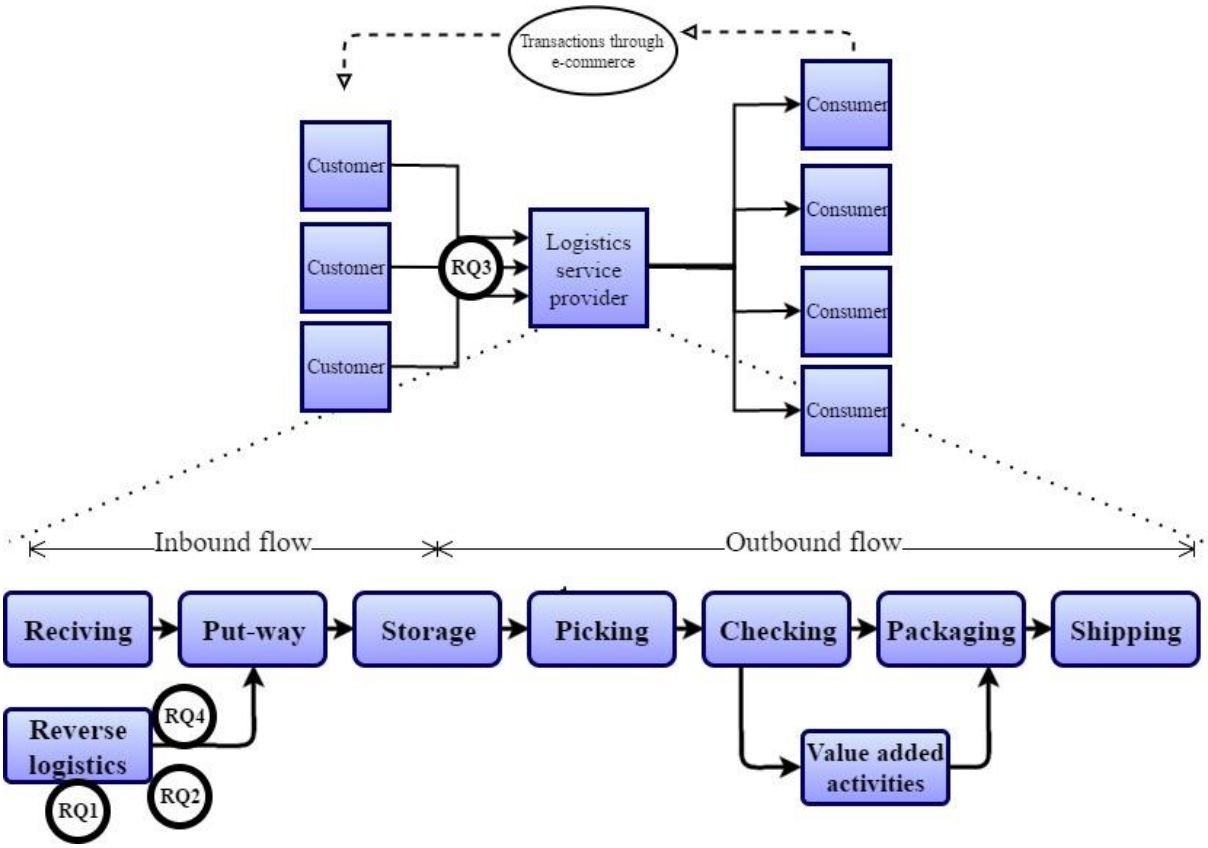

Figure 1. Context of the research questions.

1.4 Description of collaborating partner

The collaborating partner in this report is as mentioned PostNord TPL. PostNord TPL is a LSP and a part of the PostNord Group AB, see figure 2. PostNord Group AB is one of the leading companies offering logistical solutions in the Nordic area (PostNordAB, 2016c) and has an annual growth of 15 percent (PostNordAB, 2016a). A conceptual supply flow of PostNord TPL can be seen in figure 3. PostNord TPL offers complete logistic solutions within inbound transports, warehousing, and outbound transports. They are offering complementing services, such as customer service, control tower service like track and trace possibilities, and final assembly (PostNordAB, 2016a). PostNord TPL have customers in several segments. One of their largest customer segments is represented by companies operating in e-commerce (PostNordTPL, 2016). Return handling is included in the customised offerings and is used for several of their customers operating in e-commerce (PostNordAB).

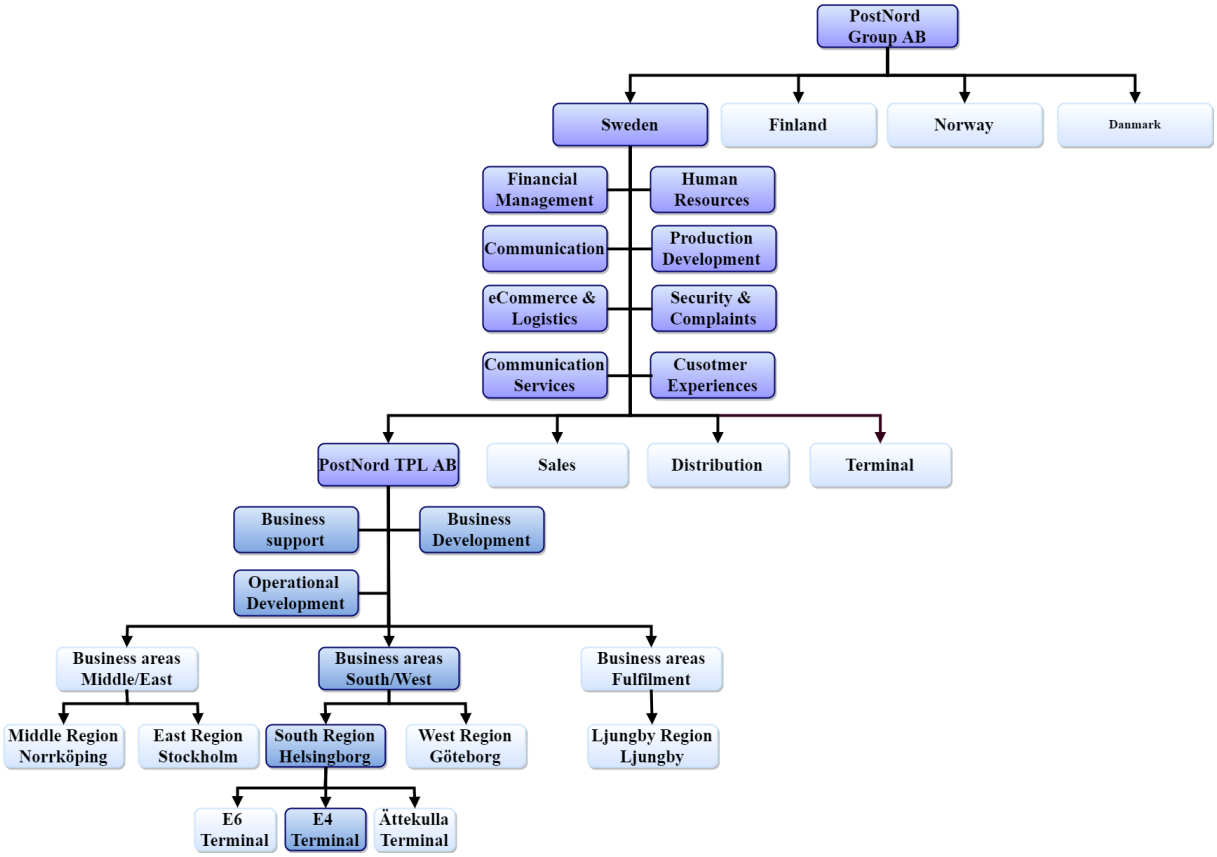

Figure 2. Organisation structure of PostNord TPL.

The collaboration with PostNord TPL are interesting due to several reasons. First, their large market share and their possibilities to impact the market provides opportunities for the framework to reach the market. Second, PostNord TPL has customers that can have returns up to 32 percent of the sales, which could be used as cases in this research. Third, PostNord TPL is developing and extending their offered services (PostNordAB, 2016c), which allow innovations and new features in the return handling. Fourth, PostNord TPL collaborate with several e-commerce companies and PostNord Group AB has decided to invest more in the e-commerce business (PostNordAB, 2016c). The fifth motive for a good collaboration is the desire of PostNord TPL to achieve a structured process for return handling.

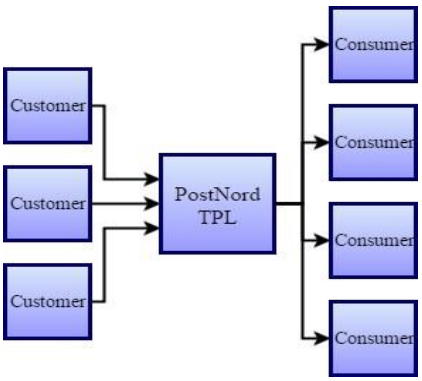

Figure 3. The flow of PostNord TPL.

1.5 Delimitations

There are some delimitations made in this research. The return handling is limited to the flow in the warehouse, from the point when the goods are received until they are put back in storage. The research only focuses on discussing the return handling and not the reverse flow with the aim of recycling and remanufacturing. The research focuses on return handling in a warehouse. To influence consumers' buying behaviour and to stop consumer returns by changing the return policy are therefore outside this research. The process of return handling is based on two cases, due to that PostNord TPL only have two cases available for investigation. The research is set to two persons work with a time delimitation of 20 weeks.

1.6 Structure of the thesis

The structure of the report is divided in six individual chapters. Chapter two, presents a literature review of the theory including general warehouse information, reverse logistics in a warehouse, resources needed in a warehouse, differences and connection between the forward and reverse flow, logistics service providers, and electronic-commerce. In the end of chapter two, a process framework conducted from the literature review is presented. Chapter three discusses the methodology and how it is chosen. Chapter three also describes the case companies and the research process. The final section of chapter three discusses how the research should ensure trustworthiness. Chapter four presents the empirics from the two case studies. Chapter five analyses the empirics and the process framework are modified into the context of e-commerce. Finally, chapter six presents the conclusions of the research questions, the theoretical and managerial contributions, and suggestions for future research.

2 Frame of reference

An extensive literature review has been conducted with focus on reverse logistics in a warehouse. Some restrictions on the reviewed literature were made. The published date was restricted to the year of 2000 until 2017. In addition, five quality criteria were determined and the articles had to fulfil at least three of the criteria. The quality criteria are: the journal is peer reviewed, the journal has an editorial board, the article is cited more than ten times a year, the article has a scientific structure, and the authors of the article are connected to a university. Below, the literature is presented in seven subchapters: Warehouse, Reverse logistics process in a warehouse, Supporting resources in a warehouse, Differences and connection between the forward and reverse flow, Logistics service providers, and Electronic-commerce. The connection between the literature areas can be seen in figure 4. Finally, in the last subchapter, the literature is summarised in a process framework.

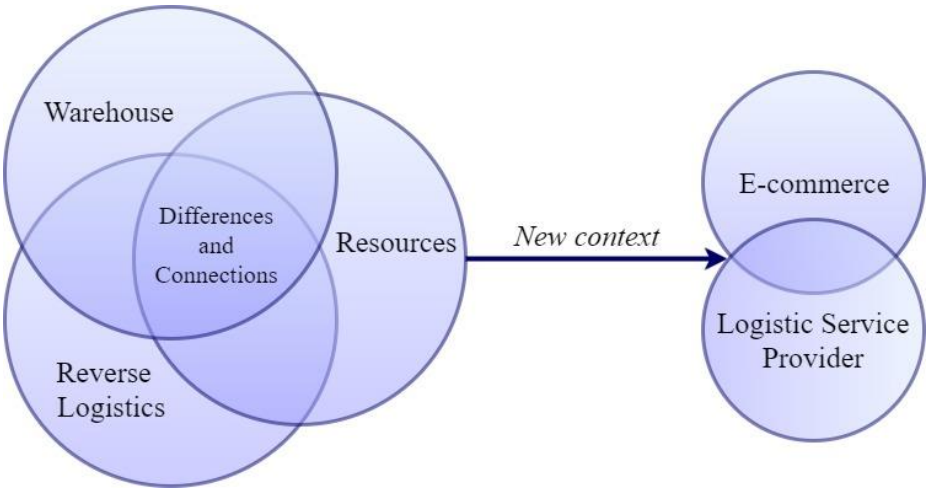

Figure 4. The connection between the literature areas.

2.1 Warehouse

According to Bartholdi and Hackman (2016), warehouses can be described as "*the points in the supply chain where product pauses, however briefly, and is touched"*. Warehouses are used in several purposes: to better match supply and demand, to consolidate products to reduce transportation costs, and to enable value-added-processes (Bartholdi and Hackman, 2016, Gu et al., 2007b). According to van den Berg and Zijm (1999), there are three types of warehouses: distribution warehouses, production warehouses, and contract warehouses. In a distribution warehouse, products from different suppliers are collected for delivery to a number of customers. A production warehouse is used for storage of raw materials, semi-finished products, and finished products in a production facility. A contract warehouse is a facility that performs the warehousing operation on behalf of customers (Bartholdi and Hackman, 2016, van den Berg and Zijm, 1999).

2.1.1 Activities in a warehouse

A warehouse can be divided into two flows: the inbound flow and the outbound flow (Bartholdi and Hackman, 2016, de Koster et al., 2007, Gu et al., 2007a). The inbound flow includes receiving of goods, put-away, and handling the reverse logistics process (Bartholdi and Hackman, 2016, Gu et al., 2007a). Receiving is the activity performed when goods arrive in the warehouse. The goods are brought into the warehouse, inspected for the right quantity and quality, and registered as inventory. Before put-away can be performed, the goods might need to be repacked in order to have the right packaging size for the dedicated location of the goods. The locations, where the goods will be stored, are registered (Bartholdi and Hackman, 2016, de Koster et al., 2007, Gu et al., 2007a). Companies can register the locations manually or with help of a warehouse management system (WMS), for more information see section 2.3.4.1. It is important to choose the optimal storage location due to that it impacts how quickly the goods can be picked later on (Bartholdi and Hackman, 2016).

The outbound flow includes order-picking, checking, packing, and shipping (Bartholdi and Hackman, 2016, Gu et al., 2007a). Order-picking is when goods are retrieved from their storage location (Rouwenhorst et al., 2000). Travel time during order-picking is a direct expense, but does not add value. Therefore, picking routes are often used to optimise picking and minimise travel distance. Depending on the size of the warehouse and size of the orders, the picking routes can be structured differently (Bartholdi and Hackman, 2016, de Koster et al., 2007). For large warehouses with many picks, a WMS can be used to give an optimal sequence of order-picking. Normally, order-picking is the most labour intensive activity (Agatz et al., 2008, Bartholdi and Hackman, 2016) due to the large amount of time spent on traveling between locations (Schrotenboer et al., 2016). Since it is a costly activity it is important to plan the handling of goods careful (Bartholdi and Hackman, 2016). Order-picking is followed by checking and packaging of goods. Each piece will be handled and this is a convenient time in the process to ensure that the right goods have been picked. Before shipping, the goods might be consolidated depending on, for example, final destination. When the goods are shipped, they are registered as sent in the system and the inventory is updated (Bartholdi and Hackman, 2016, de Koster et al., 2007).

Value added activities, can be performed in a warehouse and include, for example, ticketing or labelling, repackaging, assembly, postponement of final assembly, and invoicing. Another activity performed in the warehouse is the handling of returns in the reverse logistics process (Bartholdi and Hackman, 2016). All activities can be seen in figure 5.

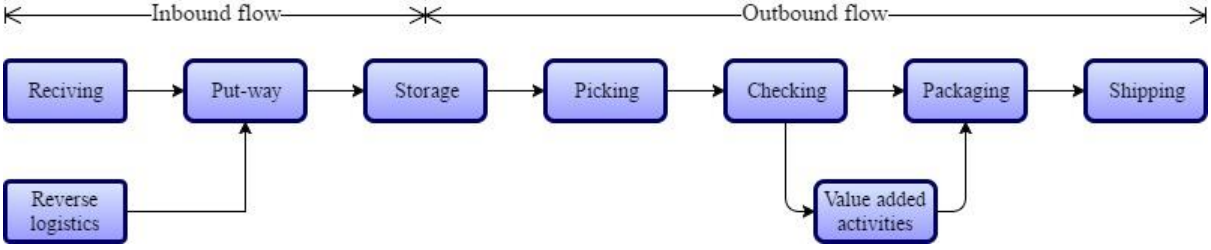

Figure 5. Activities in a warehouse.

2.2 Reverse logistics process in a warehouse

Rogers et al. (1998) define reverse logistics as:

> *The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal.*

Different types of returns are managed within reverse logistics. Rogers et al. (2002) divide returns into five different categories: consumer returns, marketing returns, asset returns, product recalls, and environmental returns. The different categories are explained in table 1. Consumer returns are in general the largest category of returns (Rogers et al., 2002).

Table 1. Description of the five different return categories (Rogers et al., 2002)

Kind of return	Description
Consumer returns	Returns due to buyers' remorse or defects.
Marketing returns	Returns from a position forward in the supply chain. Often due to slow sales, quality issues, or the need to reposition inventory.
Asset returns	Returns to recapture and repositioning assets.
Product recalls	Returns that are usually initiated because of safety or quality issues.
Environmental returns	Returns for disposal of hazardous materials or abiding by environmental regulations.

To achieve a successful reverse logistics process, time and cost should be reduced (de Leeuw et al., 2016, Dissanayake and Singh, 2007, Griffis et al., 2012, Hall et al., 2013, Ketzenberg and Zuidwijk, 2009, Stuart et al., 2005, XiaoYan et al., 2012). Badenhorst (2013) mentions a number of approaches organisations can use to limit costs in reverse logistics processes: streamline, automate and standardise their reverse logistics process, and set structured processes. Irrespective of the return category, there is a need for structure and control in the reverse logistics process (Genchev et al., 2011). The process should be formalised in order to facilitate a more efficient flow (Hall et al., 2013, Hui and Ponce Cueto, 2016). Genchev et al. (2011) define process formalisation as the agreed upon written rules and procedures regarding a particular business operation. To have a formalised return process is crucial in order to help return managers and inspectors to reduce the level of complexity and streamline the reverse logistics processes (Genchev et al., 2011, Rogers et al., 2002). Automatisation would be one good implementation to streamline the processes, but it is difficult since the reverse logistics process includes several exceptions (Rogers and Tibben-Lembke, 2001). Speed is essential in the reverse logistics process (de Leeuw et al., 2016). de Koster et al. (2002) suggest companies to bulk similar products to gain larger volumes in order to achieve a more efficient handling. LSPs are also able to achieve economies of scale by combining volumes from multiple customers (Stock and Mulki, 2009).

Guide Jr and Wassenhove (2002) stress the importance to tailor each logistics network design due to that there is no “best” design. The reverse logistics process need to be tailored depending

on the product's characteristics and the economics of their reuse (Guide Jr and Van Wassenhove, 2002). Before designing the process, the firm needs to consider how returns impact their overall customer service strategy and contribute to improved profits (Rogers et al., 2002).

Bernon and Cullen (2007), Bernon et al. (2011), Lambert et al. (2011), and Rogers et al. (2002) suggest that the reverse logistics process should be divided into hierarchical levels in order to help assigning different responsibilities and perform proper management. The process can be divided into strategic and operational (Lambert et al., 2011, Rogers et al., 2002).

2.2.1 Strategic management in the reverse logistics process

The strategic objective is to construct a formalised structure where the operational process is included (Lambert et al., 2011, Rogers et al., 2002). Three strategic activities are related to the reverse logistics flow in the warehouse. The first is to determine the goals and the strategy of the reverse logistics (Genchev et al., 2011, Lambert et al., 2011, Rogers et al., 2002). Decisions on how to best recapture value and recover assets, reviewing environmental and legal compliance issues, and understand the supply chain capabilities are included in this activity. The second is to determine rules and regulations around the secondary markets (Lambert et al., 2011, Rogers et al., 2002). The third is to develop a framework of metrics to be able to evaluate the return handling performance and the associated costs (Bernon and Cullen, 2007, Bernon et al., 2011, Lambert et al., 2011, Rogers et al., 2002), more information in section 2.2.3 Performance indicators. Bernon et al. (2011) found that it is especially important for the retail reverse logistics management to minimise logistical costs and to improve revenue for the re-sellable products. One of the particular important management areas is information technology (IT) (Bernon et al., 2011).

2.2.2 Operational management in the reverse logistics process

The operational level of the reverse logistics process consists of several steps. Researchers discuss the same steps but with some differences (Badenhorst, 2013, Blackburn et al., 2004, Genchev et al., 2011, Guide Jr and Van Wassenhove, 2002, Mukhopadhyay and Setaputra, 2006, Rogers et al., 2002, Stock and Mulki, 2009, Stuart et al., 2005, Tibben-Lembke and Rogers, 2002). The reverse logistical process starts with authorisation and screening (de Leeuw et al., 2016). Followed by the steps of collection, inspection, sorting, and disposition (Badenhorst, 2013, Blackburn et al., 2004, Genchev et al., 2011, Guide Jr and Van Wassenhove, 2002, Stock and Mulki, 2009). Some researchers also include an additional disposition options, selecting secondary markets (Blackburn et al., 2004, Genchev et al., 2011, Mukhopadhyay and Setaputra, 2006, Tibben-Lembke and Rogers, 2002). All steps will now be further explained.

2.2.2.1 Authorisation and screening

The reverse logistics process starts when a consumer returns a product at an authorisation point (de Leeuw et al., 2016). The consumer will need authorisation before the product can enter the reverse flow (de Leeuw et al., 2016, Lambert et al., 2011). Depending on the sales channel, consumers can return the product to the physical store, send the return via a collection and drop-

off point, or a carrier picks up the return at the consumer's address (de Leeuw et al., 2016). To get authorisation, screening will be performed. The screening will ensure companies to not accept unauthorised, invalid, or unwanted returns (Lambert et al., 2011, Rogers et al., 2002). According to de Leeuw et al. (2016), there are three possibilities for screening. First, centralised screening. The returns are collected to be forwarded to a central return facility where the screening will take place. This is a good layout in the perspective of the LSP (Badenhorst, 2013, Blackburn et al., 2004, de Leeuw et al., 2016). Second, decentralised screening. The returned products are screened immediate, typically at the physical store. Third, no screening. The company has a free return policy and no authorisation is needed (de Leeuw et al., 2016). According to de Leeuw et al. (2016), there are higher costs associated with centralised screening than decentralised screening. The processing on a per item basis is generally lower for decentralised companies, since they can use the physical stores for screening and thereby reduce transportation (de Leeuw et al., 2016). The first step of the reverse logistics process can be seen in figure 6.

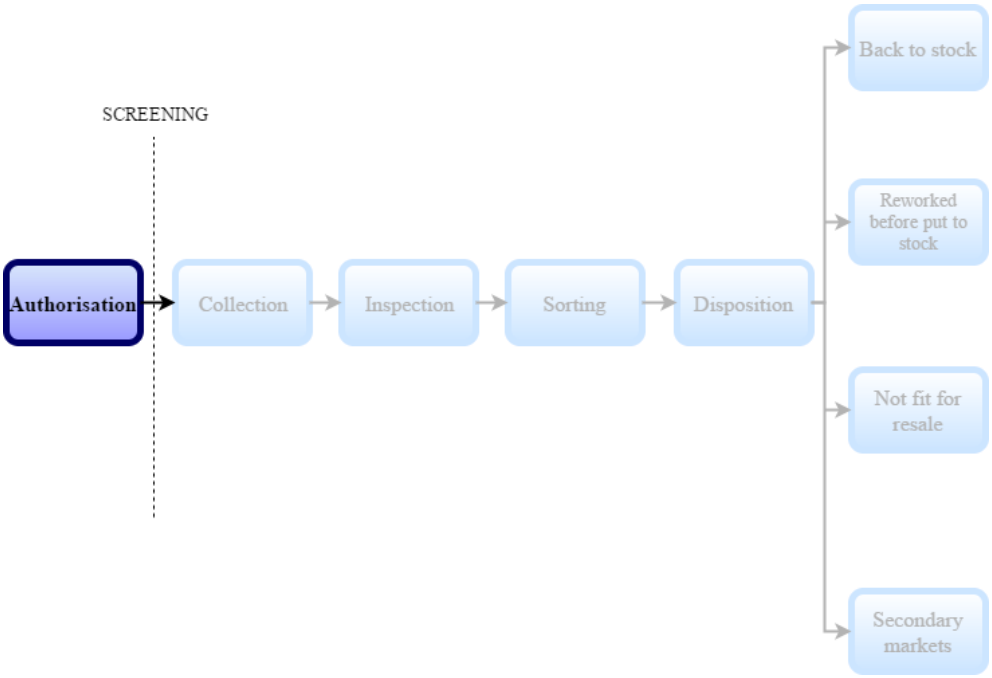

Figure 6. The reverse logistics process starts with authorisation of the return.

Some researchers state that the consumer should be refunded immediately after the return is received (Stuart et al., 2005). Other suggest that it should be the last step in the process (Genchev et al., 2011, Rogers et al., 2002).

2.2.2.2 Collection

The collection includes: pick-up, distribution, and unloading of the returns at the processing location (Lambert et al., 2011, Stock and Mulki, 2009). Genchev et al. (2011) include monitoring and controlling volumes as well. The responsibilities of the collection can rest upon the consumer, the company, or the LSP (Lambert et al., 2011).

Blackburn et al. (2004) point out the importance of doing an early product differentiation in the reverse logistics process. Returns should be separated depending on the destiny as early as possible. If treatment of returns can be separated, great savings and faster processing times can be achieved (Blackburn et al., 2004). There are many challenges with receiving returns, due to non heterogeneous products and non uniformly packages. Moreover, according to Nuss et al. (2015), the reverse flow might contain unwanted by-products that take time at the collection and the inspection. Collection is typically a manual process and should be performed as quickly as possible to improve profit (Rogers et al., 2002). The collection can be seen in connection to the previous step in figure 7.

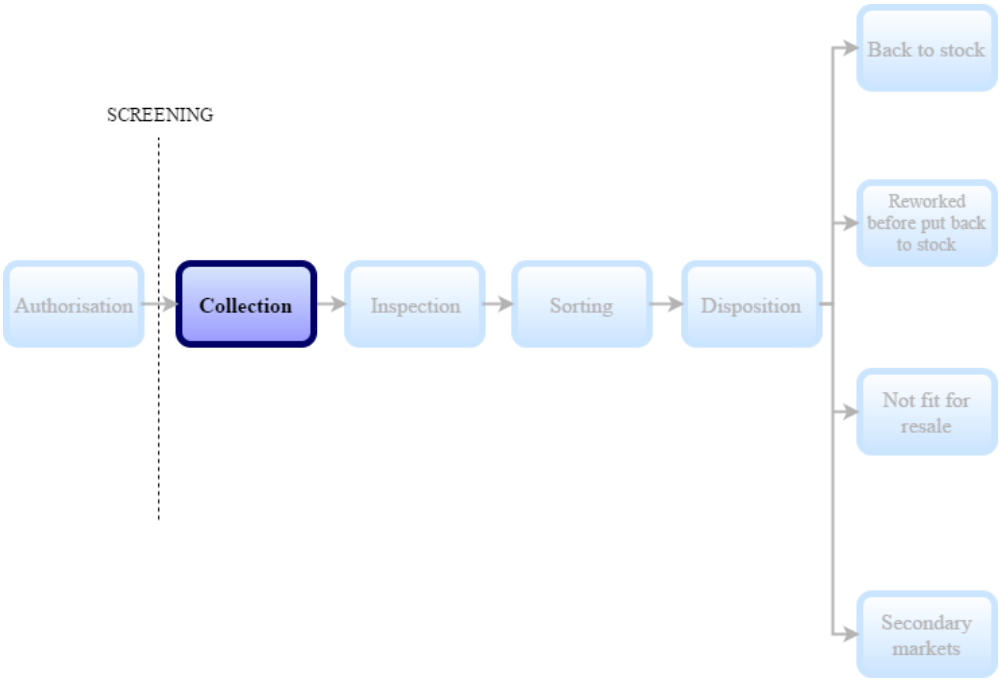

Figure 7. The second step in the reverse logistics process is collection.

2.2.2.3 Inspection

The condition of the returns will be inspected and evaluated in the third step of the reverse logistics process. According to Genchev et al. (2011), the inspection should be done through physical inspection or automated testing. Rogers et al. (2002) stress the importance of having clear guidelines and well-trained staff to ensure that the correct inspection is made. The inspection phase is also difficult and costly due to lack of uniformity of the physical products in the reverse logistics process (Tibben-Lembke and Rogers, 2002). The inspection can be seen in connection to the previous steps in figure 8.

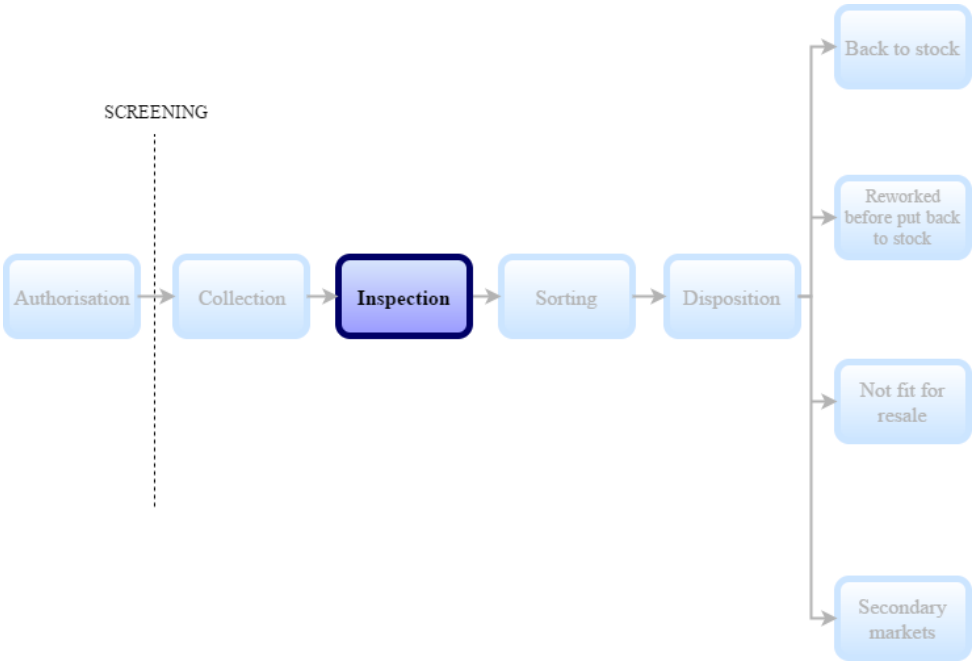

Figure 8. The third step in the reverse logistics process is inspection.

2.2.2.4 Sorting

In sorting, the main activities are to make the initial reprocessing decision and route the returns to the right disposition point (Stock and Mulki, 2009, Thierry et al., 1995). Managing the sorting well is one of the key challenges for companies according to Tibben-Lembke and Rogers (2002). Depending on the condition, the return can be reused, remanufactured, or recycled. It is important to have appropriate identification mechanisms in order to make the right decision for the return. The decision can otherwise be difficult and add cost to an already costly process, due to lack of expertise, experience, and quality deviation (Jayaraman et al., 2008). Blackburn et al. (2004) stress the importance of making the most profitable decision for disposition and Zikopoulos and Tagaras (2015) stress the need for explicit consideration of sorting accuracy. According Beh et al. (2016), companies should keep in mind if the returns can recapture value as giveaways or if the returns can be sent to charitable organisations in the sorting. The sorting in connection to the other steps in the reverse logistics process can be seen in figure 9.

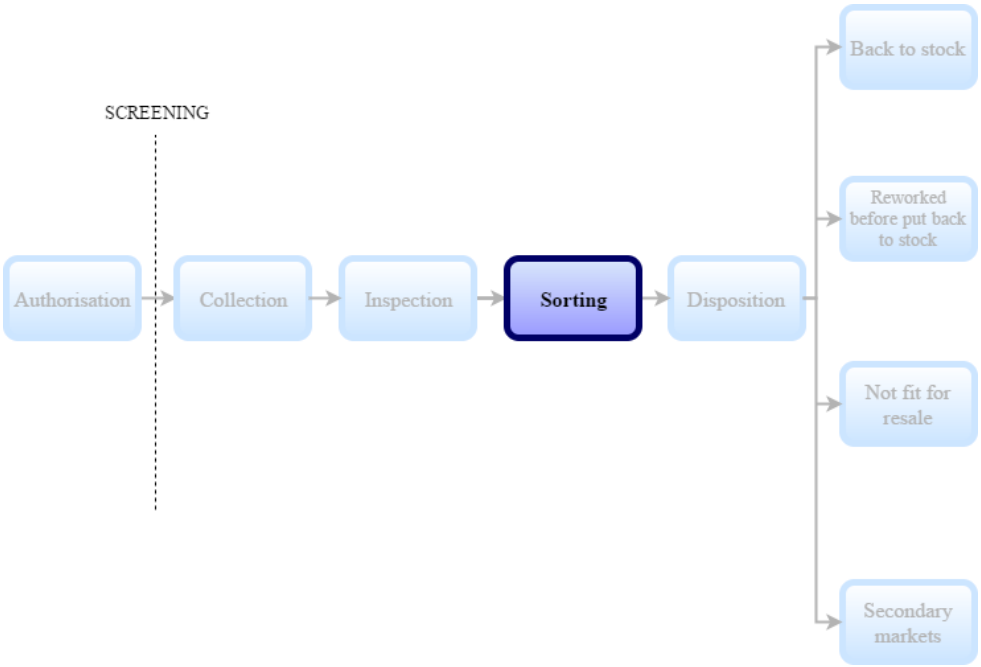

Figure 9. The fourth step in the reverse logistics process is sorting.

2.2.2.5 Disposition

Genchev et al. (2011) and Thierry et al. (1995) stress the importance of establish formal disposition options for returns. To eliminate costs, companies need to decide the disposition option as early as possible in the reverse logistics process (Guide Jr and Van Wassenhove, 2002).

Different disposition options

According to several researchers, the destinies of returns can be divided into three options. The three options are: put back to stock, rework before put back to stock, and not fit for resale (Blackburn et al., 2004, de Leeuw et al., 2016, Genchev et al., 2011, Hazen et al., 2012, Lambert et al., 2011, Rogers and Tibben-Lembke, 2001, Stuart et al., 2005). Some researchers also include a final step of creating secondary markets (Blackburn et al., 2004, Krikke et al., 2004, Mukhopadhyay and Setaputra, 2006, Tibben-Lembke and Rogers, 2002). The four disposition options can be seen in figure 10.

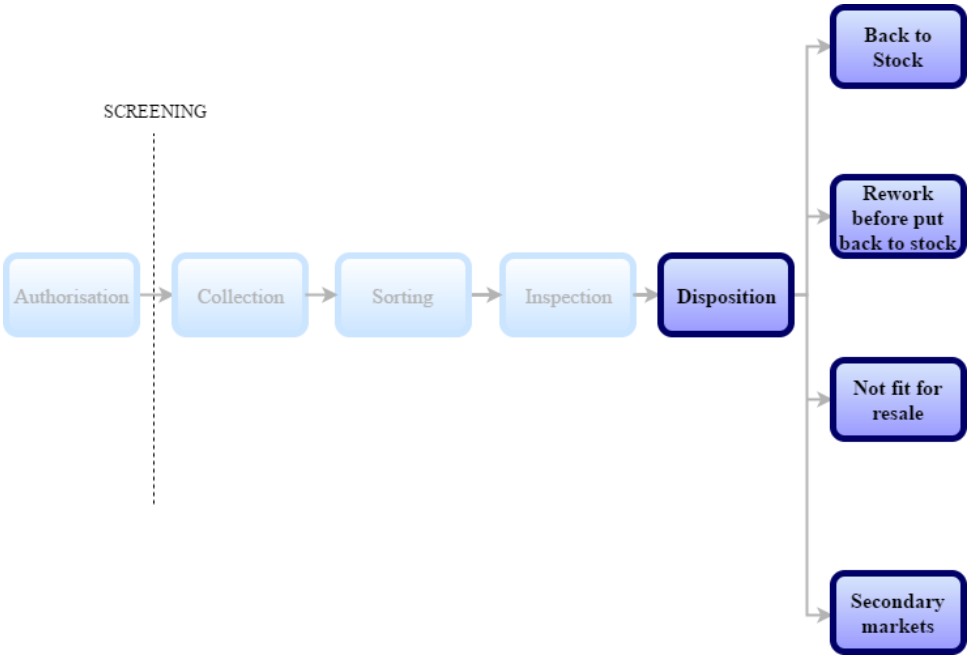

Figure 10. The four disposition options.

The first option is that the return can be put back to stock and offered for immediate resale (Badenhorst, 2013, Fleischmann et al., 2000, Stock and Mulki, 2009, Van Hillegersberg et al., 2001). According to Hazen et al. (2012), reuse is the option if the returned product is unused or has been of such light use that it can be put back immediately to stock. A direct reuse is not possible if the returned products need to be upgraded, for example, through cleaning, replacing accessories, remanufacturing, or repackaging (Hazen et al., 2012).

The second option is that the return will need rework in order to be put back to stock for resale. Rework involves repacking, refurbishing, or repairing (Badenhorst, 2013, Fleischmann et al., 2000, Stock and Mulki, 2009, Van Hillegersberg et al., 2001). Blackburn et al. (2004), Rogers and Tibben-Lembke (2001), and Stock and Mulki (2009) also include remanufacturing, with the aim to bring back the product to its original specification. Thierry et al. (1995) and Van Hillegersberg et al. (2001) also add cannibalisation and component recovery as options. Lambert et al. (2011) give similar treatment options for rework, but add upgrade options for the returned product. Rework aims to recover any part of a returned product that still contains value (Hazen et al., 2012).

The third option is when the return is not fit for sale (Blackburn et al., 2004, de Leeuw et al., 2016, Genchev et al., 2011, Hazen et al., 2012, Lambert et al., 2011, Rogers and Tibben-Lembke, 2001, Stuart et al., 2005). The returns can be discarded, recycled, or disposed. They can be handled at a central facility, for example at a central warehouse or at a physical store (de Leeuw et al., 2016, Lambert et al., 2011, Rogers and Tibben-Lembke, 2001, Thierry et al., 1995, Tibben-Lembke and Rogers, 2002). The returns become waste when they no longer have any value that can be recovered and there is no value in upgrading the returns (Hazen et al., 2012).

The fourth option of secondary markets, such as outlets, are for the returns that have been recovered but for different reasons are not fit for resale through primary channels (Blackburn et al., 2004, Krikke et al., 2004, Mukhopadhyay and Setaputra, 2006, Tibben-Lembke and Rogers, 2002). Tibben-Lembke and Rogers (2002) and Genchev et al. (2011) also suggest donation to charity if it is not possible to resell the return. Reselling reused and reworked returns at the secondary market plays a major role for apparel and fashion retailers (Beh et al., 2016). The four disposition options in connection to the other steps in the reverse logistics process and can be seen in figure 11.

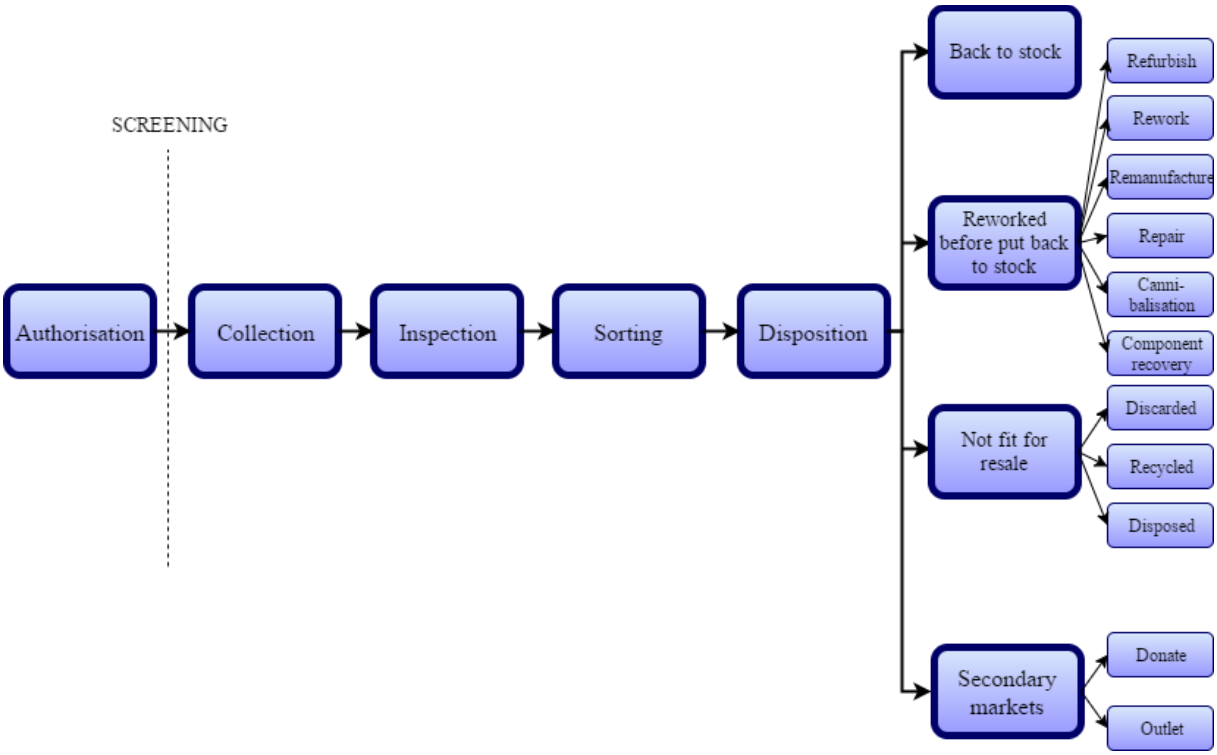

Figure 11. The four options with all the alternatives in the disposition in connection to the other steps.

Capture value in the disposition option

Companies need to take time to consider which options in the disposition that generates value for each returned product (Hazen et al., 2012, van Nunen and Zuidwijk, 2004). Lambert et al. (2011) state that the main goal of the disposition is to recapture as much value as possible from the returns, although not all activities can generate revenue.

Reuse the returned product is the best option for companies and management of supply chains (Bernon and Cullen, 2007). Tibben-Lembke and Rogers (2002) stress that the best option is to resell the item as new in order to recapture as much value as possible. Companies can maximise the asset value of returns through efficient refurbishment programmes for reused products (Bernon and Cullen, 2007). According to Stock and Mulki (2009), the recovery rate for retailers are higher compared to manufacturers or distributors. The last option of disposition is recycle, which is the best environmental route for the returns that are not fit for resale (Bernon and Cullen, 2007). Skinner et al. (2008) state that if adequate disposal resources are not available,

destroying the return is the only option. Other options require significant resources to recapture value (Skinner et al., 2008).

Managing the disposition

Stock and Mulki (2009) stress the importance to spend resources on the disposition. There are challenges to consider in the disposition (Genchev et al., 2011, Hazen et al., 2012, Lambert et al., 2011). Lambert et al. (2011) discuss the financial impact of the choices made in the disposition depending on if the return will be repaired or recycled. It is therefore important to be cautious in the previous step when managing sorting (Lambert et al., 2011). Hazen et al. (2012) point out the importance to calculate costs and be aware that unanticipated costs may surface in the disposition.

Hazen et al. (2012) stress the importance to have clear guidelines from top management in order to generate profit. It is also important to consider possible environmental guidelines when deciding disposition option. The disposition option needs to be congruent with the policies and programs of the company, due to that different disposition options impact the environment in various ways (Hazen et al., 2012).

An algorithm to connect returns to back-orders

Stuart et al. (2005) have proposed an algorithm to connect returns in the disposition to back-orders. A back-order is a consumer order that cannot be fulfilled when placed due to shortage in stock (Srivastav and Agrawal, 2016). The proposed algorithm can be seen in figure 12. It suggests reallocation of tasks to fewer workstations. By reviewing back-order status earlier in the flow, earlier identification of back-ordered products directs the returned products to be repacked and shipped faster. According to Stuart et al. (2005), usage of the algorithm will improve the service level for the company and reduce the number of back-orders and the processing costs.

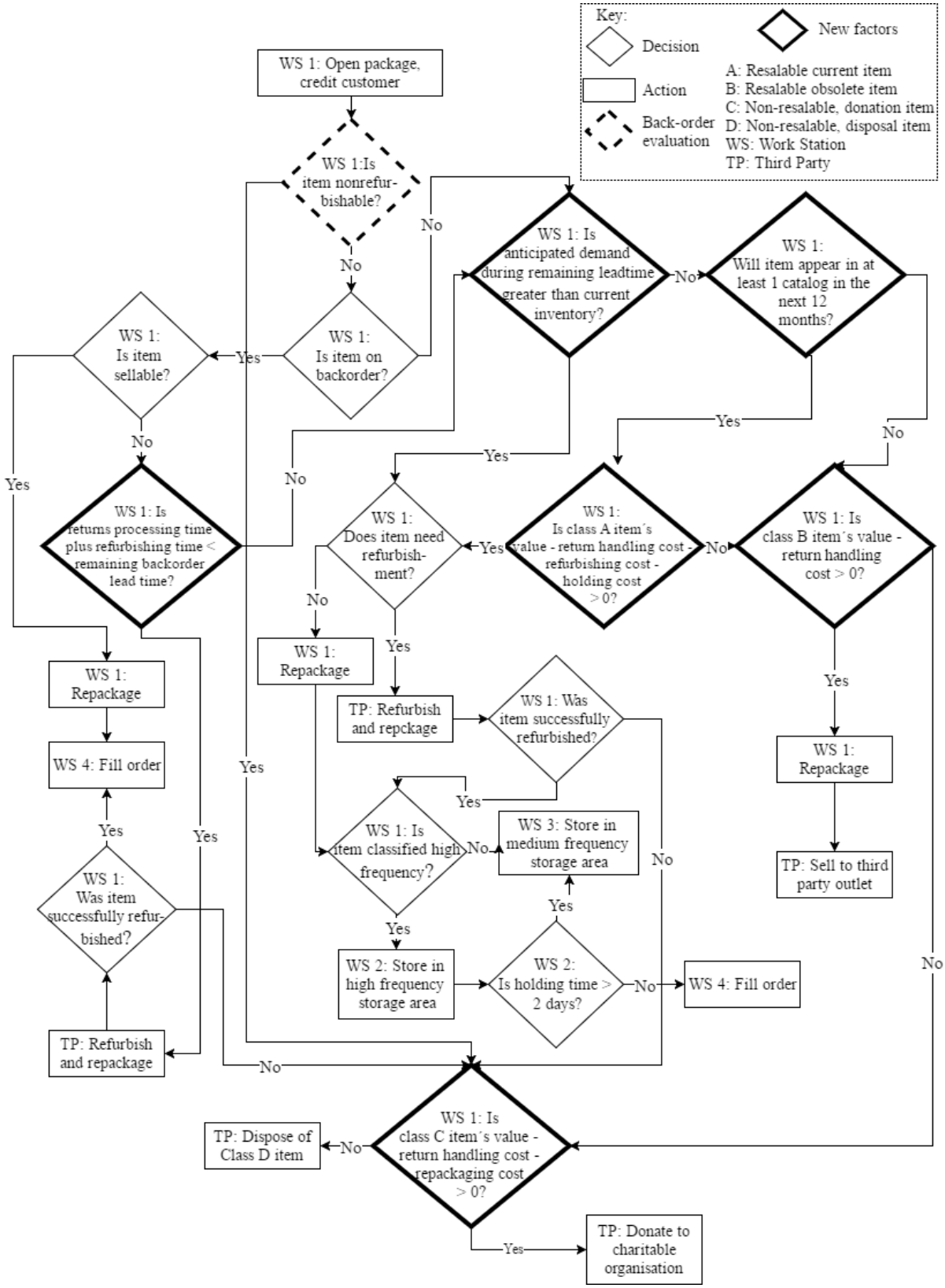

Figure 12. A proposed algorithm by Stuart et al. (2005) to connect returns and back-orders.

Adding new disposition options

When companies decide to add new disposition options, they need to be aware that they are entering a new market environment. The competitive landscape might be unlike the existing

ones (Hazen et al., 2012). Hazen et al. (2012) suggest that companies should do a market analysis similar to the one when entering any new business or market. Before adding new disposition options, companies also need to consider their capabilities and available resources. If there is a gap between existing and required capabilities, this gap needs to be filled or otherwise other disposition options should consider. Companies also need to consider and examine the consumer behaviour, existing regulation, and the environmental impact for each of the alternatives (Hazen et al., 2012).

2.2.3 Performance indicators related to the reverse logistics process

To better understand the performance of the reverse logistics process, companies need to develop methods to evaluate it (Bernon and Cullen, 2007). Performance should be measured in a cross-functional manner and feedback mechanisms should evaluate the improvements made related to the value drivers of the company (Mollenkopf et al., 2011). Cost management is a vital component for managing returns effectively. One of the components in cost management is control, which involves appropriate performance indicators. To evaluate performance, companies need to incorporate accounting systems that identify and record the full cost of managing returns. Two important cost drivers to measure performance are the overall cost of the returns operations and the obtained recovery level (Bernon and Cullen, 2007). Important performance indicators dedicated to returns are: volume of returns, type of returned product, monetary value, percent of sales, and resource utilisation (Brewer and Speh, 2000, Genchev et al., 2011, van Nunen and Zuidwijk, 2004). Lambert et al. (2011) suggest performance indicators for the different steps in the reverse logistics process and these are summarised in table 2.

Table 2. Suggested performance indicators for the different steps in the reverse logistics process adapted from Lambert et al. (2011)

	Performance indicator	Entire reverse logistics process	Screening	Collection	Inspection and sorting	Disposition
Strategic	Ease of adjusting capacity (flexibility)					X
	Financial investment in reverse logistics	X				
	Customer perceived level of service	X				
	Rate of return on investment	X				
Tactical	Costs of authorising a product return	X				
	Disposal costs					X
	Costs of returned products	X				
	Employment level	X				
	Activities cycle time					X
Operational	Cost per operation hour	X	X	X	X	X
	Verification costs of returned products				X	
	Diagnosis accuracy					X
	Time to collect a return			X		
	Capacity utilization	X				

Well defined goals and well established performance indicators are important for the level of savings (Jeszka, 2015). Hall et al. (2013) state that the disconnect between a company's goals and performance indicators will affect the performance and goal attainment negatively.

2.2.4 Barriers in reverse logistics process

There are barriers in a reverse logistics process (Rogers and Tibben-Lembke, 2001). According to Dissanayake et al. (2007), the three biggest barriers are: lack of importance, information management, and lack of resources. Other researchers agree and adds management inattention, company policies (Rogers and Tibben-Lembke, 2001, Thiyagarajan and Ali, 2016), and limitations to forecasting and visibility (Badenhorst, 2016). The barriers make it difficult to achieve a successful reverse logistics process (Thiyagarajan and Ali, 2016). However, companies should see returns as an opportunity to build competitive advantage rather than as a challenge (Griffis et al., 2012, Stock et al., 2002). When learning how to manage returns successfully, the company's profitability can be greatly increased (Shulman et al., 2010). An optimised reverse logistics process can maximise the expected market value of returned products (de Leeuw et al., 2016), be a good customer relations tool, and give the company a

quality advantage (Richey et al., 2005). To overcome the barriers various adjustments can be made, for example, standardise the reverse logistics process (Badenhorst, 2016).

The reverse logistics process will not achieve superior performance without appropriate resource commitment (Jack et al., 2010, Skinner et al., 2008). The capabilities of the process can positively impact its competitive advantage (Hsiao, 2010) and make the process more efficient (Richey et al., 2005). However, resource commitment must be focused (Richey et al., 2005). Daugherty et al. (2005) emphasise to focus on IT capabilities. Hjort et al. (2013) discuss that although companies often have an extensive amount of data, they are starving for information. Companies often need guidelines and methods of analyses to sort and collect valuable data (Hjort et al., 2013). Implementing an IT system can be costly due to the associated costs. Normally an initial capital cost arises when buying the system. The cost can include setup costs, implementation costs, and testing costs. Usually, an operation cost will be added (Jayaraman et al., 2008).

Richey et al. (2005) state that managerial resources make the biggest impact. They should focus on developing innovative ways to handle returns (Richey et al., 2005). Managerial, financial, and technical resources are used during the implementation, but they also facilitate cost reduction when the returns are handled efficient (Jack et al., 2010).

2.2.5 Trends affecting the reverse logistics process

According to Kirkke et al. (2004), the trends affecting the return handling can be summarised in four factors: environmental drivers, business drivers, new technology, and future supply chain developments. Environmental challenges are trends about: life cycle analysis, take-back responsibility, and recycled content in new products mandatory (Krikke et al., 2004). According to Rogers et al. (2002), environmental and legal trends are usually the starting point for improvements in reverse logistics. The business drivers are: warranty, claims and recalls, green image, and disposal cost. New technology is about how to handle information technology, new separation techniques for recycling, and design of life cycle products. The future supply chain developments are: mass customisation, postponement, e-commerce, and product modularity (Krikke et al., 2004).

2.3 Supporting resources in a warehouse

A warehouse requires labour, capital (land and storage-and-handling equipment), and IT, all of which are expensive. The management of a warehouse is all about careful use of space and time, which should be minimised. There are different types of equipment that reduce labour cost and increase space utilisation (Bartholdi and Hackman, 2016). Some of these equipments as well as labour and information technologies will be further elaborated below.

2.3.1 Labour

Labour is in general the largest expense in a warehouse. The most labour intensive activity is travel. The required amount of labour in a warehouse depends on the handling unit. The smaller

unit of handling the more labour is required. The smallest unit of handling is broken-case, which is generally resistant to automation due to the size and variety (Bartholdi and Hackman, 2016).

The reverse logistics flow of a warehouse should have employees with specific authority and responsibility (Richey et al., 2005). The employees' experience in handling returns impact the performance of the process (Jeszka, 2014). However, less than 50 percent of companies use formal methods to train employees involved in the reverse logistics process (Stock and Mulki, 2009). Companies need to develop appropriate methods of how to utilise internal knowledge of employees to offer and deliver value to their customers (Hjort et al., 2013).

2.3.2 Storage equipment

To better utilise the space in a warehouse, different storage equipment can be used. Common storage equipment are pallet racks, carton flow racks, and static shelving. Pallet racks are used for bulk storage and to support full-case picking. The most common pallet racks are described in table 3 (Bartholdi and Hackman, 2016).

Table 3. Description of the most common pallet racks adopted from (Bartholdi and Hackman, 2016)

Single-deep rack	Stores pallets one deep. Any stock keeping unit (SKU) can be retrieved from any pallet location at any level of the rack. It requires relatively more aisle space to access the pallets.
Double-deep rack	Stores pallets two deep. Any SKU can be stored in any lane in any level of the rack. To avoid double handling, it is recommended to fill each lane with a single SKU. However, then pallet locations will be unoccupied when a SKU is present in an odd number of pallets. The rack requires slightly more work to store and retrieve products. It requires less aisle space to access the pallets, but a special truck is required to reach past the first pallet location.
Push-back rack	Stores pallets three to five deep. To make the interior positions accessible, the rack in each lane pulls out like a drawer. Therefore, the first pallet location is always occupied when the lane is.
Drive-in rack	Drive-in racks can be considered as floor-storage for products that are not otherwise stackable. A lift truck can drive within the rack frame to access the interior loads. Therefore, a skilled forklift driver is required. To avoid double handling, it is recommended to fill each lane with a single SKU. The put-away and the picking are performed from the same aisle. In this rack, the Last-In-First-Out policy is obtained.
Drive-through rack	Drive-through racks can be considered as floor-storage for products that are not otherwise stackable. A lift truck can drive within the rack frame to access the interior loads. Therefore, a skilled forklift driver is required. To avoid double handling, it is recommended to fill each lane with a single SKU. The put-away is performed from one end of the lane and the picking is performed from the other. In this rack, the First-In-First-Out policy is obtained.
Pallet flow rack	A deep lane rack, where the shelving is slanted and lines with rollers. Therefore, when a pallet is removed, gravity pulls the pallet behind to the front. Pallets can be put-away from one side of the rack and picked from the other side. The rack is appropriate for high-throughput facilities.

Carton flow racks are appropriate for high-volume picking. They have shelves that are tilted, with rollers, to bring the cartons forward for picking. The SKU-density of the carton flow racks is high. Therefore, the travel is decreased and the picks per person-hour is increased.

Static shelving is the most basic and the least expensive storage equipment. The shelves are shallow and appropriate for slower, lower-volume picking. The SKU-density on the shelves is low, which increase the travel time and reduce the picks per person-hour (Bartholdi and Hackman, 2016).

2.3.3 Transport equipment

Transport equipment, such as forklifts and trucks, are required to enable horizontal and vertical movement of goods in a warehouse. The most common ones are pallet jacks, forklifts, counterbalance lift truck, reach and double-reach lift truck, and turret truck. Pallet jacks and powered forklifts are used for horizontal movement of goods. All lift trucks and turret trucks are mainly used for vertical movement of goods, but they have different characteristics. The reach lift trucks are equipped with a reach mechanism that allows their forks to extend to store and retrieve a pallet. The double-reach trucks are equipped with the same reach mechanism, but can access the rear positions in a double rack storage. The turret trucks have a turret that can turn 90 degrees left or right, but the truck itself does not turn and they can only operate within single deep racks (Bartholdi and Hackman, 2016).

Conveyor belts are automated transportation equipment and an efficient way to transport goods in the warehouse. Whether conveyor belts are suitable in a warehouse depends on product characteristics, equipment integration issues, and throughput requirements. Generally, conveyor belts can be used if a warehouse has conveyable products, high throughput, high material handling labour cost, and material movement between specific points (Saenz Jr, 2002). Together with scanning and IT, conveyor belts can also be used as sorting system in, for example, picking (Bartholdi and Hackman, 2016).

2.3.4 Information technology

IT provides opportunities to improve warehouse operations. The opportunities include, for example, real-time control of warehouse operations and high level of automation (Gu et al., 2007b). IT is especially important to use in the reverse logistics flow. It is important to have the right type of IT to be able to manage and support the reverse logistics process (Huscroft et al., 2013). IT interacts in all processes and will need to manage information for every process with regard to stock and product planning (Lambert et al., 2011). An IT system in the reverse logistics process helps companies to reclaim value from returns that otherwise would be lost, and at the same time enhances consumer service (Huscroft et al., 2013).

Most returns are paper-intensive (Rogers and Tibben-Lembke, 2001) and the need for IT is crucial in order to reduce costs (Ahsan and Rahman, 2016). IT will help employees in the reverse logistics process by, for example, collect customer information, find return causes, or make disposition decisions (Ahsan and Rahman, 2016). Huscroft et al. (2013) have shown that the more compatible IT system, the more effective reverse logistics process. The type of IT needs to be a best fit for the company's products, personnel, information system framework, and processes in order to achieve return on the IT investment (Huscroft et al., 2013).

There are different types IT used in practice, for example, WMS, barcodes, and radio-frequency identification (RFID-im-Blick) (Bartholdi and Hackman, 2016, Nativi and Lee, 2012). These will be further explained below.

2.3.4.1 Warehouse Management System

A WMS provides, stores, and reports the information necessary to efficiently manage the flow of products within a warehouse (Faber et al., 2002). A typical WMS knows about every item in the warehouse, its physical dimensions, all the storage locations in the warehouse, and physical dimensions. By using this information, the WMS orchestrates the flow of people, machines, and products and thereby helps to manage inventory and storage locations and ensures that consumer orders are quickly picked, packed, and shipped (Bartholdi and Hackman, 2016). To control material handling and moving within a facility, a WMS needs to communicate with technologies, like barcodes and radio frequency identification, more in section 2.3.4.2 and 2.3.4.3. A WMS is a shop-floor control system for warehouse activities with only a short-term planning perspective. It is usually integrated in an Enterprise Resource Planning (ERP) system, that focuses on a long-term planning horizon and covers all functions in the organisation (Faber et al., 2002).

Many WMSs are custom-made systems. These are tailored after specific requirements and problems of a specific warehouse (Faber et al., 2002). Provided benefits by a WMS are, for example, increased productivity, reduction of inventories, better space utilisation, and reduced errors (Faber et al., 2002). A WMS can preferably be used in the reverse logistics flow. The WMS will ease the location problems, identify and have accessibility to remanufactured parts, and properly store information about returns (Dowlatshahi, 2012). de Koster et al. (2002) recommend companies to use a dedicated module within the WMS for monitoring the handling of returns.

2.3.4.2 Barcodes

Barcodes are one technology in the category of Auto-ID. They are used to help identify objects. A barcode is a system based on ink patterns that glow when exposed to ultraviolet light. The printed label is scanned with optical laser or imaging technology and the information of the barcode is only obtained when scanned. Barcodes can only be read individually and they need to be visible to be scanned. If they become dirty or damaged, they cannot be read. The information of the barcodes cannot be updated and they need to be manually tracked for item identification (Wyld, 2006). There are two types of barcodes: one dimensional and two dimensional, see figure 13 and 14. The two dimensional barcode is able to hold more data compared to the one dimensional barcode (White et al., 2007).

Figure 13. One dimensional barcode (White et al., 2007).

Figure 14. Two dimensional barcode (White et al., 2007).

2.3.4.3 Radio-frequency identification

RFID is another technology within Auto-ID based on radio waves. It focuses on making objects intelligent and communicable. It captures automated data from static and moving targets and the accuracy is therefore improved (Poon et al., 2009). The reading device of RFID scans a tag using radio frequency signals and multiple RFID tags can therefore be read simultaneously. The tag can be printed on a label and be read even when it is concealed within an item (Wyld, 2006). However, normal one and two dimensional barcodes can be printed and read on the RFID tag as well (Identsys, 2017). Compared to barcodes, RFID tags are durable as long as they are not destroyed, read continuously, and can be automatically tracked. In addition, the electronic information on the tags can be overwritten repeatedly (Wyld, 2006). The cost of a RFID tag today is relatively low compared to the investment cost of the RFID system. Therefore, the tags should not be looked up on as a large expense. There are a great variety of tags, which implies that companies can create unique specific solutions (Identsys, 2017).

There are several components needed in a typical RFID system: tags, readers, antennae, and middleware, see figure 15. An RFID tag consists of a chip with memory. The tag has an identity that can be broadcast to a reader that is operating under the same frequency and tag protocol. The reader is a device that can read data and write data to compatible RFID tags. Communication between tag and reader enables the location information of an item to be recorded and transferred to a server through a computer network. The antennae are the channels for the communication of data between the tag and the reader. The middleware translates signals between the tag and the reader to usable data and facilitates the actual data operations. These software applications help monitoring and managing the data that RFID tags and readers transmit and read. The data are then aggregated and standardised according to specific application functionality. They can then be fed into the existing IT databases for reporting and other purposes (Langer et al., 2007, Ngai et al., 2008).

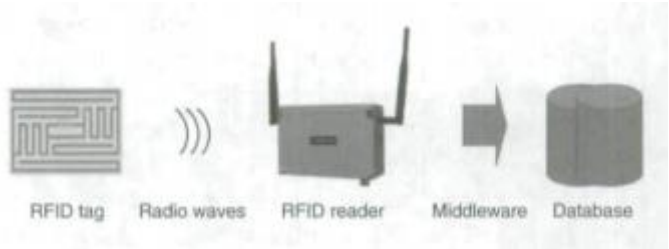

Figure 15. Structure of the RFID network (Langer et al., 2007).

RFID can be used in several business applications, for example, manufacturing process control, inventory management, supply chain optimisation, regulatory compliance, recall management, and recycling (Doyle, 2004). For LSPs and other members of the supply chain, RFID can be used to synchronise operations (Chow et al., 2007) and improve the cooperation (Frédéric et al., 2011). Jayaraman et al. (2008) suggests that managers use RFID for accurate location tracking and quality of new and returned products at key areas in the warehouse. RFID can reduce warehouse employee errors and reduce the time to research consumer claims (Langer et al., 2007). In the reverse logistics flow, RFID can be used to increase the service level to the consumers. It can be done by record the arrival time of the returned products and keep track of

the quantities of returned products at the collection points (Lee and Chan, 2009). An implementation of RFID can also attain higher environmental benefits by real-time inventory monitoring and information sharing and gain less costs through higher economic benefits (Nativi and Lee, 2012).

2.4 Differences and connections between the forward and the reverse flow

The reverse flow of a product is the opposite compared to the forward flow (Stock et al., 2002). There are many differences between the two flows and these are summarised in table 4 (Tibben-Lembke and Rogers, 2002).

Table 4. Differences in the forward and the reverse flow of a product (Tibben-Lembke and Rogers, 2002)

Forward flow	**Reverse flow**
Forecasting relatively straightforward	Forecasting more difficult
One to many transportation	Many to one transportation
Product quality uniform	Product quality not uniform
Product packaging uniform	Product packaging often damaged
Standardised channel	Exception channel
Disposition options clear	Disposition not clear
Pricing relatively uniform	Pricing dependent on many factors
Importance of speed recognised	Speed often not considered a priority
Forward distribution costs closely monitored by accounting systems	Reverse costs less directly visible
Inventory management consistent	Inventory management not consistent
Product lifecycle manageable	Product lifecycle issues more complex
Negotiation between parties straightforward	Negotiation complicated by additional considerations
Marketing methods well-known	Marketing complicated by several factors
Real-time information readily available to track product	Visibility of process less transparent

Many companies believe that the reverse flow should be disconnected to the forward flow in order to be effective (Rogers and Tibben-Lembke, 2001). However, despite the differences between the flows, they should not be seen as isolated flows. The more times a product is returned, the more times it has to be ordered and shipped, which lead to additional distributions costs (Asdecker, 2015). If only the forward flow is considered, the warehouse may end up with undesirable high costs for return handling (de Koster et al., 2002). Closer integration between the flows may result in operational improvements in both the forward and the reverse flow (Bernon et al., 2013, Melo et al., 2009).

In the forward flow, rarely any type of screening is done (Tibben-Lembke and Rogers, 2002). The products in the reverse flow are highly heterogeneous and not uniformly packaged, which lead to specific challenges in the receiving compared to the forward flow. The inspection of the

incoming goods is therefore different for the two flows. Mainly due to the big variation in quality and conditions of products and packages (Nuss et al., 2015, Tibben-Lembke and Rogers, 2002). The varying condition of proper packages and how the products are packed by the consumer impact the risk of product damage in transit (Tibben-Lembke and Rogers, 2002). It is therefore important to use packaging material which can last for at least two delivery rounds (Bienstock et al., 1997).

The handling cost within the warehouse is much higher for the reverse flow compared to the forward flow, due to smaller shipment volumes and the additional required labour to identify the disposition of each product. Nonuniformly packages make it harder to storage the returned products in an efficient way (Tibben-Lembke and Rogers, 2002).

The costly order-picking in the forward flow is challenged by returns. Returns must be put back to stock again and can therefore create congestions in the regular picking route. In addition, there may be capacity restrictions, due to the limited number of forklifts (Schrotenboer et al., 2016). de Koster et al. (2002) mention one solution, where the returns are located separately and fulfil orders before the ordinary stock. Schrotenboer et al. (2016) mention another solution. They state that order-picking and the restocking of returned products are similar processes. Both processes visit a lot of storage locations and either pick or put-away a single item per location. Their solution is a hybrid genetic algorithm. The algorithm identifies routes, where returns are put-away on their storage location while consumer orders are picked simultaneously. By using this algorithm, the travel distances are decreased significantly (Schrotenboer et al., 2016).

The forward and the reverse flow of a product have different requirements on warehouse capabilities. It is important to consider these differences to be able to achieve an efficient handling of returns (de Koster et al., 2002). The warehouse facilities must be capable of both ship finished products and receive returned products (Dowlatshahi, 2012). The special handling in the reverse flow requires additional resources compared to the forward flow (Richey et al., 2005). However, the utilisation of the existing warehousing capabilities can significantly improve the effectiveness of the reverse logistics process (Dowlatshahi, 2012).

2.5 Logistics service provider

Companies find it difficult to complete all the required operations due to high market competition and environmental changes. To better utilise its resources and be flexible, many companies choose to outsource logistics activities (Yufang et al., 2011). Many terms are used for the phenomenon of outsourcing logistics activities. A LSP is a company which perform logistics activities on behalf of others (Delfmann et al., 2002). The activities consist of, for example, management and execution of transportation and warehousing, inventory management, information related activities, and value added activities (Berglund et al., 1999, Delfmann et al., 2002, Mukhopadhyay and Setaputra, 2006, Sink et al., 1996). Designing the logistics activities efficiently and providing and managing service variety to customers with high service quality are critical success factors to LSPs (Lin and Pekkarinen, 2011).

2.6 Electronic-commerce

Today, there are several sales channels. Companies might be selling through stores, online channels, or a combination of the two options, so called omni-channels (Hübner et al., 2016). Privacy, convenience, and time pressure are reasons why consumers choose to shop from home in a greater extent (Foscht et al., 2013). The concept of goods sold via electronic channels is called electronic-commerce (e-commerce) (Dissanayake and Singh, 2007). E-commerce has shown exponential increase in number of consumers and sales (Enders and Jelassi, 2000, Ecommerce-Europe, 2016). The increase depends on several factors, for example, unlimited opening hours, wider assortment variety (Hübner et al., 2016), wider consumer reach, and less requirements on infrastructure compared to offline channels (Enders and Jelassi, 2000).

An efficient reverse logistics process is important, especially in the context of e-commerce (Ramanathan, 2011). Retailers in e-commerce have a high rate of returns returning in small quantities (de Koster et al., 2002, Bernon et al., 2016), which is costly to process (Mollenkopf et al., 2007). The main reason for returns is that the consumers are not able to physically inspect the products due to the absence of a physical store (Wood, 2001). Other reasons for returns are, for example, poor practice within forward supply chain (Bernon et al., 2011), damaged products, ordering errors, and delivery of wrong products (Dissanayake and Singh, 2007). Foscht et al. (2013) state that a mistake or failure during the delivery is a major reason for returns by consumers. The handling of returns is one of the largest logistical challenges for retailers in e-commerce (de Leeuw et al., 2016). It is therefore crucial to have an efficient reverse logistics process (Jayaraman et al., 2008, PostNordAB et al., 2016, Xu et al., 2017).

Foscht et al. (2013) consider logistics as one of the key success factors in e-commerce. Especially the handling of returns (Foscht et al., 2013, Mollenkopf et al., 2007). Some retailers in e-commerce are managing the logistics activities on their own. Others choose a low-risk approach and outsource parts of or the entire logistics process to a LSP, that leads to less capital investment required for the retailer (Xing et al., 2011). E-commerce has created major new opportunities for LSPs (Xing et al., 2011). It gives them a growth potential. Especially if they offer an efficient handling of returns (Delfmann et al., 2002, Lee and Chan, 2009), since many retailers choose to outsource if they find the cost of return handling too challenging (Badenhorst, 2013).

2.7 Process framework

In this subchapter, a process framework is created to summarise the theoretical foundation in chapter two. The process framework can be seen in figure 16. It aims to explain the relationship between the different activities within the reverse logistics in a warehouse and the connection to the forward flow.

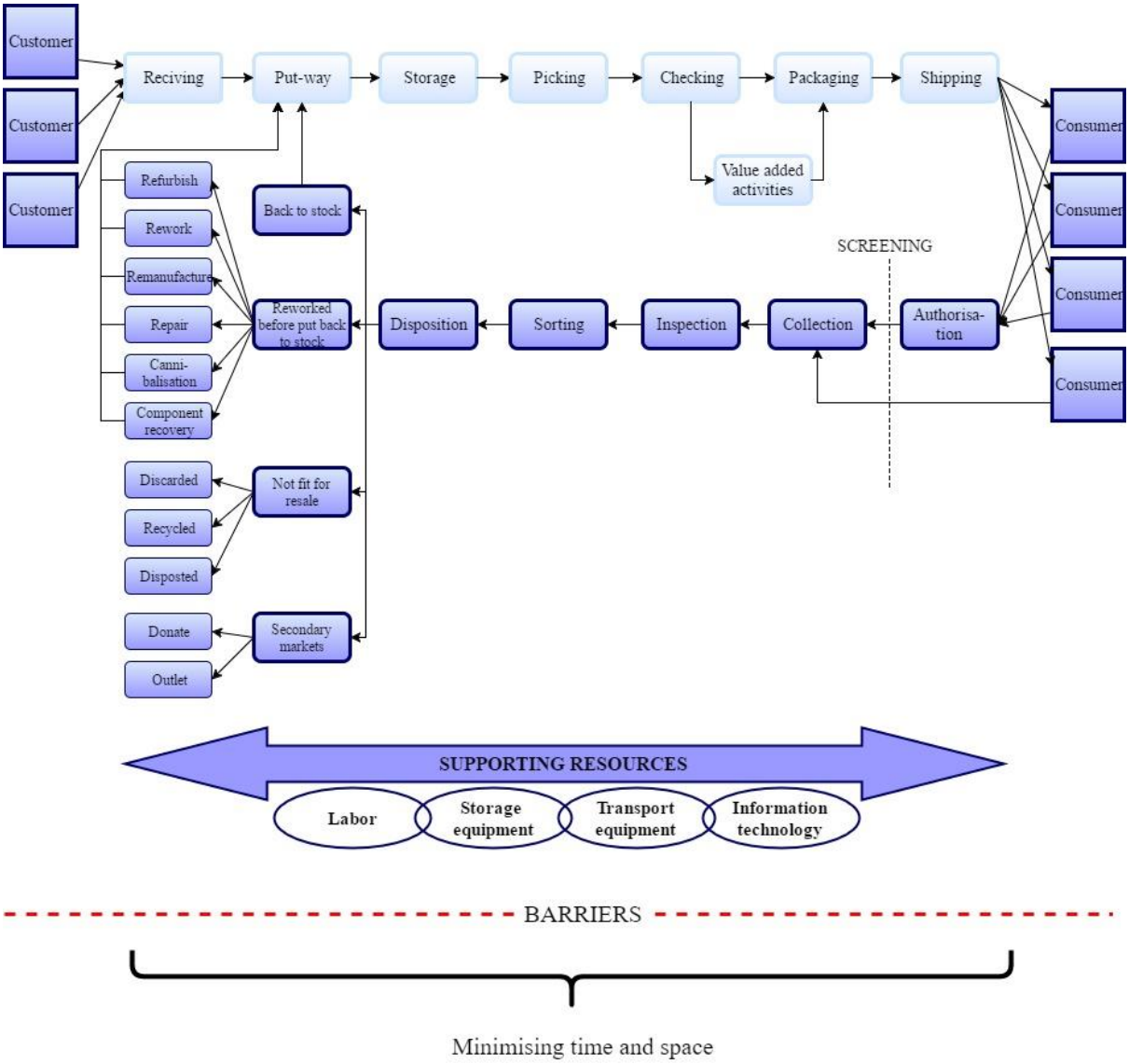

Figure 16. The process framework conducted on the reviewed literature.

The framework should be studied from the top left corner. The top of the framework describes the forward flow in the warehouse, starting with the inbound processes of receiving goods until the goods are stored, continued by the outbound processes of picking the goods until being shipped to consumers. The reverse flow should be studied from the bottom right corner. The reverse logistics process starts when a return from a consumer enters the warehouse in the collection. The final options for the return after being processed, can be seen at the bottom left corner in the framework. In order to manage both the forward and the reverse flow in a warehouse supporting resources are needed. Several barriers need to be overcome but the goal for the reverse flow is to minimise time and space.

3 Methodology

It is important to choose the right methodology to be able to execute and ensure the quality of the research. To do that, it is important to understand the different methods and the foundation they are built upon (Robson, 2011). In this chapter, the methodology of this research is elaborated. The chapter is structured as followed: first is the overall research strategy presented, followed by case selection, case description, research design and data collection plan, data analysis, research process, and finally a discussion about the trustworthiness of the methodology.

3.1 Research strategy

Methodology is of either fix or flexible nature. Depending on the aim of the research, the design should be chosen differently in order to achieve the best research method. The flexible design methodology was used in this research, since data was gathered and developed over time (Robson, 2011).

According to Höst et al. (2006) data can be gathered through either case studies or information mapping. It is recommended to perform a case study if the research question is of how or why character and focuses on contemporary events (Yin, 2003). A case study is also recommended, if the aim is to generate or extend theory (Meredith, 1998). Since the majority of the research questions are of how character and the aim is to extend theory into a new context, a case study is performed in the data collection phase. The case study can either be of single or multiple character (Robson, 2011, Yin, 2003). In the research two cases are investigated, which makes the multiple case study approach suitable (Yin, 2003).

3.2 Case selection

The case selection was based on two cases due to that PostNord TPL only has two cases available for investigation. The two case companies, Company A and Company B, were although interesting to investigate due to several reasons. The two customers correspond for the largest amount of returns in the South/West Business area of PostNord TPL. The case companies are both retailers in e-commerce, which implies that operations of handling return for PostNord TPL are similar. However, the product characteristics are different. It was therefore interesting to investigate the two cases because of both similarities and differences in product assortment and the handling of returns. The different characteristics of the products add the aspect of how the type of product impacts the return handling. Both case companies grow rapidly, which was another interesting reason why to investigate them. Both customers use PostNord TPL as their LSP for storing, packing, shipping, and return handling which allowed an equal comparison.

3.3 Case description

Company A is a retailer in e-commerce, selling shoes in several countries in Europe. They have been in business for six years and had a turnover of SEK 260 Million 2015. Company A offers more than 650 different shoe brands for sale (CompanyA, 2016).

The products are of similar size and weight. Most of the products are stored in cardboard boxes with the smallest dimension of 14x12x4 centimetres to the largest dimension of 60x36x11 centimetres. Smaller shoes, for example children shoes, can be stored in plastic bags instead of cardboard boxes but are of the similar dimension as the smallest box. The products are stored on single-deep racks in the storage on shared locations, see figure 17 for the layout and the space used in the warehouse. Company A uses 5 283 square metres, on the ground floor, in the warehouse. There are four permanent employees, six employees paid by the hour, and one manager working with returns and incoming goods. There are eight working stations and 620 square metres used at the second floor in the warehouse. The products are packed before shipped primarily in plastic bags, the smallest dimension is of 65x62 centimetres, normally for single or double orders. Depending on the size of the shoe boxes and the number of ordered shoes, either larger plastic bags or cardboard boxes can be used. The largest dimension is a cardboard box of 60x40x67 centimetres. On average 32 percent of the goods sold of Company A are returned (PostNordAB, 2016b). For more information see table 5.

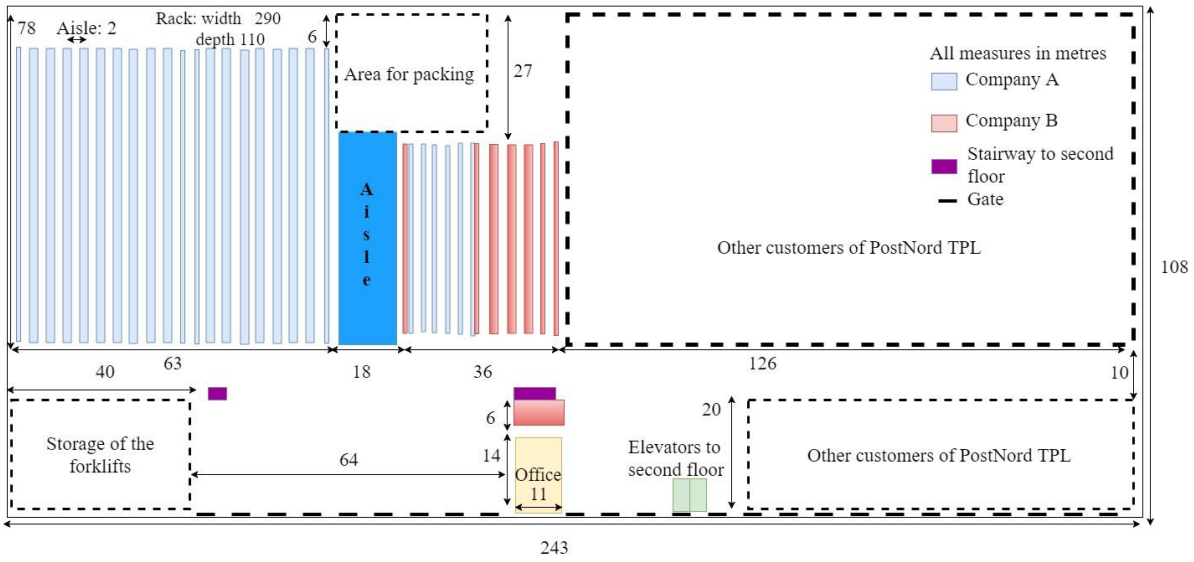

Figure 17. Warehouse layout of Company A's and Company B's space in the warehouse.

Company B is selling outdoor life products, everything from ski equipment to cross-country running equipment. Sales is primarily through e-commerce, but Company B has two physical stores in Stockholm (CompanyB, 2016b). Company B had a turnover of SEK 260 Million 2015 and offers over 100 different brands to their consumers (CompanyB, 2016c).

The product assortment is wide and the weight and size are inconstant. The dimensions of the products differ a lot, from a snap hook to a kayak. The smaller and soft products, for example clothes, are stored primarily in plastic bags and smaller cardboard boxes. They are then stored

in larger cardboard boxes, with several other products, in single-deep racks. Larger products are stored in cardboard boxes or on pallets in the racks. Special products, such as skis or ski poles, are difficult to store in racks. They are instead stored on 13 static shelves on the ground floor at a special section in the warehouse, see figure 17. All products are stored on shared locations. The layout and the space used in the warehouse for Company B can be seen in figure 17 Company B uses 873 square metres on the ground floor in the warehouse. The products are packed before shipped in both plastic bags and cardboard boxes depending on the size, product type, and number of ordered products. There is one permanent employee, one paid by the hour, and one manager working with returns and incoming goods. There are four working stations and 300 square metres used on the second floor in the warehouse. On average 16 percent of the goods sold of Company B are returned. For more information and a comparison of the case companies see table 5.

Table 5. Key information about the case companies (CompanyA, 2016, CompanyB, 2016c, CompanyB, 2016a, PostNordAB, 2016a).

	Company A	**Company B**
Consumer offerings	Shoes	Outdoor and sports products
Turnover	260 Million SEK	260 Million SEK
Growth	65%	15%
Founded in	2010	2000
Market	Swedish, Finnish, Norwegian, Danish, British, French, Polish, German, Dutch and Austrian market	Swedish
Number of different products	30 000	3 430
Number of SKUs	250 000	40 000
Parcels/ year	700 000	200 000
Return policy	Free returns within 180 days	Free returns within 365 days
Number of employees at PostNord TPL working with checking returns and incoming goods	4 permanent 7 paid by the hour 1 manager	2 permanent 1 paid by the hour 1 manager
Percent of returns	~32	~16
Smallest SKU	14x12x4 centimetres	Snap hook
Largest SKU	60x36x11 centimetres	Kayak
Return package	Primarily in bags, secondarily in boxes	In both bags and boxes
Used warehouse space for storage	5 283 square metres	873 square metres
Used warehouse space for return handling	620 square metres	300 square metres

3.4 Research design and data collection

All empirical research needs to have a research design or a plan for the execution of the research, including the process of collecting, analysing, and interpreting the observations (Yin, 2003). The case study of the research followed the multiple case study structure suggested by Yin

(2003) to ensure quality. A multiple case study can be either holistic or embedded (Yin, 2003). The two case studies of this research were performed separate and the results were collected for each case study separate. Under these conditions the embedded multiple case study design should be used according to Yin (2003).

A case study typically involves several methods for data collection (Robson, 2011). According to Höst et al. (2006) and Robson (2011), data collection can be done through observations, questionnaires, interviews, and tests. When doing a case study, interviews and observations are the most commonly used methods (Höst et al., 2006, Robson, 2011). According to Robson (2011), interviews and observations are two good methods to use when gathering information since they complement each other. Robson (2011) stress the amount of time the two methods usually requires and the importance to plan before carrying out the methods. Yin (2003) also stress the large amount of time a case study requires. The time frame of the case studies was therefore set to four weeks. Previously gathered historical data from the two companies, were used as a complement to capture trends for a longer period of time.

3.4.1 Data collection for the interviews

The execution of interviews can be more or less systematic evolving under a specific subject (Höst et al., 2006). Interviews can be structured, semi-structured, and unstructured depending on the depth of the interview (Lantz, 2013, Robson, 2011). A semi-structured interview is normally used if the research has a flexible design. The approach is appropriate when the interviewer is involved in the research project (Robson, 2011) and the purpose of the interviews are to gather explorative and descriptive information (Höst et al., 2006). Semi-structured interviews were in line with the design and aim of this research. To get the best results from the interviews, interview schedules were created. The structure of the interviews was a mix of clearly stated questions and open questions (Robson, 2011).

The employees of PostNord TPL working on an operational, tactical, and strategic level with returns were targeted for interviews. The interviews were restricted to employees that have been working with returns for more than two weeks at the time of data collection. The time set for the interviews varied depending on the number of questions. The interviewed employees, the data that were gathered from the interviews, and the dates for execution can be seen in table 6. The mix of employees increased the trustworthiness of the data collection due to the mix of employees´ knowledge, working tasks, and opinions of the processes. The interview questions were based on the reviewed literature and the responsibilities of the interviewed employees. The interview schedules can be seen in appendix A.

Table 6. The interviewed employees of PostNord TPL and the date of the interview

Role			Purpose of the Interview	Date of interview
Area Manager South/West			Strategic perspective of PostNord TPL's return handling	2017-04-12
Warehouse Manager E4 Terminal			Economic perspective of PostNord TPL's return handling. Also, how they are performing today, how this is measured and how they work today in some extent.	2017-04-18
Head of Operations E4 Terminal			Information about the operations in the warehouse today as well as information systems, equipment and personnel.	2017-03-30
Manager of Inbound for Company A			Overall information about the return handling in Company A.	2017-04-05
Manager of Inbound for Company B			Overall information about the return handling in Company B.	2017-04-04
Operational employees in the stages: inspection, sorting, and disposition	*Permanent*	*4 people for Company A*	The interviews are made during the observations. The purpose is to understand how they are working today and making decisions.	2017-04-04 - 2017-04-06
		1 people for Company B		2017-04-03
	Paid by the hour	*5 people for Company A*		2017-03-31 - 2017-04-18
		1 people for Company B		2017-04-03
IT Manager South Region			Information and capabilities of the software system Diracom, used today at PostNord TPL	2017-05-11

3.4.2 Data collection for the observations

Observations are in general used when people are involved in the studied object or process. A typical observation means monitoring actions and behaviour under control. Direct observations are used when the observations are carried out by a human observer and one advantage is the directness (Robson, 2011). Direct observations were carried out in this research to collect data about the processes of return handling. The observer can have different degrees of participation, either as a strict observer or as a participant (Höst et al., 2006). According to Höst et al. (2006), there are two different kinds of observers: participant observers or complete observers. The difference between the two observers are whether they are visible in the observations or not. If the observers are clearly visible, but not part of the study, they are participant observers. Due to security reasons of PostNord TPL and the layout of the warehouse, the research needed to be performed by participant observers. One advantage of participant observations is that questions from the observer can be asked during the study and the observed employee can explain the process during the observation (Höst et al., 2006). To collect data from an observation, a descriptive observation can be used. It should be used if the aim is to describe a setting, people, and a particular event (Robson, 2011), which were done in this research to explain the process of return handling. The different aspects the observations focused on can be seen in table 7.

Table 7. The dimensions of a descriptive observation (Robson, 2011, Spradley, 1980)

Space	Layout of the physical setting: rooms, outdoor spaces, etc.
Actors	The names and relevant details of the people involved.
Activities	The various activities of the actors.
Objects	Physical elements, furniture etc.
Acts	Specific individual actions.
Events	Particular occasions, e.g. meetings.
Time	The sequence of events.
Goals	What actors are attempting to accomplish.
Feelings	Emotions in particular contexts.

Two areas were observed: the receiving of incoming products and returns and the return handling on the second floor. Employees that were observed, the dates of the observations, and the purposes of the observations can be seen in table 8. The time was not set for the observation of the receiving of incoming goods and returns since this observation was executed to observe, among others, the amount of time required for this activity. The time set for each observation of the return handling was set to 30 minutes on the second floor. The time was fixed to ensure that the same amount of time was used for each observation. The time of 30 minutes was considered to be enough in order to understand the way the returns are handled since the observation were complemented with interviews and historic data.

Table 8. Role of employees, execution dates, and purposes of the observations

Observation	Role of employee		Purpose of the observation	Date of observation	Days of participation
Receiving and sorting of incoming goods	*Operational employee at inbound activities*		Understanding the receiving and sorting at the terminal as well as measuring time for the activity	2017-03-31 - 2017-04-06	2017-03-31 - 2017-04-06
	Operational employee working with quality and claims				2017-04-03 - 2017-04-06
	Manager of Inbound for Company A				2017-03-31 - 2017-04-06
	Employee 1 Company A				2017-04-04
	Employee handling picking and packing				2017-03-31
	Head of Warehouse Operation				2017-03-31
	Employee working with various inbound and warehouse activities				2017-03-31 and 2017-04-05
Return handling for Company A	*Employee 1*	*Operational employees in the stages: inspection, sorting, and disposition for the returns*	The purpose is to understand how they are working today and making decisions for the different disposition options.	2017-04-04	
	Employee 2			2017-04-04	
	Employee 3			2017-03-31	
	Employee 4			2017-04-06	
	Employee 5			2017-03-31	
	Employee 6			2017-03-31	
	Employee 7			2017-04-18	
	Employee 8			2017-04-04	
	Employee 9			2017-04-04	
Return handling for Company B	*Employee 1*	*Operational employees in the stages: inspection, sorting, and disposition for the returns*	The purpose is to understand how they are working today and making decisions for the different disposition options.	2017-04-03	
	Employee 2			2017-04-03	

3.5 Data analysis

After the interviews, the gathered data were analysed and interpreted. According to Robson (2011), if a flexible design is followed researchers should analyse the gathered data immediately after collecting it to ensure the quality and trustworthiness. Data from the interviews were analysed to understand the problems with the reverse logistics process today from different perspectives. From the interviews, conclusions whether PostNord TPL have goals for the reverse logistics process were made in order to analyse whether these are achieved or not. Performance indicators for the reverse logistics process were also analysed and compared with how they work today. From interviews with the management of PostNord TPL, the strategic thinking about the return handling was compared and analysed with the operational management of the returns. The reasoning behind the structure of today's operations was

analysed, in order to get a deeper understanding and knowledge about the starting point of the research.

The warehouse activities and the flow between them as well as the connection between the forward and reverse flow were also analysed from the interviews and observation. Whether the flow between the performed activities of today work or not were analysed due to the information from several perspectives. Information and capabilities for the software used in the warehouse were analysed from the interview with the IT Manager South Region.

The different point of views of the employees, working on different levels in the process, are also a major part that were analysed from the interviews. The interviews enabled analysis of how management reason and make decisions considering employee's length and type of employment. Information about other available resources were also gathered from the interviews, for example information about equipment and IT. Analyses whether PostNord TPL has enough and the right resources for the return handling were then made. Finally, the interviews clarified how the management and the employees think the return handling is performed and this were then analysed together with the observations of how they actually work. An important part of the interviews to analyse was if there have been methods and ways of working that have been tried out but were unsuccessful. The interviews and observations were the basis to understand the barriers of the return handling from strategic to operational level.

The major part that was analysed from the observations is how the return handling is performed today. Each employee's unique way of handling returns was analysed to discover if there are different ways to handle returns. The different processing methods were analysed with the data gathered from the interviews to understand the handling of today with the intention of how the handling should be performed. The observations also gathered information about the process from the point of receiving until the return is put back in storage. They contributed with performance and time references, where there was no data available.

Historic data were used as a complement to analyse the return handling over a longer period of time. From the historic data collection, trends and seasonalities in the return handling were analysed. Data about the number of processed returns per employee were analysed together with the observations to understand if there is an optimal way of handling returns. The analysis was based primarily on the technique of handle returns and the number of returns processed. In those cases where no historic data was available, physical collection was performed, for example considering unregistered times and measurements in the warehouse.

A cross-case analysis was performed to understand the different needs and demands from the customers of PostNord TPL and how the demands might affect the return handling. From the case analyses, different aspects were analysed and compared between the cases. The speed of handling the returns was compared between the two cases to understand the importance of speed and the effects on the return handling. The same analysis was performed for refunding the consumer and the speed of updating the warehouse system. The case comparison also helped

to analyse how the product characteristics affects the return handling, the different resources needed, and the volume of returns. The barriers of the two cases were analysed to find synergies. From the case analyses, possible synergies were also analysed to see if there is an optimal way of handling returns.

3.6 Research process

The structure of the research process is described in figure 18. The research process started with studying the objective and determine the project scope. Based on the research questions a suitable research method was developed. Through a literature review the necessary information was gathered and during the review the process framework was created. In the next step, the multiple case study was carried out and an analysis of the collected results was made. From the analysis suggestions of improvement was developed. The knowledge of the entire research contributed to the development of the framework of return handling.

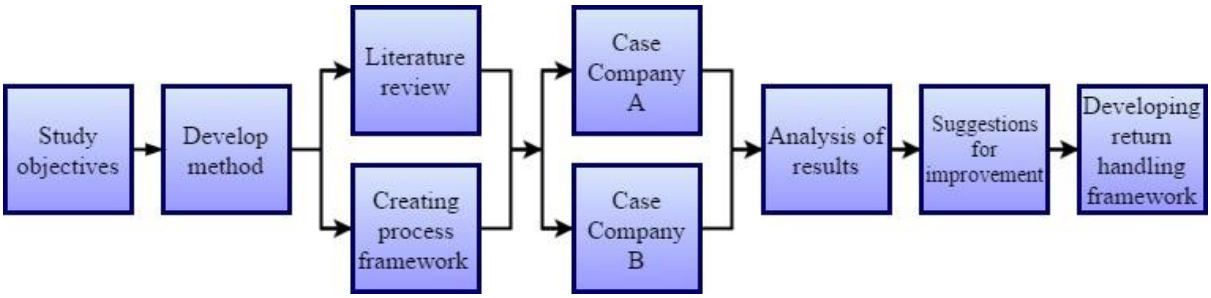

Figure 18. Description of the outline of the research.

3.7 Trustworthiness of the research

To ensure trustworthiness of the research, several actions can be taken. Höst et al. (2006) and Robson (2011) are discussing three central concepts to ensure the quality of research: validity, generalisability, and reliability.

To ensure reliability, the data collection and analysis should be thorough. In addition, the report should be well explained so that the reader can understand the structure of the research (Höst et al., 2006, Robson, 2011). In this research, an extensive data collection was carried out and the structure of the report connect the reader to all assumptions and analysis made throughout the research.

Validity implies making sure that there is a connection between the investigated object and the measured object. Triangulation, which is when the same object can be studied with different methods, can be used to increase the validity (Höst et al., 2006, Robson, 2011). To ensure validity, the research gathered information from several sources with thorough and well structured observations and interviews.

Generalisability can only be done within the population, where the sample has been executed. Doing large samplings and include as many aspects as possible will improve the generalisability (Höst et al., 2006, Robson, 2011).

Yin (2003) discuss criteria for judging the quality of the research design for case studies. For case studies the focus is on validity and reliability. There are four different tests that should be performed: construct validity, internal validity, external validity, and reliability. The first test can be done to ensure that no subjective judgment is used. For the case being studied, this step will establish the right operational measures. Internal validity is only for explanatory studies and therefore not of concern in this research. External validity includes trying to establish if the empirics from the study can be generalised beyond the specific setting in the study. Reliability according to Yin (2003) is similar as to Höst et al. (2006) and Robson (2011), the research should be repeatable and the steps of the study should be easy to understand.

To make a rigor case study it is important to follow a systematic procedure and do a thorough information gathering to avoid biased views (Yin, 2003). The research followed the case study method suggested by Yin (2003) to ensure a rigorous case study. To prevent generalisation on a single case, a multiple case study of two case studies was executed. Replicating a study makes the results robust and rigorous for further analysis (Yin, 2003). Data were collected with different methods to prevent biased views. To ensure the quality of the interviews the results can be put together so the interviewed people can confirm or possibly change the answers if necessary. The interview should be planned and well thought through in an interview schedule to ensure the quality of the interviews and ensure that the same questions are asked (Robson, 2011, Yin, 2003).

Researchers should set a design before the observation starts to ensure the quality of the observations, like the descripted setting mentioned above in 3.4.2 Data collection for the observations. The observation should be reproducible and carried out the same way independent of observer and time to ensure the quality and trustworthiness of the observation (Robson, 2011). It is also desirable to have more than one observer for each study to show validity and greater trustworthiness. Robson (2011) calls this the inter-observer agreement. Two observers performed the observations. During both interviews and observations, the researchers had the same individual responsibilities to ensure replicability and reliability.

4 Empirics

The following chapter is presenting the findings from the interviews, the observations, and the historic data collection. The chapter is structured as follows: a short description of the warehouse activities, followed by the reverse logistics process in the warehouse, and the supporting resources. The subchapters are divided in findings related to PostNord TPL and the customers in general, findings related to Company A, and findings related to Company B.

4.1 Activities in the warehouse

PostNord TPL has an inbound and an outbound flow in the warehouse. The inbound flow starts when the products are received at the dock, see point A in figure 19. The goods can be either new products or returns and are sent to the second floor at point C. On the second floor, the flow of new goods and returns are separated, more about the reverse logistics flow in section 4.2 Reverse logistics process at PostNord TPL. The new products are controlled, registered, and labelled with specific barcodes that will be used by PostNord TPL. The products will then be put-away in storage at point H1 or H2 depending on which customer the products belong to (HeadofOperations, 2017). The reverse logistics flow in the warehouse will be further explained in section 4.2 Reverse logistics process at PostNord TPL.

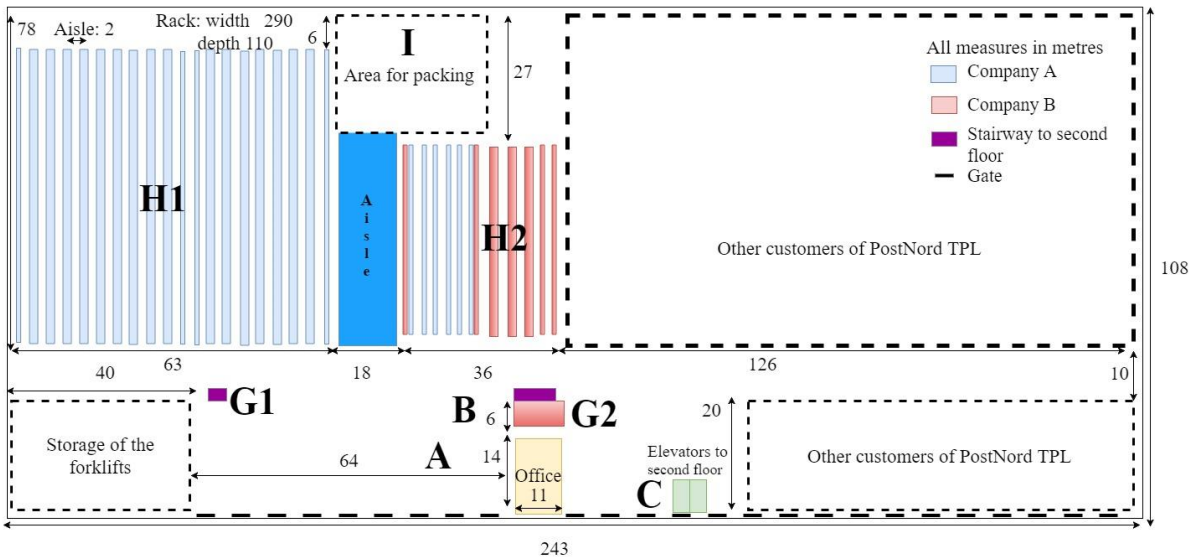

Figure 19. Map of the first floor in the warehouse, where the location of the activities are pointed out.

The outbound flow starts when a product is being picked from the storage at point H1 or H2. After the product is picked, the product is brought to the packing point I. To ensure that the right product is shipped to the right consumer, the product is compared with the order. Then the product is packed after different customer requirements. Company A requires that everything should be sent in their plastic bags, except for larger orders that can be sent in cardboard boxes. Sometimes, Company A wants to send giveaways or thank you notices. According to the Head of Operations (2017), it takes a lot of extra time, but it is a demand from Company A. Company B wants to ship soft products in plastic bags and hard products in cardboard boxes. The

packages are then brought back to point A to be loaded on trucks, and registered as shipped. The shipping area and the receiving area is the same areas and congestions often appear (HeadofOperations, 2017).

4.2 Reverse logistics process at PostNord TPL

One of PostNord TPL's strategies is to divide customers into segments, where fashion and fast moving consumer goods are two examples. The strategy drives which customers to consider in the different regions for PostNord TPL (AreaManager, 2017). The south region of PostNord TPL is focusing on customers in e-commerce among others (AreaManager, 2017, HeadofOperations, 2017).

The aspects of returns differ for different segments and customers, for example the return reason and volume. The return volume is lower for the business to business segments than for e-commerce, especially for fashion products. It is important for the customers of PostNord TPL to have a fast and flexible return handling and to give the consumers a good experience when returning a product. PostNord TPL, as the LSP, needs to adjust to the preconditions of each segment and customer in order to fulfil the customer satisfaction. In fashion, the return needs to be confirmed quickly in order to enable the refund to the consumer (AreaManager, 2017). According to the Area Manager (2017), it is important to have the mindset that the return handling is a competitive activity that is prioritised, when working in the e-commerce segment. The return handling is a success factor for attracting new customers (AreaManager, 2017). The requirements of the customers regulate the return handling of PostNord TPL. They need to be perceptive and flexible to find solutions that fulfil the requirements of each customer (AreaManager, 2017).

PostNord TPL aims to have maximum customer satisfaction. Both for PostNord TPL's customers and the consumers (AreaManager, 2017). According to the Warehouse Manager (2017) and the Head of Operations (2017), the strength of PostNord TPL's reverse logistics processes of today is speed, but they need to be even faster. The consumer needs to receive the refund quickly and the return needs to be put in storage, available for resale, as fast as possible. However, the reverse logistic process is complex and there are some limitations how fast the process can be to still keep the accuracy and quality (WarehouseManager, 2017). Therefore, it is required to have a fast reverse logistics process that ensures the quality of the returns. The cost of the reverse logistics process needs to be as low as possible since the return handling is an additional cost that does not add value (AreaManager, 2017). However, according to the Warehouse Manager (2017), it is hard to lower the costs since there is often an investment cost involved. PostNord TPL should instead focus on improving the speed and enable feedback and refund to the consumers earlier in the process to improve the customer satisfaction (WarehouseManager, 2017).

According to the Area Manager (2017), the setup of the reverse logistics process today is built upon the requirements of the customers and the capabilities of PostNord TPL. Below is the reverse logistics process in the warehouse described. The warehouse is open all weekdays

except Saturdays, which corresponds to approximately 302 days a year. However, the receiving of returns is only possible Monday to Friday, which correspond to approximately 254 days a year.

4.2.1 Collection

The returns are received to the warehouse in different ways depending on their origin. The returns from the consumers in Sweden are delivered by PostNord AB for both Company A and Company B. All these returns are received in wagons, mixed with new goods delivered in parcels during the morning at point A, see figure 19. There is no particular reason for why the receiving is performed at point A. However, according to the Head of Operations (2017), there are advantages with the location since it is close to the door where the truck drivers register the truck and to the office door.

Approximately 938 goods are received each day from PostNord AB and 88.5 percent of the these are returns, see appendix B. The content in the wagons are sorted in separate wagons for the specific customer and the received new goods are put on pallets for the specific customer. The sorting is performed manually by different employees, but there is one operational employee at inbound activities who always is in charge and involved in the sorting. The sorting takes approximately nine seconds per return, see appendix B.

After the wagons are sorted they are stored temporarily at point B, see figure 19. The wagons are moved manually, by employees from Samhall[1], from the collection area to the elevators, see point C. The transportation of one wagon takes approximately 43 seconds, see appendix C. However, the employee of Samhall only performs one task at a time, which means that one employee is dedicated to moving the wagons until the collection is performed. Before sending the wagons to the second floor, the wagons are labelled with date of arrival on a piece of paper. The date of arrival will ensure that the right prioritisation of the wagons and pallets is done on the second floor. It is important to label the wagons and pallets since this is the only way for PostNord TPL to know when the returns have arrived at the warehouse. The employee of Samhall puts each wagon in the elevator. On the second floor another Samhall employee takes the wagon from the elevator at point D and manually moves it to point E1 for Company A and E2 for Company B (HeadofOperations, 2017). The traveling time takes approximately 78 seconds from point C to point E1 and 53 seconds from point C to point E2, see appendix C.

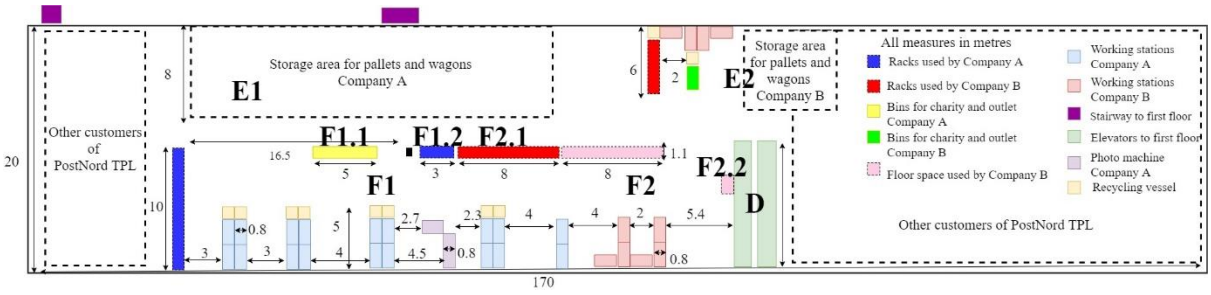

Figure 20. The layout of the second floor in the warehouse.

[1] Samhall, a state-owned company that create work for people with functional impairment causing the employees a reduced working capacity SAMHALL. 2017. *In English* [Online]. Stockholm: Samhall. Available: https://samhall.se/in-english/ [Accessed 2017-04-27 2017].

The volume of incoming returns can vary a lot, which is a problem when it comes to planning the need of employees and the required amount of time. According to the Head of Operations (2017), PostNord TPL does not receive a forecast for the returns. The number of returns is calculated based on how much that has been shipped and how many percent that normally will be returned for Company A and Company B. According to the Head of Operations (2017), this is particular a problem with Company A, since it causes problems to handle the peaks.

Except the returns from the consumers in Sweden, Company A receives returns from the other markets as well. The returns from Finland, Norway, and Denmark are delivered on separate pallets. The returns from the remaining markets are delivered by PostNord AB together with the returns from the Swedish consumers. Company B receives reclaims and returns from the two stores, which are delivered on pallets.

4.2.2 Inspection, sorting, and disposition

The inspection, the sorting, and the disposition are performed on the second floor at point F1 for Company A and F2 for Company B in the warehouse, see figure 20. For both Company A and Company B, operational employees dedicated to returns are handling one wagon each at a time. The return handling procedure differs between the two customers and the procedure will be explained below.

4.2.2.1 Inspection, sorting, and disposition Company A

The inspection, the sorting, and the disposition are individually performed in the same way independent of the operational employee performing the activities or the sales price of the returned product. The return package is opened and the return label is cut out of the package with a knife. Information about the order and whether the return was collected from the postal office or not is available on the return label. The return is inspected if it is the right product, the right package, the right size, and the condition of the product. Company A is accepting all returns regardless of the condition or the time when ordering the return (Employee6CompanyA, 2017).

After inspection of the return, sorting and disposition are followed. Depending on the condition of the return, there are three different disposition options: back to stock, rework before put back to stock, or secondary markets with the option of outlet and charity. The employee, who handles the return, chooses disposition option. The usage of the disposition options can be seen in table 9, for more information about the calculations see appendix D. The returns going to outlet or charity are put on specific pallets without any refurbishment at point F1.1. The returns going back to stock is refurbished, if necessary, and repacked. The shoebox is exchanged if necessary. The checked return is then scanned into the system for the first time in the warehouse.

Table 9. The percentage of the disposition options

Back to stock or rework before put back to stock	95.85%
Outlet	1.98%
Charity	2.17%

When the return is scanned, Company A gets notice of the arrival of the return and can make the refund to the consumer. If the label or the barcode of the label is damaged, the reference number need to be manually typed into the system. After the return is noted in the system, it is stacked in a wagon that later will be used for put-away and the wagon is scanned into the system. According to Employee 6 for Company A (2017), the scanning does not take much effort and time. The return labels, which were cut out from the return packages, are saved and placed in the wagon as well.

The wagon is placed behind the employee at the working station. Every time a return is placed in the wagon or the wagon is scanned, the employee needs to rotate 180 degrees. The rotation is painful for the back and knees of the employees (Employee2CompanyA, 2017, Employee3CompanyA, 2017, Employee9CompanyA, 2017). Many of the employees copy the barcode from the wagon to avoid the rotation. According to Employee 3 for Company A (2017), the scanning of the wagon is only required one time, which reduces the time. Employee 7 for Company A (2017) claims that many of the barcodes on the wagons are timeworn and cannot be scanned as easily as newer barcodes. Therefore, the barcode of the wagon is copied into the system instead of scanned. The copying of the wagon's barcode entails increased risk that mistakes occurs. Therefore, it is not recommended to the new employees (Employee7CompanyA, 2017). According to the Manager of Inbound Company A (2017), the scanning of labels is the most important activity in the return handling and it has to work. If not, it becomes tricky and require a lot of extra work (ManagerofInboundCompanyA, 2017).

Every employee, who handles returns, have their own wagon where they stack the returns. There are four different wagon areas: (i) one for small shoeboxes and plastic bags, (ii) one for medium shoeboxes, (iii) one for large shoeboxes, and (iv) one separate wagon for extra large shoeboxes, see figure 21. The last mentioned is the same wagon for all employees handling returns. The layout of the wagons can be changed depending on the season to better match the demand of that specific time period (Employee3CompanyA, 2017).

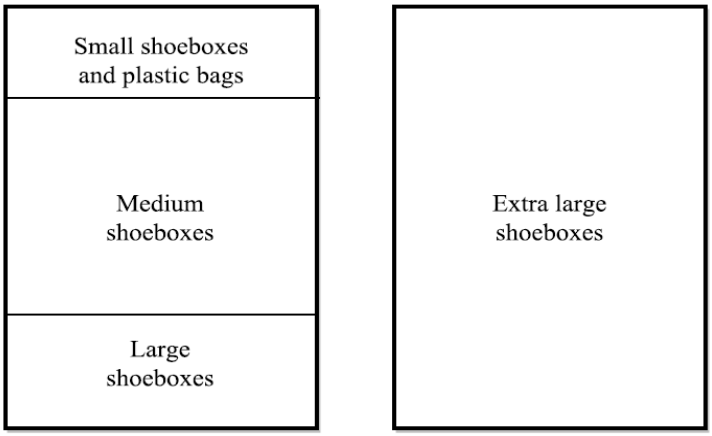

Figure 21. Layout of the wagons for Company A.

When the returns have been handled, they are going to be either put back to stock or put into outlet or charity bins. When the bins are filled, they are transported down on pallets to the first

floor for shipping. The returns, which should be put back to stock, are transported back from point F1 to point D and sent down in the elevators to point C, see figure 19 and 20. They are then manually transported to temporary storage at point G1. The transportation from point F1 to point G1 is performed by employees of Samhall and takes approximately 119 seconds, see appendix C. The wagons are then left at the temporary storage location until put-away is performed.

All the employees handling returns in the inspection, the sorting, and the disposition are performing the steps in the same way. However, they all have some individual procedures in terms of, for example, how many returns they process at a time, if they are handling different sizes of SKUs at different times, and if they are processing the returns depending on the disposition option separately. The individual hourly rates[2] and the processing times can be seen in table 10 and the individual procedures can be seen in table 11, for more information about the calculations see appendix D.

Table 10. The processing time of the employees performing the inspection, the sorting, and the disposition for Company A

Employee	Employment	Years of working with returns	Working hours per month	Number of returns per hour	Time per return	Outlet (%)	Charity (%)
Employee 1	Permanent	3	Full time	1.49 X	Y	1.93	2.31
Employee 2	Permanent	1.5	75 %	1.26 X	1.15 Y	3.61	2.25
Employee 3	Permanent	1	Full time	1.30 X	1.08 Y	2.72	2.46
Employee 4	Permanent	0.5	Full time	1.30 X	1.03 Y	0.50	1.84
Employee 5	Employed by the hour	1.3	Full time	1.18 X	1.28 Y	1.27	1.84
Employee 6	Employed by the hour	1.5	Full time	1.30 X	1.21 Y	2.31	2.28
Employee 7	Employed by the hour	0.8	Full time	1.32 X	1.09 Y	0.80	2.13
Employee 8	Employed by the hour	1.4	Full time	1.47 X	Y	2.53	2.32
Employee 9	Employed by the hour	0.05	Full time	X	1.31 Y	0.63	1.58

All employees claim that processing one return at a time takes longer time compared to processing several at a time. How many returns that are processed at a time is individual for all employees. All employees choose the number of returns in order to keep track of how many returns that have been processed and minimise the number of mistakes. According to the Manager of Inbound Company A (2017), the best way of handle returns is individual. Every

[2] The time is not stated due to company confidentiality.

employee is individual and they need to find their best way of working (ManagerofInboundCompanyA, 2017). There is never an organised meeting where employees can share how they are working in order to enlighten efficient ways of handling (Employee3CompanyA, 2017).

Table 11. The individual procedures of the employees performing the inspection, the sorting, and the disposition for Company A

Employee 1	Process as many returns as could fit on the desk independent of size. These are checked, reworked (if necessary), scanned and stacked in a wagon. The wagon is scanned every time in the scanning process. The return reason is noted in the system. All claims are handled last. Extra shoeboxes are stored close to the desk and changed immediately when needed.
Employee 2	Some returns are checked, reworked (if necessary), scanned and stacked in a wagon at a time. Process claims after each wagon. The wagon location is copied in the scanning process. Extra shoeboxes are retrieved and changed immediately when needed.
Employee 3	The big SKUs and the SKUs in bags are processed first and then the remaining returns are handled. These are checked, reworked (if necessary), scanned, and stacked in a wagon. As many returns as could fit at the desk are processed at a time. The wagon location is copied in the scanning process. The claims are handled in the end of the day. Some extra shoe boxes are stored close to the desk and changed immediately when needed.
Employee 4	The returns are checked, reworked (if necessary), scanned, and stacked in a wagon. Piles of 10 returns is stacked on the table until the table is full independent of SKU size. The wagon location is copied in the scanning process. The claims are processed immediately. Some shoeboxes are stored close to the desk and changed immediately when needed.
Employee 5	100 returns are checked, reworked (if necessary), scanned and stacked in a wagon at a time. The wagon is scanned each time in the scanning. The return reason is noted in the system. The claims and the largest shoeboxes are processed in the end of the day. A new shoe box is retrieved and changed immediately each time when needed.
Employee 6	The amount of returns as could fit on the desk are checked, reworked (if necessary), scanned, and stacked in a wagon independent of SKU size at a time. The wagon location is copied in the scanning process. The shoebox is changed where necessary when all the desk is full, the needed number of shoeboxes is retrieved each time. The claims are processed immediately.
Employee 7	The big SKUs are processed first then the remaining returns are stacked in piles of 5 and 50 returns are processed at a time. The returns are checked, reworked (if necessary), scanned, and stacked in a wagon. The wagon is scanned or copied in the scanning process. The return reason is noted in the system. Claims are processed after each 50 returns. Some extra shoe boxes are stored close to the desk and changed immediately when needed.
Employee 8	20 returns are checked, reworked (if necessary), scanned and stacked in a wagon at a time. The wagon is scanned each time in the scanning. The return reason is noted in the system. Small shoes, big shoes, and reclaims are processed immediately. A new shoe box is retrieved each time it is necessary and changed immediately.
Employee 9	Stack the returns in piles of 10 and process at least 100 returns at a time independent of the size. These are checked, reworked (if necessary), scanned and stacked in a wagon. The wagon is scanned each time in the scanning. The return reason is noted in the system. Claims are processed immediately. Some extra shoe boxes are stored close to the desk and changed immediately when needed.

Figure 22 shows the number of processed returns during a year for Company A. Since the returns are scanned for the first time during the disposition, this is the available information about the received return volumes. On average 1003 returns are processed per day for Company A, for more information about the calculations see appendix D. Manager of Inbound Company A (2017) stresses the fact that PostNord TPL do not know what actually is received each day

since the returns are not scanned until during the disposition. According to the Head of Operations (2017), the return volumes for Company A are expected to increase in the future.

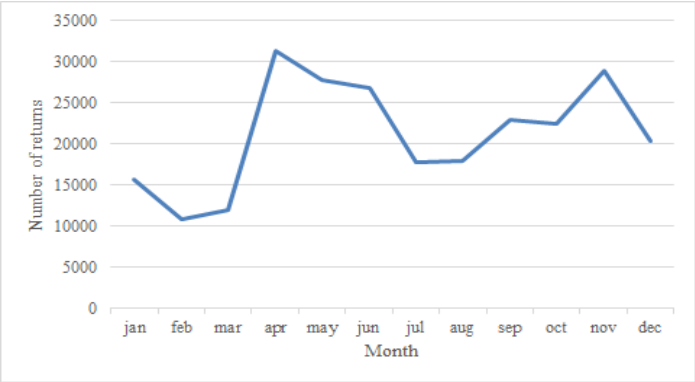

Figure 22. Number of handled returns per month for Company A.

Overall the employees think the inspection, the sorting, and the disposition is working well. The most mentioned issues are when the label is cut out from the package and the opening of the package. These cause pains in the shoulders of the employees (Employee4CompanyA, 2017, Employee8CompanyA, 2017). The employees also mentioned other problems. According to employee 3 for Company A (2017), the returns from Finland often have a black line over the barcode, which damage the barcode and the return information needs to be manually put into the system. Employee 7 for Company A (2017) claims that a big issue is when the consumer is sending the wrong label back to PostNord TPL. The wrong label can be sent due to that consumers sometimes have received several orders and by mistake paste the wrong label with the wrong order information on the return package. The order needs to be manually found in the system by searching for the name of the consumer, which is time consuming (Employee8CompanyA, 2017). Another problem is when the workload is too heavy, this implies that the employees cannot give the same service to all consumers (Employee7CompanyA, 2017).

The disposition option is chosen based on the employee's common sense and individual perspective. Therefore, there are variations in the condition of the returns sent back to stock (Employee2CompanyA, 2017). Employee 3 for Company A (2017) stresses that the number of returns increases, due to that employees send returns back to stock even though they are in a bad condition. Company A sometimes complains about that the condition of the returns sent back to stock is too bad and sometimes that the number of returns sent to outlet and charity is too high (Employee5CompanyA, 2017, Employee8CompanyA, 2017). All employees handling returns are not equally careful when handling returns (Employee6CompanyA, 2017). According to employee 7 for Company A (2017), better rules and guidelines for how to choose the disposition option are needed. Employee 2 for Company A (2017) believes that PostNord TPL will help Company A if they are stricter in the choice of disposition option. Since the handling of returns is manual, all the returns are checked even though they have never been retrieved from the postal office. The returns can be old products that have been in stock for a long time and look dull or mistakes could have been made during the receiving of new goods (ManagerofInboundCompanyA, 2017). Approximately 1.69 percent of the returns are not

retrieved from the postal office. The inspection, the sorting, and the disposition of these returns corresponds to a cost of SEK 22 262, for more information about the calculations see appendix D. Employee 6 for Company A (2017) claims that if all employees followed the same rules and guidelines in the choice of disposition option, the unretrieved returns do not have to be checked.

Better rules and guidelines are also needed considering the shoeboxes. Some consumers want the original shoebox even if it is broken and others value a complete, undamaged shoebox (Employee6CompanyA, 2017, Employee7CompanyA, 2017). According to the Manager of Inbound Company A (2017), not even Company A knows how to make the decision considering keeping or replacing shoeboxes. Therefore, the guideline today is that the shoebox should be exchanged if it is damaged or looks dull (ManagerofInboundCompanyA, 2017).

4.2.2.2 Inspection, sorting, and disposition Company B

The inspection, the sorting, and the disposition are individually performed in the same way independent of the operational employee performing the return handling. The return package is opened and the order information is available on a separate paper in the return package. The return is inspected whether it is the right product, the right package, and the right size. The condition of the product is inspected as well. Company B do not accept all returns, which means that if a return is not authorised the return is sent back to the consumer. After the inspection, it is time for the sorting and the disposition. Depending on the condition of the return, there are three different disposition options: (i) back to stock, (ii) rework before sent back to stock, which could imply sending the return back to the headquarter of Company B or minor rework performed in the warehouse, or (iii) not fit for resale which means that the product is discarded. The employee, who handles the return, makes the decision whether the return can be put back to stock. If there is any uncertainty, Company B gets involved in the decision. In some cases, the consumer has already been in contact with Company B. If so, there is a note in the system telling the employee what to do with the return. Otherwise, a photo of the return and a written description are sent to Company B, who decides the disposition option. While waiting for the response, the return is stored in a CC box, a RT2 box, or a RT3 box in a shelf, see point F2.1 in figure 19. The first mentioned box contains a reclaim that should be wasted or sent back to the head quarter. A RT2 box contains a return that is damaged, but the damage has not been reported by the consumer. The return is stored in the RT2 box until an answer is received from Company B. Then the return is moved to a CC box. The RT3 box contains a reclaim that should be processed after further instructions from Company B and then put back to stock. The reclaim in the RT3 box is returned due to, for example, wrong size but there is not anything wrong with the product. If there are uncertainties even when Company B has been contacted, the return is sent back to their headquarter. The return is then inspected by Company B, who makes the decision if the return can be sent back to PostNord TPL and resold or if it should be discarded (ManagerofInboundCompanyB, 2017).

The returns that need rework are refurbished before being put back to stock. Clothes are always repacked in plastic bags and other products are repacked if necessary. The order information related to the checked return is scanned into the system. This is the first time the return is noted in the system. When the return is scanned, Company B gets notice of the arrival of the return

and can refund the consumer. On the paper with the order information, the consumer has marked the return reason in predefined alternatives, see number one to eight in table 12. The marked reason is noted in the system when the return is scanned. If no reason is marked, number 99 should be marked in the system. Number six is not used by the consumer as intended. It should be used when the wrong product is delivered to the consumer. However, it is often used when the product is not fulfilling the consumer's expectations or when the consumer has ordered the wrong product. When number six is marked as the return reason, Company B needs to be contacted and the product needs to be checked on the website and followed up, which cause a lot of extra work (Employee1CompanyB, 2017, Employee2CompanyB, 2017). If number six is used in the wrong way by the consumer, number 99 is noted instead. The percentage of the registered return reasons can be seen in table 12, for more information see appendix D.

Table 12. Predefined return reasons by Company B and the percentage of the registered return reasons

1	*Unsatisfied with the product*	9.76%
2	*Too small*	31.64%
3	*Too big*	21.71%
4	*Do not conform with the description*	0.49%
5	*Defect, damaged, scratched, dirty, or creased*	2.51%
6	*Wrong product*	0.77%
7	*The product did not fulfil the expectations*	23.38%
8	*Delayed delivery*	0.17%
99	*No return reason marked or misuse of number six*	8.16%
	Others	1.41%

After the return is scanned into the system, it is stacked in a wagon that will be used for put-away and the location in the wagon is scanned into the system. Every employee handling returns have their own wagon where they stack the returns. There are four different wagon areas: (i) two small cardboard boxes divided in three parts for small SKUs, (ii) one small cardboard box for small to medium SKUs, (iii) one big cardboard box for medium and large SKUs, and (iv) one separate wagon for shoes, see figure 23. The system is updated once every hour and the inventory level is then updated with the scanned returns. If a consumer order is waiting for one of the returns, the wagon needs to be released for put-away and packing. Approximately three wagons are transported down for put-away every day (Employee2CompanyB, 2017).

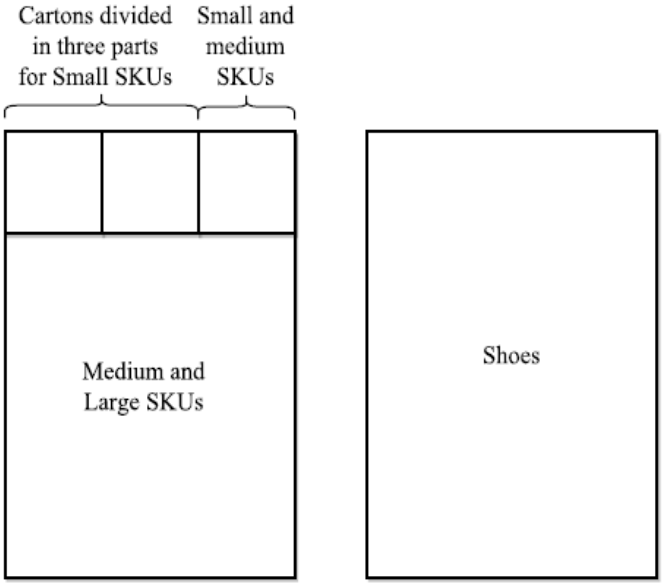

Figure 23. Layout of the wagons for Company B.

When the returns have been handled, they are going to be either put back to stock or sent back to the headquarter of Company B. The returns going to the headquarter are transported down on pallets to the first floor for shipping. The returns, which should be put back to stock, are transported back from point F2 to point D and sent down in the elevators to point C, see figure 19 and 20. Then they are manually transported to temporary storage at point G2. The transportation from point F2 to point G2 is handled by employees of Samhall and takes approximately 79 seconds, see appendix C. The wagons are left at the temporary storage location until put-away is performed.

All employees are performing the steps in the same way. However, they all have some individual procedures in terms of, for example, how many returns they process at a time. The individual procedures, the individual hourly rates[3], and the processing times can be seen in table 13 and for more information about the calculations see appendix D.

[3] The time is not stated due to company confidentiality.

Table 13. The individual procedures and the processing time of the employees performing the inspection, the sorting, and the disposition for Company B

Employee	Employment	Years of working with returns	Working hours per month	Number of returns per hour	Time per return	Working procedure
Manager of Inbound	Permanent	1.5	Full time	Z	1.33 W	Takes one returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.
Employee 1	Permanent	1.5	Full time	1.18 Z	W	Takes one returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.
Employee 2	Employed by the hour	1.4	Full time	1.15 Z	1.24 W	Takes some returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.

Figure 24 shows the number of processed returns during a year for Company B. Since the return is scanned for the first time in the warehouse during the disposition, this is the available information about the received return volumes. On average 334 returns are processed per day for Company B, for more information about the calculations see appendix D. According to the Head of Operations (2017), the return volumes for Company B are expected to increase in the future.

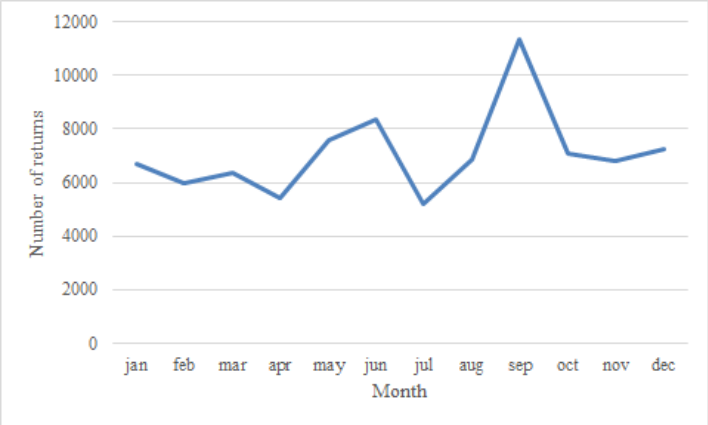

Figure 24. Number of handled returns per month for Company B.

Overall the employees for Company B think the return handling is working well (Employee1CompanyB, 2017, Employee2CompanyB, 2017, ManagerofInboundCompanyB, 2017). Employee 2 for Company B (2017) stresses a problem when returns are sent back in the original product package instead of the shipping package. The original product package is then damaged by the tape and the return label pasted on the package. Clear instructions how to return the product is provided when buying products from Company B, but the problem still exists (Employee2CompanyB, 2017). The Manager of Inbound Company B (2017) mentions an issue related to the opening of the return packages, where a knife is used, and there is a big risk of damaging the product.

Employee 1 for Company B (2017) and the Manager of Inbound Company B (2017) think it is hard to know the reclaim issues if the consumers have not mention it. Usually the consumers have been in contact with customer service at Company B and the cause and how the reclaim should be handled are stated in the system. However, this is not always the case. When a cause is not stated, the reclaim sometimes need to be inspected by all three employees to find the cause, which is time consuming (Employee1CompanyB, 2017).

4.2.3. Put-away

According to the Head of Operations (2017), the waiting time at the temporary locations before put-away are varying a lot due to several reasons. First, picking of consumer orders are prioritised and the wagons ready for put-away need to be on hold. Second, forklift drivers are evaluated based on the speed of put-away. The wagons with returns are mixed and the forklift drivers need longer time to put-away these. The processing order of the wagons is therefore sometimes skipped. Third, there are only a specific number of forklifts that can operate at the same time. The WMS, Diracom, is used to search for free storage locations for both customers, but it does not offer an optimal route for put-away (HeadofOperations, 2017).

According to the Head of Operations (2017), it is extremely important that the employees, which handles returns, put the returns in the right location in the wagons, otherwise the forklifts must drive extra routes and that will increase congestions. The put-away flow is separated for Company A and Company B.

4.2.3.1 Put-away Company A

The average waiting time at the temporary location, see point G1 in figure 19, is 3,3 days. For more information about the calculations see appendix D. When the wagon is picked up for put-away, the average transportation time before the first SKU can be put back to storage is 84 seconds, see appendix C. The forklift driver decides in which aisle the put-away will be made. The decision is based on the driver's knowledge of the content in the aisles, but also Diracom's ability to indicate how many free locations each aisle has. The driver can also choose a specific working section. Diracom shows all the free locations and the driver can do put-away on any of those locations. There are often several available locations and the driver normally chooses the one that is fastest and easiest to access due to the time limit. Each wagon approximately contains 75 to 80 pair of returns (HeadofOperations, 2017). The return labels from the consumers are saved until all the returns are put away and the wagon is empty. According to the Manager of Inbound Company A (2017), the labels are kept if one of the returns, by mistake, have not been scanned during the disposition. The labels are then used to connect the return to the right consumer order (ManagerofInboundCompanyA, 2017). A maximum of nine to ten forklifts can be doing put-away and picking at the same time for Company A. According to the Head of Operations (2017), more is not possible due to congestions. An inventory update is sent once a day before midnight to Company A (HeadofOperations, 2017).

According to the Head of Operations (2017), it would not be possible to combine the put-away and the picking today, due to that the wagons include mixed sizes of SKUs and the driver therefore needs to change aisle. If the content of the wagons were of the same size, the forklift drivers would not need to change aisle. The put-away could be done faster and a combination of put-away and picking would be possible (HeadofOperations, 2017). Employee 7 for Company A (2017) points out that only stacking small SKUs in the wagons will cause problems when doing put-away, since they cannot be stacked properly and the risk of the SKUs falling out is large. However, Employee 7 for Company A (2017) agrees with the Head of Operations (2017) when it comes to separating the sizes in the wagons. Only storing small and medium sized SKUs in a wagon could make the put-away faster and easier. The outcome might also depend on, for example, where there is free space in storage (Employee7CompanyA, 2017). There will be problems with separating the SKUs. Mistakes during scanning occurs frequently and to be able to find the problem all returns from one order need to be stored in the same wagon. If not, the return cannot be connected to the right order label (ManagerofInboundCompanyA, 2017).

The Manager of Inbound Company A (2017) points out that even though the inspection, the sorting, and the disposition have been executed fast, the wagons are often put on hold at the temporary storage location to wait for put-away for a few days. If an employee has missed to scan one return during the disposition, the mistake might not be discovered and corrected until the put-away of the wagon is done a few days later. The longer time it takes to discover possible mistakes the longer time it takes until the consumer gets refunded. A scanning mistake happens at least once a day (ManagerofInboundCompanyA, 2017).

4.2.3.2 Put-away Company B

The average waiting time at the temporary location, see point G2 in figure 19, is 13,81 hours, see appendix D. When the wagon is picked up for put-away the average transportation time before the first SKU can be put back to storage is 84 seconds, see appendix C. The forklift driver decides in which aisle the put-away will be made based on the SKUs in the wagon. Company B has four different storage options: (i) small cardboard boxes divided in three parts for small SKUs, (ii) small cardboard boxes for small to medium SKUs, (iii) big cardboard boxes for medium and large SKUs, and (iv) stored on the rack. The decision for put-away is based on the driver's knowledge of the aisles, but also Diracom's ability to indicate how many free locations each aisle has for the specific storage option and the volume of the products. Diracom shows all the free locations and the driver can do put-away on any of those locations. There are often several available locations and the driver normally chooses the one that is fastest and easiest to access due to the time limit (HeadofOperations, 2017).

According to the Head of Operations (2017), the strength of the put-away for Company B is the efficiency, which is possible due to that the wagons are containing the same type of SKUs. According to the Head of Operations (2017), it would be possible to combine the put-away and the picking due to the separation of the SKUs in the wagons (HeadofOperations, 2017).

4.2.4 Summation of the operational management

In this subchapter, the operational management of the reverse logistics process is summarised for Company A and for Company B.

4.2.4.1 Summation of the operational management Company A

The operational management of the reverse logistics process in the warehouse for Company A is summarised in figure 25. The figure shows the different activities in the process and where in the warehouse these are performed.

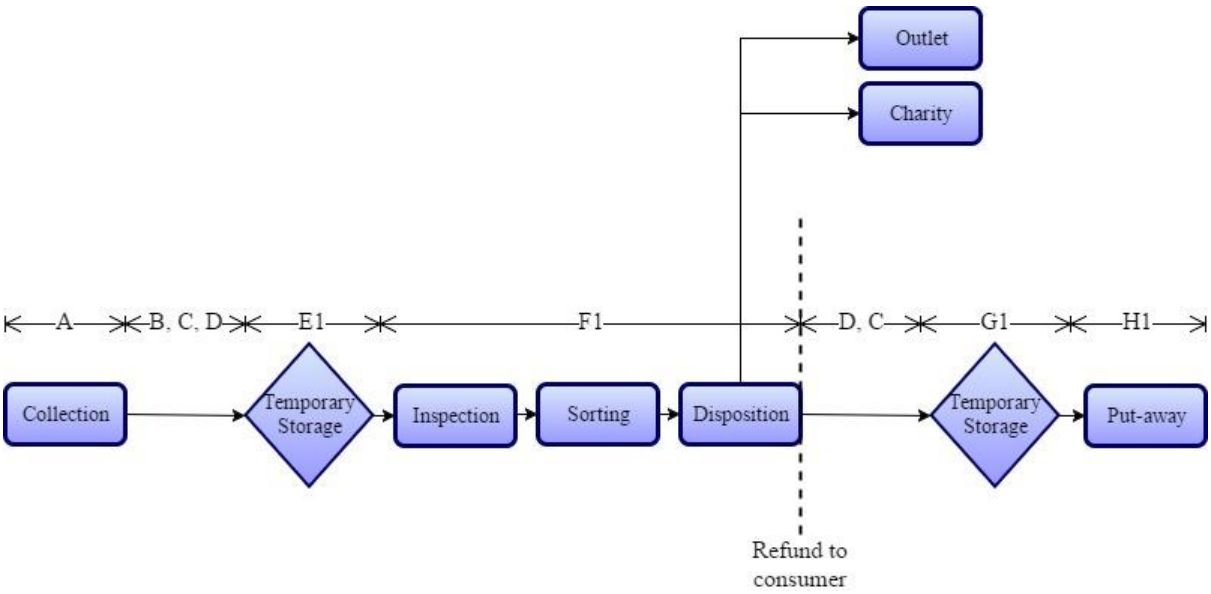

Figure 25. The reverse logistics process in the warehouse for Company A.

The times of the different activities can be seen in table 14. Since the returns are transported in wagons and handled per wagon, there are two different times in the table: one that shows the time per wagon and one that shows the efficient time used for one return. The times are calculated based on the actual time the returns are waiting, meaning that weekends are included in the calculations. For example, if a return wagon is handle on a Friday and moved to the temporary storage on the second floor on that Friday, it will be processed again on Monday. For more information about the times see appendix E.

Table 14. The times of the reverse logistics process in the warehouse for Company A

Activity	Time in the activity	Efficient time for one wagon	Efficient time for one return
Arrival at point A	00:00:00		
Collection		00:32:30	00:00:08
Temporary storage at point B	00:32:30		
Transportation B - E1		00:01:43	00:01:43
Storage at point E1	00:34:13		
Average waiting time at E1		73:05:15	73:05:15
Inspection, sorting, disposition, start	73:39:28		
Processing time		2:32:14	-[4]
Inspection, sorting, disposition, stop	76:11:42		
Transportation F1 - G1		00:02:00	00:02:00
Storage at point G1	76:13:42		
Average waiting time G1		79:12:00	79:12:00
Transportation G1 - H1		00:01:24	00:01:24
Put-away H1	155:27:06	0:18:34	00:00:12

4.2.4.2 Summation of the operational management Company B

The operational management of the reverse logistics process in the warehouse for Company B is summarised in figure 26. The figure shows the different activities in the process and where in the warehouse these are performed.

[4] The time is not stated due to company confidentiality.

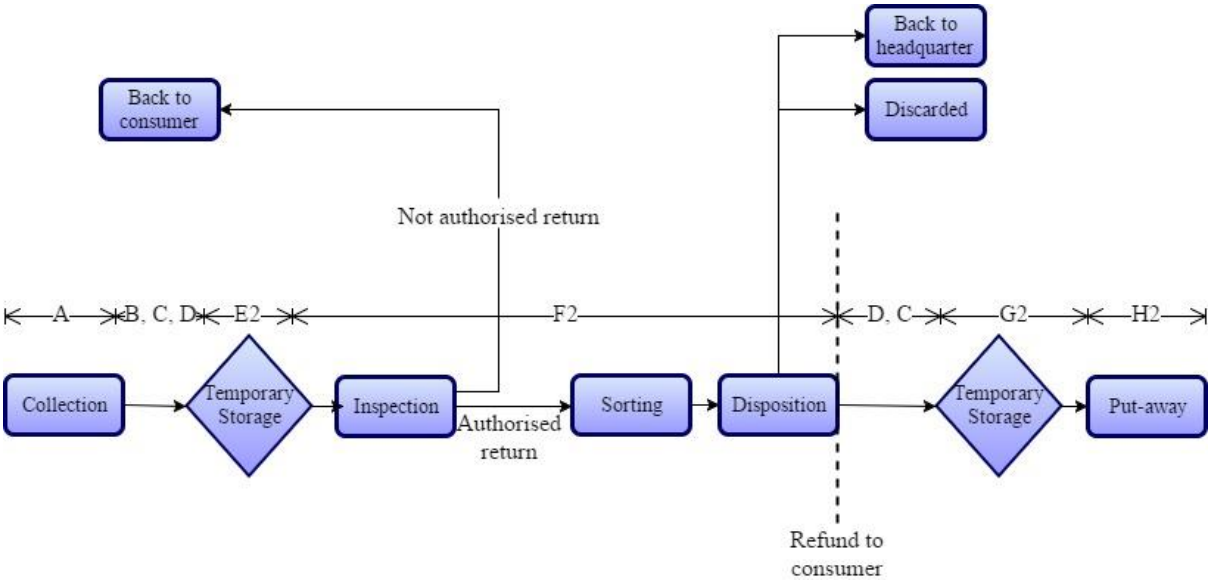

Figure 26. The reverse logistics process in the warehouse for Company B.

The times of the different activities can be seen in table 15. Since the returns are transported in wagons and handled per wagon, there are two different times in the table: one that shows the time per wagon and one that shows the efficient time used for one return. The times are calculated based on the actual time the returns are waiting, meaning that weekends are included in the calculations. For more information about the times see appendix E.

Table 15. The times of the reverse logistics process in the warehouse for Company B

Activity	Time in the activity	Efficient time for one wagon	Efficient time for one return
Arrival at point A	00:00:00		
Collection		00:32:30	00:00:08
Temporary storage at point B	00:32:30		
Transportation B - E2		00:01:36	00:01:36
Storage at point E2	00:34:06		
Average waiting time at E2		01:10:37	01:10:37
Inspection, sorting, disposition, start	01:44:43		
Processing time		01:39:48	-[5]
Inspection, sorting, disposition, stop	03:24:31		
Transportation F2 - G2		00:01:20	00:01:20
Storage at point G2	03:25:51		
Average waiting time G2		13:49:11	13:49:11
Transportation G2 - H2		00:01:24	00:01:24
Put-away H2	17:16:26	00:18:03	00:00:19

[5] The time is not stated due to company confidentiality.

4.2.5 Performance indicators

Key Performance Indicators (KPIs) are used to evaluate the performance of PostNord TPL. Mostly, these are covering picking accuracy, inventory accuracy, and speed in receiving. If the returns are of large amount and importance for a customer, a KPI of the return handling can be included. The KPIs are documented and available for customers in the control tower. A log with the KPIs related to a specific customer is sent on a daily basis. All customers require quality in the return handling. The reverse logistics process needs to fulfil the KPIs that are set in the contract (AreaManager, 2017). The performance of the return handling are only measured based on time (WarehouseManager, 2017). According to the Area Manager (2017), there is currently no KPI in the contract for Company A and Company B related to returns. However, according to the Warehouse Manager (2017), there are verbally set KPIs for both customers.

4.2.5.1 Performance indicators Company A

One of the KPIs for Company A is 24 hours from receiving a return in the warehouse until it is back in stock (WarehouseManager, 2017). To be able to fulfil the KPI, PostNord TPL requires to receive forecasts of, for example, promotions. PostNord TPL needs the information in order to be able to plan the schedule according to demand. Company A cannot provide this information and an agreement has therefore been made. Depending on the number of returns received per day, PostNord TPL has minimum levels on how many returns they should handle per day. The levels can be seen in table 16. The KPI is not fulfilled during peaks due to, for example, promotions (WarehouseManager, 2017). According to the Warehouse Manager (2017), the mean of the KPI is 32 hours and 38 minutes if the weekends are excluded.

Table 16. The number of returns PostNord TPL needs to handle within specific times depending on how many returns received adopted from (WarehouseManager, 2017)

Number of received returns / **Hours from the moment of receiving**	**1000**	**2000**	**3000**
24	80%	40%	25%
48	100%	80%	50%
72		100%	80%
96			100%

PostNord TPL has a daily productivity goal[6] per employee which is performing the inspection, the sorting, and the disposition for Company A (AreaManager, 2017). Employee 4 for Company A (2017) claims that the productivity goal is manageable without stress. However, to be able to reach the productivity goal the employees need to handle more than one return at a time (Employee6CompanyA, 2017). When processing more than one return at a time, unnecessary interruptions are avoided (Employee9CompanyA, 2017). According to Employee 2 for Company A (2017) and Employee 3 for Company A (2017), the productivity goal is hard to

[6] The productivity goal is not stated due to company confidentiality.

manage during the winter. It takes longer time due to, for example, that there are bigger cardboard boxes and more wagons are required (Employee3CompanyA, 2017). Employee 6 for Company A (2017) claims that the refurbishment cannot be made as careful as desired if the productivity goal should be reached. Therefore, the returns are sent to outlet or charity instead of back to stock in a greater extent (Employee6CompanyA, 2017). Employee 6 for Company A (2017) states that it is often quantity before quality. However, the productivity goal is appreciated by the employees since it gives them a daily goal (Employee2CompanyA, 2017).

4.2.5.2 Performance indicators Company B

Depending on the disposition option, a KPI is set for when the received returns for Company B should be processed or put back to storage. Regular returns should be put back to storage within 24 hours. Returns stored in RT2 boxes should be processed within 48 hours. Returns in RT3 boxes and CC boxes should be processed within 72 hours (WarehouseManager, 2017).

PostNord TPL has a daily productivity goal[7] per employee which is performing the inspection, the sorting, and the disposition for Company B (AreaManager, 2017). If e-mails should be answered and reclaims processed during the day, the productivity goal cannot be handled (Employee1CompanyB, 2017, Employee2CompanyB, 2017). Employee 2 for Company B (2017) claims that there is no problem to reach the productivity goal if only returns are handled. However, according to the Manager of Inbound Company B (2017), it is hard to reach the productivity goal if the returns should be inspected carefully.

4.3 Supporting resources

In this subchapter, the used resources related to the return handling in the warehouse will be described.

4.3.1 Labour

On the operational level, the employees are split between Company A and Company B. There are employees dedicated to handle returns, put-away, picking, and packing. It is only shared employees for the receiving part of the warehouse activities. Employees driving the forklifts, can handle both the picking, put-away of returns, and put-away of new products (HeadofOperations, 2017).

According to the Warehouse Manager (2017), the big cost driver of the reverse logistics processes today is labour. PostNord TPL must manually open the return, check it if it is the right product and size, and refurbish if needed. According to the Head of Operations (2017), the manual handling is one of the biggest barriers in the return handling. The inspections are not always performed carefully and faulty returns might be sent back to the storage. When there is people involved there is always a risk that mistakes are done and it is hard to predict and avoid (HeadofOperations, 2017).

[7] The productivity goal is not stated due to company confidentiality.

For customers in e-commerce, the return handling is prioritised equally among the other warehouse activities. However, a reconciliation is done with the customer to decide the different prioritisations during different circumstances, since the available staff is fixed. For example, when a lot of goods is received to the warehouse, the receiving activity is prioritised or after a promotion activity, the return handling is prioritised since the volume of returns will have a peak during and after that period. The prioritisation is based on the activities that keep the consumer satisfaction (AreaManager, 2017, HeadofOperations, 2017).

The customers of PostNord TPL do not always provide forecasts for, for example, promotions, but the customers still require speed in the reverse logistics process. PostNord TPL needs to make the forecasts themselves and it is hard for them to keep up with the speed during fluctuating volume of returns. Therefore, pressure is put on their flexibility in labour in order to be able to keep the speed even though the volume of returns increase (AreaManager, 2017).

To reduce labour costs PostNord TPL uses a lot of employees that are paid by the hour. The flexibility is increased, since the staff can be on different positions and scheduling can be adjusted depending on the need of a specific day (HeadofOperations, 2017, WarehouseManager, 2017). Approximately 60 percent of the employees are paid by the hour at the E4 Terminal. Employees with more responsibilities, such as team leaders, are often permanent employees. Independent on the employment, the employee is getting the same education and the same possibilities (WarehouseManager, 2017). Employees can only be employed by the hour for two years at PostNord TPL. After two years, they have to quit if PostNord TPL cannot offer them permanent employment (ManagerofInboundCompanyA, 2017). The Employees from Samhall are paid by the hour and the cost is SEK 138.9 per hour. PostNord TPL employees, who are paid by the hour and working on an operational level, are paid SEK 222 per hour (WarehouseManager, 2017).

4.3.1.1 Labour Company A

The employees have a big impact on the performance of the return handling. If they make mistakes, secondary failures occur in the remaining flow (ManagerofInboundCompanyA, 2017). According to the Manager of Inbound Company A (2017), the employees, need to have the right eye for the return handling and it is hard to find suitable employees. There are only women handling the returns in the inspection, the sorting, and the disposition for Company A. From the beginning, there were a lot of men handling returns, but they did not have the same eye and were not as careful as the women (ManagerofInboundCompanyA, 2017). According to Employee 3 for Company A (2017), women are faster and more careful than men.

The education of the new employees in the inspection, the sorting, and the disposition for Company A is performed by current employees. The current employee is learning the new one how to handle the returns, how to refurbish them, and how to choose the disposition option until the new employee manages the work independently. The education is based on guidelines that the Manager of Inbound Company A has received from Company A (ManagerofInboundCompanyA, 2017). The education takes approximately one to three days but after there is always an old employee around for advices and questions

(Employee4CompanyA, 2017, Employee5CompanyA, 2017). All employees claim that the education time is enough to be able to make the decisions on their own. They all make the decision based on common sense and their own point of view (Employee1CompanyA, 2017, Employee2CompanyA, 2017, Employee4CompanyA, 2017, Employee6CompanyA, 2017, Employee7CompanyA, 2017). According to employee 7 for Company A (2017), the return handling is easy to learn, but it is harder to learn the IT.

The return handling is prioritised at the second floor for Company A, especially the returns from outside the Nordic countries and Norway. The reason is that the consumers should be refunded as early as possible and those returns have been traveling for the longest time (ManagerofInboundCompanyA, 2017). The Manager of Inbound Company A (2017), is planning the work in the return handling on the second floor each day and tries to rotate the employees on different activities to avoid monotonous work. However, when there is a lot to handle, the employees need to be stationed on the activity that they are performing the best. New employees always start with the return handling. When they have a good flow, they learn how to process the new received goods. They will also learn how to perform the picking and put-away, if they have driving license for turret trucks (ManagerofInboundCompanyA, 2017).

4.3.1.2 Labour Company B

All employees working at the second floor for Company B should manage both the return handling and the receiving of new goods. According to the Manager of Inbound Company B (2017), the received new goods and the returns are prioritised in the same way. The return handling for Company B is performed by both men and women (ManagerofInboundCompanyB, 2017). According to the Manager of Inbound Company B (2017), the gender of the employee does not impact the performance of the return handling.

The education of the new employees for inspection, sorting, and disposition is made by an old employee for at least two days. The old employee shows how the returns should be handled, how to perform the refurbishment, and gives guidelines in decision making. After the two days, the employees can ask each other for advice considering, for example, the choice of disposition option (Employee2CompanyB, 2017).

When Company B outsourced the warehousing activities to PostNord TPL, the Manager of Inbound Company B was visiting Company B's warehouse and was shown how they handled returns. Representatives from Company B were at PostNord TPL during the first weeks. They taught the employees at PostNord TPL, at that time, how to handle returns, make decisions, and perform refurbishment. (ManagerofInboundCompanyB, 2017).

4.3.2 Storage equipment

PostNord TPL is renting the warehouse and the layout of the warehouse is therefore set from the beginning. Before taking on a new customer, PostNord TPL visits the current warehouse of the customer. According to the Head of Operations (2017), the visit can be the base to the layout created in PostNord TPL´s warehouse. Specific customer requirement is taken into account, but if the current warehouse layout of PostNord TPL is working, no changes will be made

(HeadofOperations, 2017). The storage is located on the first floor for both Company A and Company B. The layout of the first floor in the warehouse can be seen in figure 19. Today, shared storage locations are used in the warehouse for the two customers.

4.3.2.1 Storage equipment Company A

Single-deep racks are used for Company A, but in some aisles two single-deep racks are put together in pairs to form double racks, see figure 19. The SKUs are classified in the same way as in the return handling: small, medium, large, and extra large. The SKUs are stored in all aisles, but there are some exceptions. In the twelfth aisle, the extra large SKUs are mainly stored. The most frequently picked SKUs are the medium sized and these are supposed to be stored in the aisle closest to the packing area. According to the Head of Operations (2017), this is not always possible to apply to due to congestions and time limits (HeadofOperations, 2017).

On row one to two of the racks, small SKUs in plastic bags are stored in larger cardboard boxes. On row three to nine, four SKUs of the middle or large size can be stored on top of each other and on row ten to eighteen, three SKUs of the middle or large size can be stored on top of each other (HeadofOperations, 2017).

4.3.2.2 Storage equipment Company B

Single-deep racks are used for Company B, but in some aisles two single-deep racks are put together in pairs to form double racks, see figure 19. There is also a special section next to the office, see figure 19, that stores special products, for example skis and ropes. There are four types of storage locations on the single-deep racks: (i) small cardboard boxes divided in three parts for small SKUs, (ii) small cardboard boxes for small to medium SKUs, (iii) big cardboard boxes for medium and large SKUs, and (iv) storage directly on the racks. The storage location depends on if the product is being stored in a plastic bag or a box. Shoes are stored directly on the racks on top of each other.

The storage locations are built based on that each product are measured by volume by Company B. The volume of the products is considered when the storage location is chosen. According to the Head of Operations (2017), this is a challenge since the measuring of volumes have been inconsistent. The volume can sometimes be misleading, for example a jacket and a pair of skis might have the same volume but will need to be stored very different in the warehouse. However, there have been great progress and when the volume storage is working well the traveling time is reduced, the picking and the put-away route can be optimised, and the packaging can be done faster (HeadofOperations, 2017).

4.3.3 Working area on the second floor

Due to the layout and the restricted space on the first floor, the inspection, the sorting, and the disposition are performed on the second floor. According to the Head of Operations (2017), the inspection, the sorting, and the disposition cannot be made on the first floor due to the number of customers in the warehouse. The Head of Operations (2017) stresses that if these steps could be done on the first floor, time could be saved and employees could be utilised in a better way (HeadofOperations, 2017). The layout of the second floor can be seen in figure 20.

4.3.3.1 Working area on the second floor Company A

There are nine working stations dedicated to Company A for both return handling and receiving of new goods, see figure 20. According to Employee 5 for Company A (2017), the working stations are good and there is enough room. However, some employees would have preferred bigger work desks (Employee7CompanyA, 2017). The area under the work desks are in some extent used when processing new received goods (Employee8CompanyA, 2017).

The material of the work desks is very soft and they are therefore easily damaged (Employee4CompanyA, 2017). The height of the work desks is adjustable. However, the work desks are usually turned since they are damaged. The employees can therefore not reach the control to change the height of the work desks (Employee7CompanyA, 2017). The tools used for refurbishment are placed in a messy way in a box on the work desk. They become dirty and the refurbishment cannot be done as well as desired (Employee8CompanyA, 2017).

New shoeboxes and paper for packaging are stored in a separate shelf a few metres away from the working stations, see point F1.2 in figure 20. Some of the employees retrieve a shoebox or paper each time needed and some retrieve a bunch of shoeboxes and paper to their working stations. According to Employee 8 for Company A (2017), the paper is sometimes not changed even though it should be due to that there is no new paper close to the work desk.

The setup on the second floor is not based on any structure. It has been expanded during time when the volume and needed capacity have increased (ManagerofInboundCompanyA, 2017). The Manager of Inbound Company A (2017) claims that the working stations for Company A are too far away from the elevator.

4.3.3.2 Working area on the second floor Company B

There are four working stations dedicated to Company B on the second floor, see figure 20. According to the Manager of Inbound Company B (2017), the setup on the second floor for Company B is not based on any structure. Employee 2 for Company B (2017) states that the setup is working well. Employee 1 for Company B (2017) and the Manager of Inbound Company B (2017) claim that they would have appreciated more shelves by the working stations. Today, they put many things in a mess under the work desk in the absence of shelves (Employee1CompanyB, 2017, ManagerofInboundCompanyB, 2017). According to the Manager of Inbound Company B (2017), there is a need for more shelves for the RT2 boxes, the RT3 boxes, and the CC boxes.

The majority of the new package material is stored by the work desk. However, new cardboard boxes are stored a few metres away by the elevator, see point F2.2 in figure 20 (Employee2CompanyB, 2017).

4.3.4 Transport equipment

There are two powered forklifts used at the receiving. Since the goods of Company A and the goods of Company B arrive mixed, the two powered forklifts are not dedicated to any specific

customer at PostNord TPL (HeadofOperations, 2017). The forklifts used in the receiving are from Linde and the required aisle width, lifting height, speed, and lifting weight can be seen in table 17 (Linde, 2017).

In the return handling on the second floor, pallet jacks are used for both Company A and Company B to move the wagons and the pallets of incoming products (HeadofOperations, 2017). Information about the used pallet jacks can be seen in table 17 (Linde, 2017).

Turret trucks are used in the put-away and picking area of the warehouse (HeadofOperations, 2017). The turret trucks are also from Linde and information about the required aisle width, lifting height, speed, and lifting weight can be seen in table 17 (Linde, 2017). PostNord TPL have thirteen turret trucks. Three of them are only used for Company B and eight are only used for Company A. The two remaining are not bound to a specific customer of PostNord TPL and can be used for both Company A and Company B. According to the Head of Operations (2017), the remaining two turret trucks are used almost all the time, but since they are not bound for any specific customer they can help to cope with the varying demand (HeadofOperations, 2017).

Table 17. Forklift information (Linde, 2017)

	Required aisle width (metres)	**max height (metres)**	**max travel speed (kilometres/hour)**	**max lifting weight (kg)**
Pallet jack	0.9	-	-	2500
Forklift (powered)	1.0	-	12	2400
Turret truck	1.6	16.2	10	1500

4.3.5 Information technology

In this subchapter, the information technology used at the E4 Terminal is described.

4.3.5.1 Warehouse Management System

In the south/west region of PostNord TPL, Diracom is used as WMS (AreaManager, 2017). According to the Area Manager (2017), Diracom is working well in the E4 Terminal and there are no plans to exchange it. The Head of Operations (2017), also stress that Diracom is working well as a WMS. It is used in the entire warehouse for all the warehouse activities. All activities have their own code and the information sharing and connection between them are working well. Diracom is built on a First In First Out (FIFO) principle, which means that the oldest product will be picked first if there are several products of the same specific product. One strength with Diracom is the blocking system. If a product, for example, has been classified wrongly, the system can freeze all products in the warehouse and flag if those products for some reason are arriving as returns. The blocking system is detecting mistakes and faults fast and helps to stop those products and fix the problem before sending them to the consumer (HeadofOperations, 2017).

PostNord TPL has a control tower, where as much information as possible is stored. It is used for the return handling, track and trace, and lead time statistics (WarehouseManager, 2017). According to the Warehouse Manager (2017), it is not fully implemented yet, but it should be used as an overall ERP system in the future. More modules are developed but not yet adopted. The goal is to develop the control tower to include all the information and make it available for the customers (WarehouseManager, 2017).

Currently, Diracom is sending periodic reports automatically to both Company A and Company B with wanted information. For both customers, external reports are sent through Qlickview, with information on a weekly basis with, for example, number of handled returns and incoming products. Qlickview is a software used to share information and create easy reports based on the information gathered in Diracom (HeadofOperations, 2017).

PostNord TPL cannot share all information related to returns that Company A and Company B desire. Both want to know when a return is received. The information is not available since the returns are scanned during the disposition and not immediately when received at the warehouse. Due to the lack of scanning in the receiving, the available information is not as accurate as desired (WarehouseManager, 2017).

PostNord TPL have their own department where development of the software Diracom take place. According to IT Manager South Region (2017), it is possible to connect a unique code to the products and connect that specific code with the latest order it has been attached to in Diracom. Meaning that if a product gets a unique code it can be connected through Diracom with the latest order. That is not something PostNord TPL have today, however, the implementation would not be hard to perform (ITManagerSouthRegion, 2017).

4.3.5.2 Barcodes and Radio-Frequency Identification

PostNord TPL uses barcodes and finger scanners to document the activities in the warehouse (WarehouseManager, 2017). The scanners can scan both one and two dimensional barcodes (Honeywell, 2017). A subsystem of Diracom, called Logtrade, is subscribing all the barcodes and labels (HeadofOperations, 2017). RFID is not used today, due to that it has been a very expensive solution. According to the Warehouse Manager (2017), as long as the scanners can keep up with the processes and the requirements of the customers, no RFID technology will be needed. If RFID would be implemented in the future, the finger scanners could still be used if one or two dimensional barcodes are put on the RFID tags, but new printers will be needed (ITManagerSouthRegion, 2017).

5 Analysis

In this chapter, the findings from empirics and the literature review will be compared and analysed. The chapter is structured on the reverse logistics process, starting with collection, followed by inspection, sorting, and disposition. Then analysis about the overall reverse logistics process and the supporting resources is conducted. In each subchapter, the important aspects to consider, the problems of today, and the future recommendations will be analysed. In the end of this chapter, the changes of the process framework in the context of e-commerce and the trustworthiness of the empirics is analysed.

As Griffis et al. (2002) and Stock et al. (2002) suggest, PostNord TPL looks upon the return handling as an opportunity to build competitive advantage rather than as a challenge. According to the Area Manager (2017), PostNord TPL aims to have maximum customer satisfaction, both for the customers and the consumers. The customers demand a fast and flexible reverse logistics process that gives the consumer a good experience when returning a product. The consumer needs to be refunded quickly and the return needs to be put back to storage available for resale as fast as possible. Even though the process should be fast and flexible, it has to ensure the quality of the return handling. According to the Warehouse Manager (2017), PostNord TPL should focus on improving the speed and enable feedback and refund to the consumers earlier in the process to improve the customer satisfaction.

The reverse logistic processes for Company A and for Company B are very similar with only a few differences. The similarities and differences are summarised in table 18 and will be analysed through the different subchapters.

Table 18. The similarities and differences of the reverse logistics processes for Company A and Company B

Activity	Similar	Different	Comments
Collection	x		The activity is performed the same way for the returns from Swedish consumers for both customers. The collection for the other returns differ.
Temporary storage	x		The activity is performed in the same way for both customers. Only on different locations.
Inspection	x		The activity is performed in the same way for both customers. Only on different locations.
Authorisation		x	Only Company B is performing this activity, since Company A is accepting all returns.
Sorting		x	For Company A, the choice is made by PostNord TPL. For Company B, the choice is made by PostNord TPL together with Company B.
Disposition		x	Company A and Company B have different disposition options except from put back to stock and rework before put back to stock.
Refund to consumer	x		The activity is performed in the same way for both customers.
Temporary storage	x		The activity is performed in the same way for both customers. Only on different locations.
Put-away	x		The activity is performed in the same way for both customers. Only on different locations.

5.1 Collection

The collection is performed in the same efficient way for both customers. According to Lambert et al. (2011) and Stock and Mulki (2009), collection includes receiving of returns at the warehouse, which is in line with the handling at PostNord TPL today. The returns are received from the trucks, sorted by the employees, and moved to the second floor for further processing. In collection, the returns delivered by PostNord Group AB are handled in the same way, at the same time, and at the same place for both customers. However, the collection of the delivered returns by other LSPs for Company A and from the store of Company B differ. They arrive to the warehouse at different times and in different ways depending on how the customers have ordered the transportations. The sharing of forecasts by both customers are limited both in extent and time. Therefore, it is hard for PostNord TPL to know how many returns that will be received each day. According to Badenhorst (2016), limitations to forecasting and visibility is one of the barriers mentioned in theory.

According to Genchev et al. (2011), it is important in the collection to monitor and control the received volumes. However, PostNord TPL does not know what actually is received in the warehouse and when since no scanning is performed during the collection. One problem due to lack of scanning is that PostNord TPL may have to pay for returns that have been received on

paper but not in practice due to, for example, that they have been left behind or dropped from the trucks.

To solve the lack of scanning, the recommended solution is to implement RFID. A reader needs to be installed either as a metal arch close to the gateway or as a box on the wall next to the gateway, see figure 27 and 28. The reader will detect everything that comes through the gateway and all returns in the wagons will be registered at once. To be able to read the returns, all articles need to have a unique identification code. The barcodes used today need to be exchanged to RFID tags with a unique code. To be able to exchange the barcodes of today, new barcode printers will be needed and the RFID tags need to be connected to the Diracom system. When the returns are scanned, the unique codes can be connected to their latest order in the system (ITManagerSouthRegion, 2017). The reader of a basic RFID cost approximately SEK 130 000 to 200 000, but the cost of printers will be added (SICK-TechnicalSalesSupport, 2017). According to theory, the cost of RFID tags is considered to be negligible and should not be look up on as a large expense. All scanners used in the warehouse today can read the RFID tags as long as a one or two dimensional barcode is put on the RFID tag.

Figure 27. RFID with a metal arch (RFID-im-Blick, 2014).

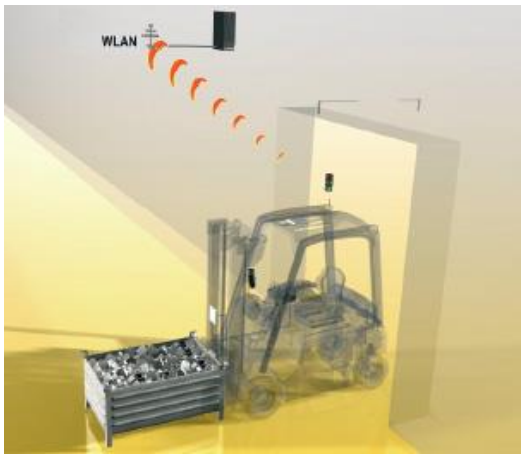

Figure 28. RFID with a sensor on the wall (Hartmann, 2017).

If the returns are scanned automatically during the collection, a lot of the issues mentioned in the empirics would be solved. PostNord TPL would know exactly what is received in the warehouse and when. Both PostNord TPL and the customers will get notice of the received returns earlier. Thereby, both customers can give feedback of the returns to the consumers earlier. According to Stuart et al. (2005), the refunding to the consumer should be made immediately after receiving the return. By implementing RFID, companies such as Company A, which not require authorisation, have the possibility to refund consumers immediately when the returns are received in the warehouse. The consumers of Company A will then be refunded approximately 76,25 hours earlier than today in most cases. In worst cases, where a scanning mistake has occurred, the consumers of Company A will be refunded approximately 155,5 hours earlier than today, see table 14 section 4.2.4.1. Irrespectively of which case, the consumer

satisfaction would be increased. However, the RFID cannot control the content of the return packages. There is therefore a risk that the received return packages contain the wrong content or no content at all. If a customer would like to offer immediate refund to the consumer, the customer needs to be informed about that risk. The customer needs to make sure that the consumers are aware that the refund can be drawn back if the wrong product or no product are returned. Company A wants to refund the consumers as early as possible and would probably accept the risk.

The RFID solution enables other benefits as well. The KPIs, which are based on when the returns arrive, could be measured in an accurate way. The prioritisation of the returns depending on the origin would not be necessary due to that all returns would be registered immediately when received. In addition, the problem with the damaged return labels will be solved since they do not need to be scanned anymore. Mistakes due to the manual scanning would be avoided with RFID and the extra work required by the Manager of Inbound for Company A to find the returns will no longer be needed. The RFID barcodes are longer lasting and less easily damaged than regular barcodes. Therefore, the employees would not have to manually type the barcode into the system in the same extent. Regardless of the implementation of the RFID reader, PostNord TPL should implement unique identification codes to avoid the cutting of return labels.

The manual sorting of the received returns is still something that needs to be performed. The process could be automated with conveyor belts and scanners. However, the solution will require that one employee puts all returns on the belt and at least two employees put everything down from the belts to the wagons. The reason is that the packages cannot be dropped down in the wagons due to the risk of damaging the returns. Approximately the same man-hours will therefore be needed plus the cost of implementing conveyor belts and scanners. In addition, the warehouse layout of today is limited. With the return volumes of today, there is therefore no need for the solution. However, if the return volumes increase, the implementation needs to be reconsidered.

Based on theory and empirics of this research three important aspects to consider when the returns are received have been identified. They are: unloading of the returns, monitoring and controlling received volumes, and early differentiation of the returns. From the theory and the findings of the empirics, it can be concluded that monitoring and controlling the received volumes are critical for a LSP. It is important for the LSP to register the received returns to be able to share required information with their customers. Therefore, registration of the received returns followed by differentiation of the returns should be an individual step in the reverse logistics process in the context of e-commerce. The first two activities of the suggested reverse logistics process can be seen in figure 29.

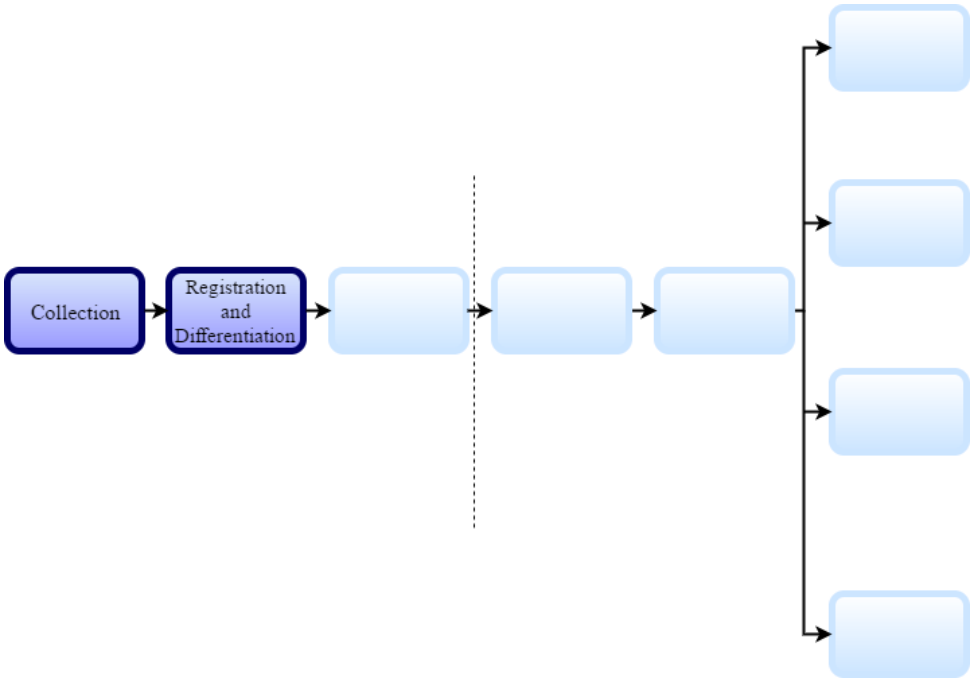

Figure 29. Collection followed by registration and differentiation are the first two activities performed in the reverse logistics process.

The collection would then include the receiving and unloading of returns. The registration and differentiation of returns would include the monitoring and controlling of volumes and the sorting of the returns. The suggestion for the second step is, as mentioned, to introduce RFID scanning. That will imply that the customers of PostNord TPL can give feedback about the return arrival to the consumers, they can offer immediate refund to consumers if that is requested, the KPIs can be measured properly, and more accurate information can be shared with customers. The sorting of the returns in the second step should still be performed manually.

Two important aspect to consider in collection are summarised based on the theory and the findings from the empirics and can be seen in table 19. It is also concluded whether these are performed for the customers today and the effect of the recommendations in the collection.

Table 19. Aspects to consider in collection

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Receiving of returns	✓	✓	✓	✓
Unload the returns	✓	✓	✓	✓

Important aspect to consider in the registration and differentiation are summarised based on the theory and the findings from the empirics and can be seen in table 20. It is also concluded whether these are performed for the customers today and the effect of the recommendations.

Table 20. Aspects to consider in registration and differentiation

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Monitoring and controlling volumes	×	✓	×	✓
Early product differentiation	✓	✓	✓	✓

According to Bartholdi and Hackman (2016), transportation should be minimised in the warehouse. Collection is today performed far away from the elevator to the second floor, which results in unnecessary transportation. It could be minimised by moving the collection closer to the elevators. PostNord TPL is recommended to move the collection to point J, see figure 30. Today, the area between the office and the elevators is unutilised. By moving the collection point to J, 559 hours will be saved every year, which corresponds to SEK 77 618 per year, for more information see appendix F. Moving the collection point will not affect other warehouse activities, only make the collection of returns easier. Today, the receiving and shipping take place in the same area, which often causes congestions (HeadofOperations, 2017). By moving the collection, the shipping can be performed without disturbance. There are no costs associated with the relocation of the collection, since there is no need to move any equipment. However, the advantage of being close to the office door will fall behind when changing the collection location. The problem can be solved by installing one extra door on the other side of the office facing the new collection area. It is possible since there is enough space in the office to install a door.

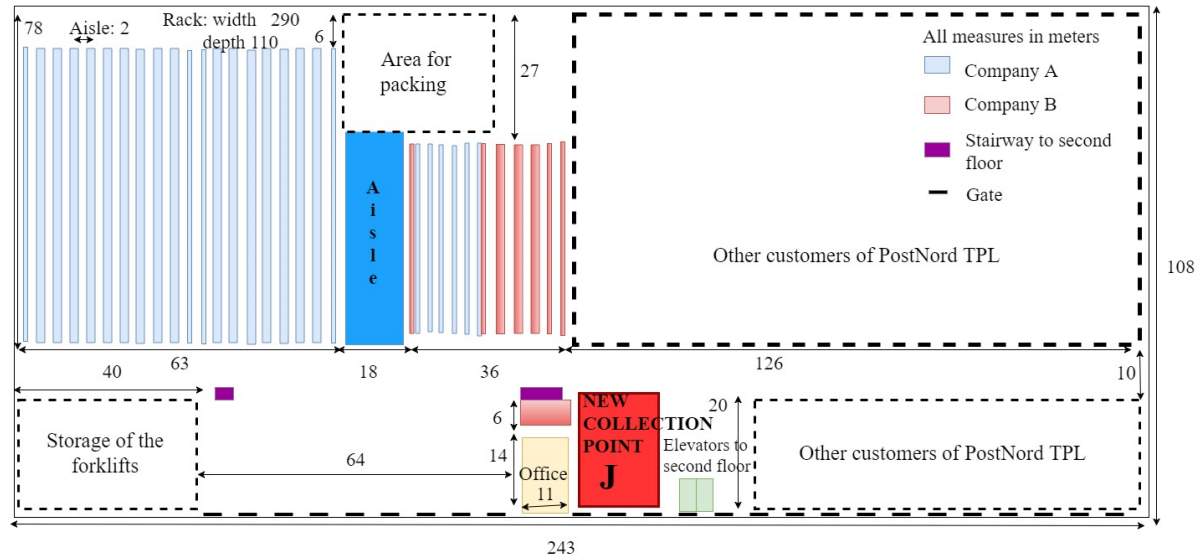

Figure 30. The new layout of the warehouse after relocating the collection point.

From the collection and the registration and differentiation several problems have been identified. The problems are summarised in table 21.

Table 21. Identified problems in collection and registration and differentiation

Step	Problem	Reference
Collection	Limitations to forecasting and visibility	Head of Operations (2017)
	Unnecessary transportation	Observations
Registration and Differentiation	Lack of monitoring and controlling volumes	Observations, Manager of Inbound Company A (2017)
	Delayed customer feedback	Observations

5.2 Inspection

After the collection and the registration and differentiation, the returns are transported up in the elevator and to the temporary storages before the inspection takes place. Until at this point, the activities are performed in the same way for the customers. The wagons need to be transported manually and the transportation is working well today.

As mentioned before, it is important to minimise the transportation in the warehouse. The transportation of the return wagons on the second floor could be minimised by relocating the customer with the largest amount of returns closest to the elevators. The Manager of Inbound for Company A (2017) also believes the work desks of Company A is too far away from the elevators. There are two alternative solutions: (i) relocate Company A to where Company B is located today and vice versa or (ii) relocating both customers closer to the elevator, see figure 31. Based on the calculations for the two alternatives, the second alternative is the most beneficial, see appendix F. The temporary storages will be located closest to the elevator, which will minimise the transportation of the wagons. By implementing the second alternative, 22 hours and a cost of SEK 3 890 can be saved each year, see appendix F.

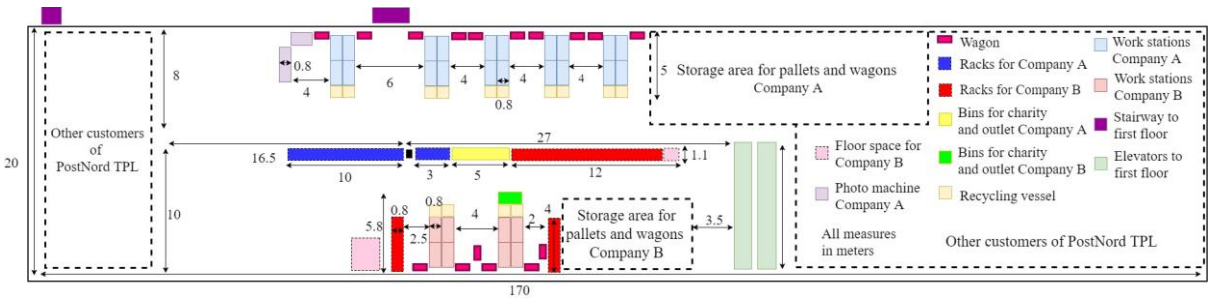

Figure 31. New layout of the second floor.

When changing the layout of the second floor, more shelves should be installed for Company B. The Manager of Inbound for Company B stores a lot of things on the floor, due to lack of shelves. Shelves should therefore be installed next to the work desks in the new layout to enable a better organisation of things, see figure 31. The employees would also like more shelves for the RT3 and CC boxes. With the new layout of the second floor, the space can be better utilised and there is room for more shelves, see figure 31. The suggested layout will help to prepare for the customers' increasing volume of returns considering both storage locations and work desks. It is a challenge for PostNord TPL to keep a flexible design of the layout, so that it can change fast after the different requirement of the customers.

The inspection of today is performed well and in the same way for the two customers. The return package needs to be open and the return needs to be inspected so it is the right product and size and potential defects are found. According to Genchev et al. (2011), the inspection should be done through physical inspection or automated testing. Both customers have products that are suitable for physical inspection. However, if a customer has more complex products, PostNord TPL may have to implement automated testing for that specific customer. Rogers et al. (2002) stress the importance of having clear guidelines and well-trained staff to ensure that the correct inspection is made. PostNord TPL is recommended to set clear guidelines of how the inspection should be performed together with each customer. The inspection is performed by employees, which are dedicated to the return handling for one specific customer. They are therefore considered to be well-trained.

An issue considering the return package mentioned by the employees of both customers is when the return package is well sealed with tape and plastic. It is hard for the employees to open the return package and there is a big risk of damaging the product and the package of the product. However, it is hard for PostNord TPL to affect how the consumers are returning the products, but they can put pressure on the customers to have clearer descriptions of how to return a product. Ultimately, the customer decides which instructions to send to the consumer and the consumer decides which instructions to follow. Company B already sends instructions of how to return products to their consumers, but the problem still exists.

All employees for Company A claim that one of the largest problems during the inspection is the need of cutting out the return label. It is time consuming, causing work-related injuries, and damage the work desks. However, the cutting is necessary in order to save the return label in case any mistakes occur in the scanning during the disposition. With the RFID solution and the unique identification codes mentioned earlier, this would no longer be necessary.

The suggestion for PostNord TPL is to perform the inspections in the same way as today, but with one minor difference. The employees should still open the return package and thoroughly inspect the return to make sure that it is the right product and the right size and look for potential defects. The difference is that PostNord TPL should set clear guidelines of how the inspection should be performed together with each customer. The second activity performed in the reverse logistics process can be seen in figure 32.

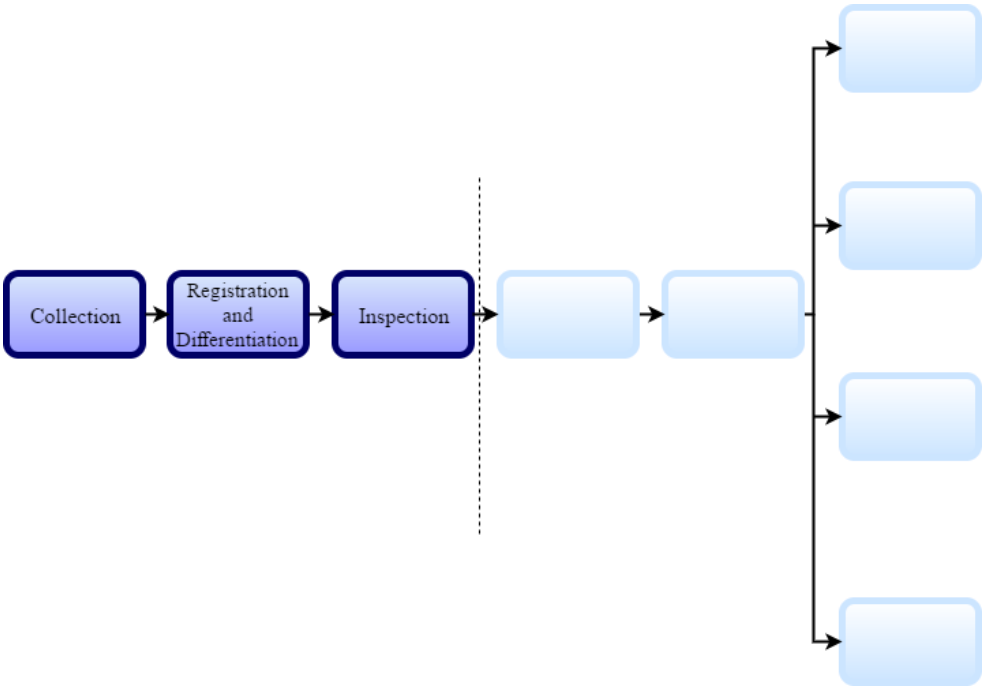

Figure 32. Inspection is the second activity performed in the reverse logistics process.

Based on the theory and the empirics of this research several important aspects to consider in the inspection have been identified. These are summarised in table 22. It is also concluded whether these are performed for the customers today and the effect of the recommendations in the inspection.

Table 22. Aspects to consider in inspection

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Physical inspection	✓	✓	✓	✓
Automated testing	×	×	×	×
Clear guidelines	×	✓	×	✓
Well-trained staff	✓	✓	✓	✓

According to de Leeuw et al. (2016), Lambert et al. (2011), and Rogers et al. (2002), authorisation should be the first step performed in the reverse logistics flow for traditional stores. To get authorisation, screening needs to be performed (Badenhorst, 2013, Blackburn et al., 2004, de Leeuw et al., 2016, Rogers et al., 2002). The context of e-commerce differs from the context of a regular store, which the theory is built on today. Since there is no physical store in the context of e-commerce, the screening needs to be performed after the collection. The return is inspected for the first time during the inspection and it is not until this point the consumer can get authorisation. Therefore, the screening and the inspection coincide in the context of e-commerce and the consumer gets authorisation after the inspection. Since the consumer needs authorisation, the refund to the consumer cannot be made before the inspection.

For PostNord TPL the authorisation only needs to be performed for Company B since Company A has a free return policy. All returns for Company B needs to get authorisation. If there are any uncertainties in giving authorisation to a consumer, Company B is involved in the decision. It is up to the customer to decide the return policy, which implies that PostNord TPL needs to be able to handle situations with and without authorisation.

In the context of e-commerce, the authorisation will take place after the inspection, see figure 33. If a customer has a free return policy there will be no need for authorisation. If PostNord TPL needs to give authorisation, support from the customer should be requested, for example, about clear guidelines and instructions.

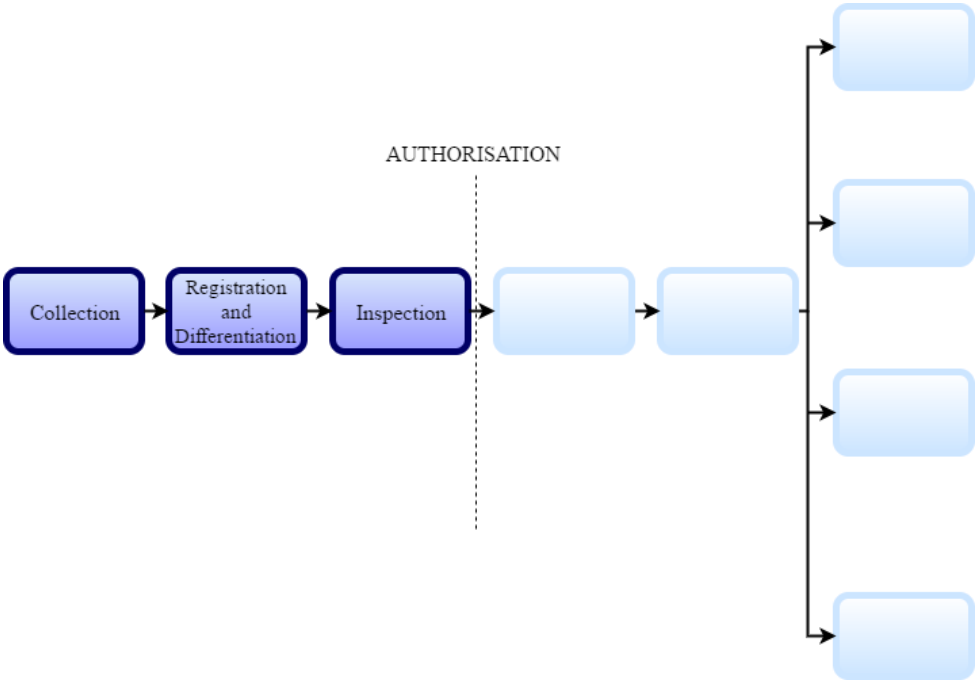

Figure 33. Authorisation takes place after the inspection in the context of e-commerce.

From the inspection, several problems have been identified. The problems are summarised in table 23.

Table 23. Identified problems in inspection

Step	Problem	Reference
Inspection	Unnecessary transportation	Observations, Manager of Inbound Company A (2017)
	Unorganised layout	Observations
	Cutting out return label	Employee 4 for Company A (2017), Employee 8 for Company A (2017)
	Better guidelines	Observations, Employee 6 for Company A (2017)
	The return package is well sealed	Manager of Inbound Company B (2017), Employee 2 for Company B (2017)
	Damaged/wrong return label	Employee 3 for Company A (2017), Employee 7 for Company A (2017)
	Long waiting times	Observations

5.3 Sorting

It is important to make a profitable decision in the sorting and this is one of the key challenges for companies (Blackburn et al., 2004, Stock and Mulki, 2009, Thierry et al., 1995, Tibben-Lembke and Rogers, 2002, Zikopoulos and Tagaras, 2015). There are some differences in the sorting for the two customers. For Company A, the choice is made by employees of PostNord TPL based on their common sense. Many of the employees for Company A mention that the condition of the returns that are sent back to stock are varying. The percentage of the processed returns that are sent to outlet or charity are varying per employee, see figure 34. From a statistical point of view, each employee should have approximately the same number of returns in the same condition. However, this is not the case. The reason can depend on varying accuracy of the employees' performance and that the individual judgement of the employees differs in the sorting decision. Therefore, it is recommended to have stricter guidelines to guarantee the quality of the returns sent back to stock and that not too many returns are sent to the secondary markets.

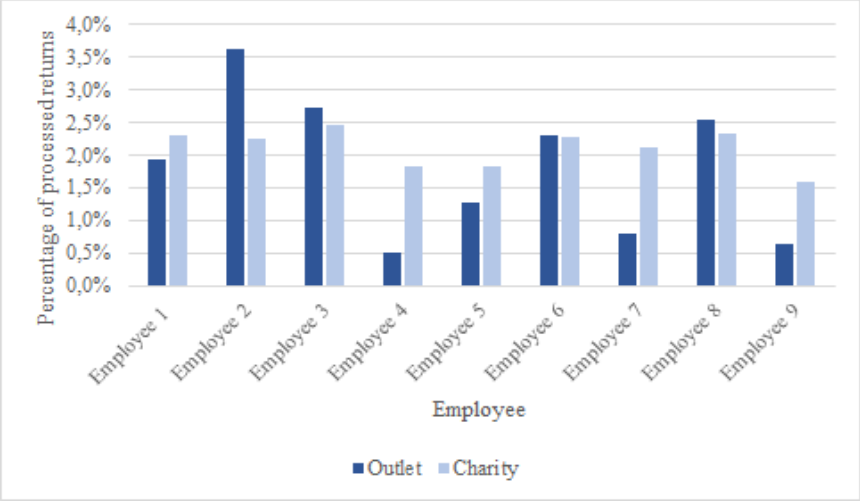

Figure 34. Percentage of the processed returns that are sent to outlet and charity per employee for Company A.

For Company B, the choice is made by PostNord TPL but Company B is involved in the decision if there are any uncertainties. The process is extensive, but it ensures that the decision is made based on the same preconditions each time and avoids varying condition of the products in storage.

Jayaraman et al. (2008) stress the importance of having appropriate identification mechanisms in order to make the right decision in the sorting. Today, the employees for Company A experience that the customer sometimes is too uninvolved, which leads to that the disposition option sometimes can be hard to decide. For Company B, the employees can contact Company B and let them decide. However, reaching out to Company B takes time and the returns cannot be processed as fast as for Company A. Having clearer guidelines and more appropriate identification mechanisms to better chose the disposition option could help the employees for Company A, which would lead to better and more homogeneous decisions. If the employees for Company B could have more power and less contact with Company B, faster processing times for the returns could be received. Since PostNord TPL is a LSP, they need to fulfil the requirements of the customer. Therefore, if a customer of PostNord TPL requires that they should be involved in the decision or the other way around, that must be followed in the process. To fulfil the requirements of the customer is a barrier for PostNord TPL.

Blackburn et al. (2004) stress the importance of making the most profitable decision for disposition. However, since PostNord TPL is the LSP there is no need for them to make the most profitable decision. It is the customer's responsibility to set clear instructions, identification mechanisms, and guidelines to enable that the most profitable decision is made by the employees at PostNord TPL. Therefore, this is not considered as an important aspect to consider for PostNord TPL.

The sorting should be performed in the same way as it is performed today. However, PostNord TPL should make sure that the customer offers clear instructions and guidelines so the employees of PostNord TPL can choose the disposition option fast and accurate. The third activity performed in the reverse logistics process can be seen in figure 35.

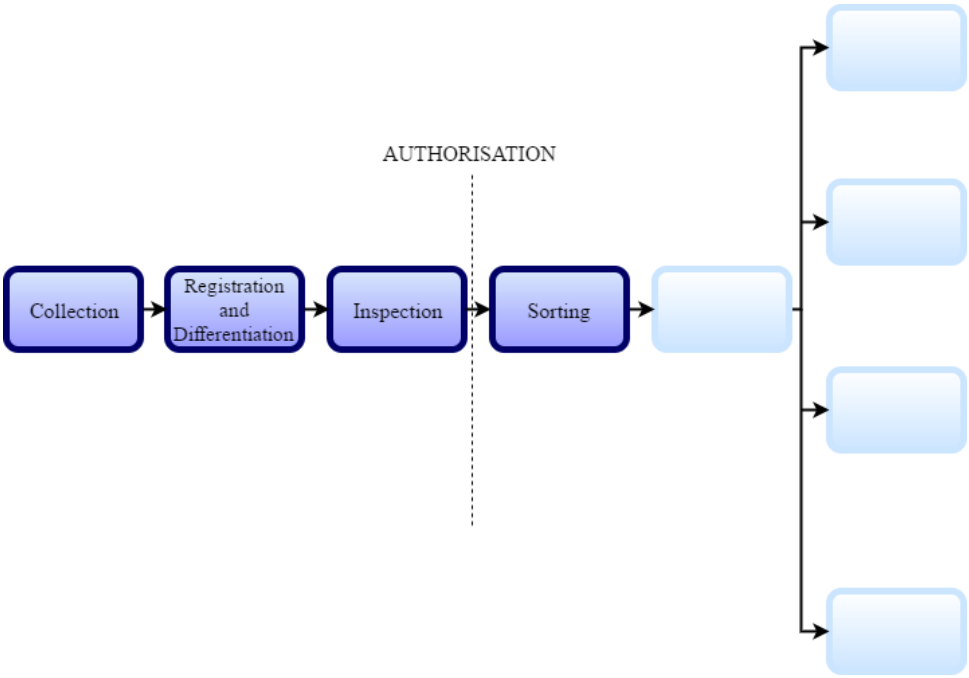

Figure 35. Sorting is the third step in the reverse logistics process.

Based on the theory and the empirics of this research two important aspects to consider in the sorting have been identified. These are summarised in table 24. It is also concluded whether these are performed for the customers today and the effect of the recommendations in the sorting.

Table 24. Aspects to consider in sorting

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Clear guidelines	×	✓	✓	✓
Appropriate identification mechanisms	×	✓	✓	✓

From the sorting, two problems have been identified. The problems are summarised in table 25.

Table 25. Identified problems in sorting

Step	Problem	Reference
Sorting	Individual judgement in decision making	Observations, Employee 1 for Company A (2017), Employee 2 for Company A (2017), Employee 4 for Company A (2017), Employee 6 for Company A (2017), Employee 7 for Company A (2017)
	Difficulties in decision making	Employee 2 for Company A (2017), Employee 7 for Company A (2017)

5.4 Disposition

The next activity is disposition, according to Guide Jr and Van Wassenhove (2002), it is important to decide disposition option as early as possible. PostNord TPL is doing that in the reverse logistics process of today for both customers. Therefore, PostNord TPL is recommended to continue to decide disposition option as early as possible.

According to Genchev et al. (2011) and Thierry et al. (1995), it is important to have formal disposition options. Theory suggests four disposition options: (i) put back to stock (ii) rework before put back to stock, (iii) not fit for sale, and (iv) secondary markets. Both customers have the option of put back to stock and rework before put back to stock. However, only Company B have the option of not fit for sale and only Company A have the option of secondary markets, such as charity and outlet. It is important to recapture as much value as possible when choosing the disposition option (Hazen et al., 2012, Lambert et al., 2011, van Nunen and Zuidwijk, 2004). To recapture as much value as possible in the disposition, clearer guidelines from the customers are needed.

The put back to stock option is performed similar for the two customers. If the return is in good condition and can be put back in the same package, the return is scanned and put in the wagon ready for put-away. The other options differ between the customers, and will be further elaborated. The option of rework exists for both customers and can be either refurbishment or minor rework. Company A does not want the employees to spend too much time on refurbishing the returns before these are put back to stock. Therefore, if the refurbishment of the return will take too much time, the return is instead sent to secondary markets. The employees then make the choice whether the return is fit for sale to a reduced price at the outlet or should be donated to charity. The employees of Company B are on the other hand allowed to spend more time on the refurbishment and the returns can be sent to the headquarter if further refurbishment is needed. The process is extensive, but it ensures that the decision is made based on the same preconditions each time, avoids varying condition of the products in storage, and ensures that the most profitable disposition option is performed. It is a great advantage, but the disadvantage is the time required to contact and communicate with Company B. Today, nothing is wasted for Company A and very little is wasted from Company B, which is a good way to recapture value in the process. The returns of Company B will be not fit for sale if the headquarter has given those instructions. The returns of Company A that are considered by the employees to not be resalable to sales price will be sent to secondary markets.

Company B´s disposition options are formal both considering the options but most importantly considering the guidelines for the different options. A fast and a cost effective disposition is therefore enabled and no changes is recommended. However, for Company A, there is less formal disposition options established. It results in that the employees for Company A are not sure how the disposition options should be most efficiently performed. There is a need for better guidelines considering refurbishment of the shoeboxes and the shoes. It is therefore, recommended that PostNord TPL requests clearer rules and guidelines from Company A.

Theory suggests having appropriate refurbishment resources considering: employees work tools, space, and time. The refurbishment for Company A includes exchanging the shoebox and fixing small removables, for example, stains and scratches. The refurbishment for Company B is similar. It includes exchanging the package of the product and smaller refurbishing, like fixing scratches. According to the employees working on the second floor, there is a need to structure the working stations in a better way to enable a better, faster, and easier refurbishment. All employees for Company A need to retrieve extra shoeboxes from a shelf a few metres from the work desks. Six out of the nine observed employees normally store extra shoeboxes by their work desks already. Storing the boxes on the floor is difficult, since they are unorganised and get dirty. By installing extra shelves on the side of the work desks, all the different sizes of the shoeboxes can be stored by the work desk and the employees do not have to retrieve new shoeboxes from the shelf as often. A recommended solution can be seen in figure 36. Except from the shoeboxes, the employees need to use extra packing paper, which also is stored a few metres from the work desks. Employee 8 for Company A stresses that the exchange of packaging paper is sometimes skipped due to that it takes time to retrieve new paper. Therefore, it is recommended to store the packing paper under the work desks as well, see figure 36. The employees for Company B store the plastic packaging material on the work desk. However, they also need to retrieve new cardboard boxes from a shelve a few metres away, which causes unnecessary time loss. Therefore, the suggested packaging material and shoebox solution in figure 36 is recommended for the work desks of Company B as well.

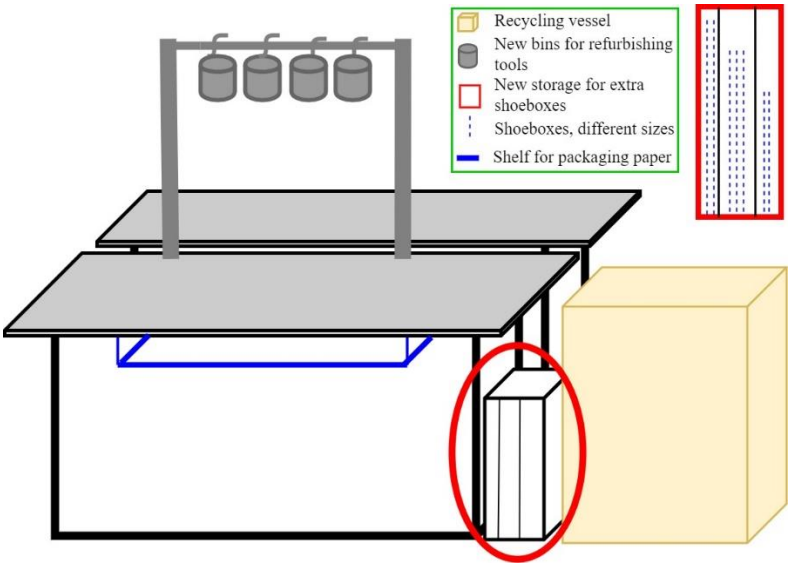

Figure 36. The recommended layout of the work desks.

Today, it is hard for the employees for Company A to find the right refurbishment tools since they are stored in a mess. The problem can easily be fixed by installing extra storage possibilities by the work desks, see figure 36. The tools can then be found fast and kept in a better condition. Even though this is not a mentioned problem for Company B, they can also use the suggested layout to better store the refurbishment tools. The work desks for both customers are recommended to be exchanged, since these are worn out and cannot be adjusted in height.

PostNord TPL possesses the required resources to be able to perform the disposition. They have dedicated employees and dedicated warehouse space. Accept from the minor changes at the working stations they have the needed warehouse equipment to perform the disposition.

There are individual problems for the two customers in the disposition. A mentioned problem for employees working for Company A is the location of the wagon for the processed returns. It causes a painful rotation in the back and the knees of the employees. To avoid the rotation, many of the employees are performing the scanning of the wagon incorrectly and the risk of mistakes are therefore increased. The employees claim that it requires less time to copy the barcode. However, Employee 1 for Company A handles returns the fastest and scans the wagon each time. Therefore, the reduced time is not an acceptable excuse. PostNord TPL is recommended to change the position of the wagon by the work desks. The wagon should be located next to the employee instead of behind the employee. The rotation in the knees and back of the employees would then be reduced from 180 degrees to 90 degrees. Therefore, there would no longer be a reason for the employees to perform the scanning incorrectly and the risk of mistakes will be reduced. According to the Manager of Inbound for Company A (2017), the scanning of labels is the most important activity in the return handling. To enable a correct scanning, the barcodes of the wagons needs to be exchanged, since these are worn out according to the employees.

A mentioned problem for Company B is the predetermined return reasons. When the returns are scanned into the system, the employee notes the marked return reason in the system. All employees stress that number six of the predefined return reasons is mostly not used as intended. Although the empirics showed a low percentage of the usage of number six, number 99 is also used for consumers misusing number six. However, number 99 is also used when no return reason is marked, which implies that it is hard to express how many returns that actually have been marked with number six. The procedure for the employees when number six is marked is time consuming due to that the return has to be rigorously investigated for defects although there are no defects. Therefore, PostNord TPL is recommended to put pressure on Company B to change the description of number six.

The disposition options are based on what the customers would like PostNord TPL to perform. It is important to make sure that the customers offer clear and structured guidelines for how the disposition options should be performed considering time and resources. To make economical and homogenous decisions are barriers for PostNord TPL. According to theory, much more rework can be done before the return is put back to stock than PostNord TPL is doing today. However, since PostNord TPL has retailing customers in e-commerce which in turn, order products from several different suppliers, there cannot be any: rework, remanufacturing, larger repairs, cannibalization, or component recovery. If customers would like to introduce a new disposition option in the return handling, it is important for PostNord TPL to evaluate their capabilities to handle a new disposition option before a contract is signed. Today, PostNord TPL does not have a customer that to a large extent supply backorders with returns. If a customer in the future would like to supply backorders with returns, the algorithm of Stuart et

al. (2005) can be used due to that PostNord TPL have the layout of the workstations suitable to use the algorithm.

The disposition should be performed in the same way as it is performed today. However, PostNord TPL should make sure that the customer offers clear instructions and guidelines so the employees of PostNord TPL can perform the disposition fast and accurate. In addition, more organised refurbishment tools, possibilities to discuss uncertainties, and formalisation of the education of new employees are actions that can be taken to better perform the disposition in the future. The fourth activity performed in the reverse logistics process can be seen in figure 37.

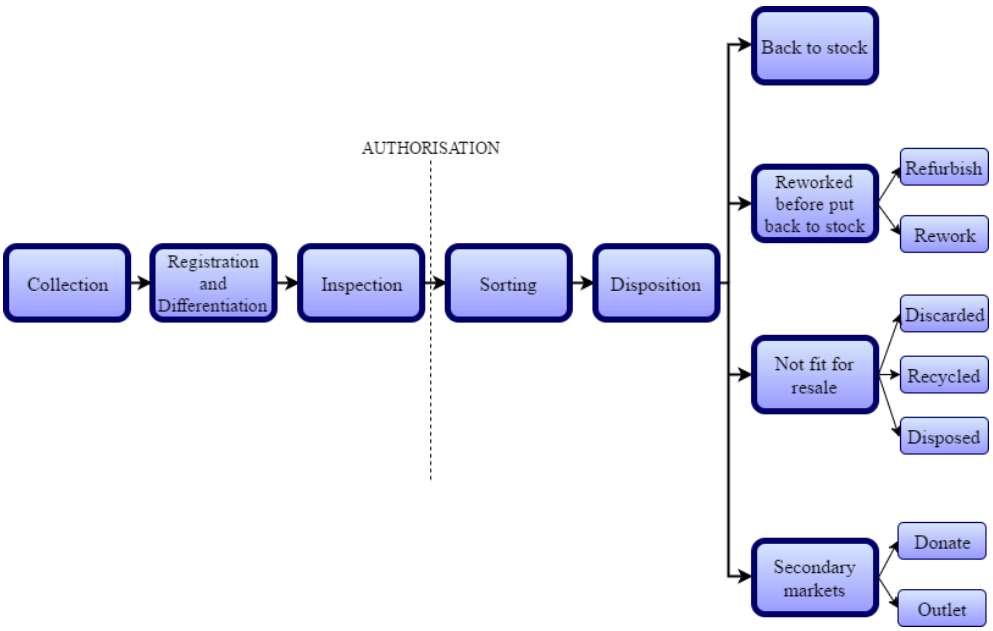

Figure 37. The disposition options possible in the context of e-commerce.

Based on the theory and the empirics of this research several important aspects to consider in the disposition have been identified. These are summarised in table 26. It is also concluded whether these are performed for the customers today and the effect of the recommendations in the disposition.

Table 26. Aspects to consider in disposition

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Disposition option decided early	✓	✓	✓	✓
Formal disposition options	×	✓	✓	✓
Appropriate refurbishment resources	×	✓	×	✓
Appropriate resources	✓	✓	✓	✓

Today, the disposition is performed based on common sense of the employees working for Company A. Therefore, there are variations in the condition of the returns that are sent back to stock and the shoeboxes. With stricter guidelines, it becomes clearer for the employees how the returns should be processed and when the shoebox should be exchanged, which leads to reduced variation. If the variation is reduced, the quality of the processed returns will be higher and the returns, that are not retrieved from the postal office, do not need to be checked. Today, they are inspected since they can look dull or to identify mistakes that can have been made during, for example, the receiving of new products. However, only 1.69 percent of all returns are not retrieved from the Postal Office. The inspection, the sorting, and the disposition of these returns corresponds to a cost of approximately SEK 22 300 per year. Even if these returns would not be inspected, they still need to be unpacked from the return package and scanned into the system. The actual cost saving is therefore lower than SEK 22 300. The cost saving is relatively low given that PostNord TPL then can identify mistakes and reduce the number of future returns. Therefore, PostNord TPL is recommended to continue to check all received returns even though they have not been retrieved from the Postal Office.

Today, the refunds are sent to the consumers during the disposition. The refund is performed through the system in the same way, for both customers. When the return is scanned, the system gets an update and the refund to the consumer can be made at once. With the RFID solution, Company A can refund consumers earlier as desired and since Company B´s consumers need authorisation the time for refunding will not be affected.

After the disposition, the wagons are transported down to the first floor again and will be put in the temporary storages before being put away in storage. The transportation is the same for the two customers. However, there is a difference for how long time the wagons have to wait at the temporary storages. The returns for Company A is waiting for 79 hours and 12 minutes on average and the returns for Company B are waiting for 13 hours and 49 minutes on average. The waiting time is affecting the customer satisfaction, since it takes longer time than necessary until the returns are ready for resale again. The long waiting time is a result of that the picking is prioritised over the put-away of returns for both customers.

The wagons of Company B are put in storage much faster than the wagons for Company A. There are two reasons for the difference: (i) the aisles of the location for Company A is often congested and there is therefore a limited number of forklifts that can operate at the same time and (ii) the wagons of Company B are sometimes released during the return handling at the second floor due to that products in the return wagons are ordered, which pushes the put-away to be done much faster for Company B. To be able to reduce the long waiting time for the wagons of Company A, the suggestion is to spread the products in a greater extent between the aisle. Nor the space or the aisles are the limitation today, instead the limitation is that too much articles have been put in the same aisle. Therefore, most of the forklifts need to drive in the same aisle causing congestions. By spreading out the articles better, more forklifts can operate at the same time. Thereby, the waiting times will drop. Another additional solution is that the returns are sorted based on the size of the SKUs in the wagons. The put-away can then be done at the same time as the picking takes place and thereby reduce the required time. The time could

be improved since the SKUs are stored depending on size and the forklift drivers would not have any incentive to not follow the handling order of the wagons. In addition, the put-away time would be reduced due to that the required travel between the aisles is reduced. The solution is possible due to the recommended implementation of RFID and unique identification codes and there is no longer any need to save the order labels.

From the disposition, several problems have been identified. The problems are summarised in table 27.

Table 27. Identified problems in disposition

Step	Problem	Reference
Disposition	Improved formal disposition options	Observations
	Heterogenous refurbishment	Employee 3 for Company A (2017), Employee 6 for Company A (2017)
	Unorganised work desks and tools	Manager of Inbound Company B (2017), Observations, Employee 7 for Company A (2017), Employee 8 for Company A (2017), Employee 1 for Company B (2017),
	Unergonomic handling	Employee 2 for Company A (2017), Employee 3 for Company A (2017), Employee 9 for Company A (2017)
	Unclear predetermined return reasons	Employee 1 for Company B (2017), Employee 2 for Company B (2017)
	Performance based on common sense	Employee 2 for Company A (2017), Employee 3 for Company A (2017)
	Long waiting times	Observations

5.5 The overall reverse logistics process

The way the inspection, the sorting, and the disposition are performed today for the two customers is effective, even though the employees choose the working procedure individually. However, the required time to perform the three activities differ between the two customers. The processing times are hard to compare since Company B requires additional time consuming tasks during the return handling, for example give authorisation, answering emails, and contacting headquarter. However, comparison between the employees for each customer is possible since the same activities are performed. The individual processing times differ for the employees for Company A. Even when Employee 9 is disregarded, the average processing time for the employees differ even though they have been employed for a long period of time and are using approximately the same procedures. Figure 38 shows the disguised processing times[8].

[8] Times cannot be shared due to company confidentiality.

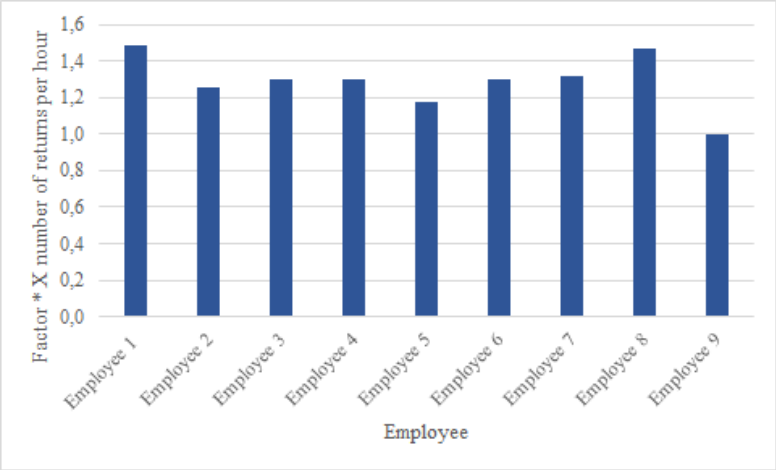

Figure 38. Disguised number of processed returns per employee for Company A.

For Company B, the average handling time per employee differs even though they have been employed for a long period of time and are using approximately the same procedure. The disguised processing times[9] can be seen in figure 39. The individual difference in processing times for both customers can depend on, for example, varying accuracy in how the activities are performed and the individual working pace of the employees. It is hard to influence the last mentioned issue for PostNord TPL without exchanging the employees. The accuracy of how the activities are performed affects the time. The more accurate the employee is, the more time is needed for the activity. However, the accuracy of how the activity is performed can affect the number of future returns. For example, if a return is refurbished carefully, the number of returns due to the product's bad condition would decrease. Therefore, it is important to have a high level of accuracy in the activities even though longer time is required to perform the activities per return. It can be concluded that there is no optimal procedure for the inspection, the sorting, and the disposition in order to reduce the average time for handling one return. It is therefore better to let each employee find the individual procedure in order to reduce time and the number of mistakes.

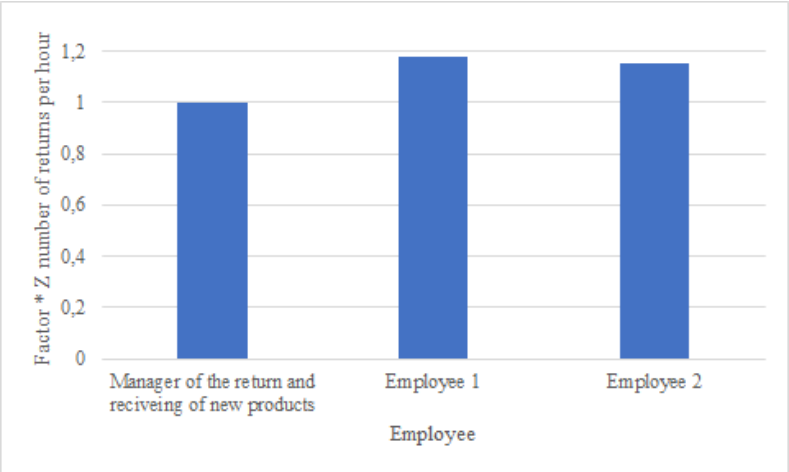

Figure 39. Disguised number of processed returns per employee for Company B.

[9] Times cannot be shared due to company confidentiality.

According to Hjort et al. (2013), companies need to develop appropriate methods of how to utilise internal knowledge of employees. However, this is not something PostNord TPL is doing today but they are recommended to introduce meetings where internal knowledge between the employees are shared. The meetings could be appropriate for discussing, for example, the individual procedures of how to process returns. It is also recommended to have a more formalised education of new employees. The new employees would thereby achieve the same knowledge from the beginning and PostNord TPL can achieve a higher quality of the reverse logistics process.

According to Stock and Mulki (2009), LSPs are able to achieve economies of scale by combining volumes from multiple customers. To be able to combine volumes of different customers the LSP need to evaluate the customers' requirements and the characteristics of the handled returns. A 2 x 2 matrix has been created to help LSPs evaluate whether the return handling can be unified or should be kept separate, see figure 40.

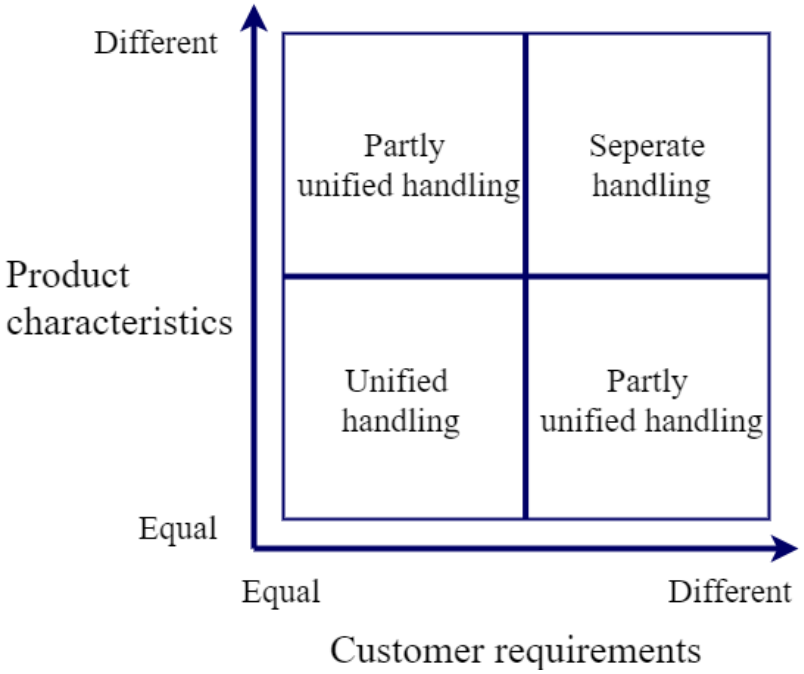

Figure 40. 2 x 2 matrix considering the effects of the customer requirements and product characteristics on the return handling.

The four areas will now be further elaborated. If the customers of the LSP have different products in the reverse logistics process but equal requirements, the LSP should have partly unified handling of the returns. For example, if one customer resells clothes and the other customer resells appliances, but both customers would like the LSP to perform minor tests of the returns, the LSP needs to handle the returns differently. If the returns are of different characteristics and the customers requires different handling the LSP is positioned in the top right corner and should perform separate handling. It could be one customer reselling t-shirts and one reselling security alarms. The customer selling alarms requires that the LSP is testing all returns in a special equipment and sends broken alarms for repair. The t-shirt customer rather recycles the return if it is not resalable than having employees spending time on refurbishment.

The flow cannot be unified and the customers' return flow need to be separate. An LSP can be positioned in the bottom left corner if the requirements of the return handling for the different customers is equal and the product characteristics is equal. For example, both customers are reseller of shoes and the requirements are to collect, inspect, and sorting the shoes according to predefined guidelines and then either perform minor rework or send the returns to charity. There are no unique requirements of the customers which implies that the handling could be performed together. If the LSP handles similar returns but the requirements of the customers are different, the LSP should have partly unified handling. For example, the LSP is still handling returns of two shoe customers however one customer requires that the LSP should photograph every return and send them to the customer for further evaluation before the disposition option is chosen.

Combining volumes is not performed today in the reverse flow of PostNord TPL. They are not recommended to combine the volumes of the different customers due to the different requirements of the customers, which causing differences in how the activities are performed.

Rogers and Tibben-Lembke (2001) stress that automatisation would be one good implementation to streamline the processes, but it is difficult since the reverse logistics process includes several exceptions. Automatisation is not used in the warehouse of PostNord TPL today. In line with theory, the reason is due to the different requirements of the customers and the products. The different requirements and the current volume of returns makes it not profitable to implement automatisation today. If PostNord TPL would consider automating some part of the return handling in the future, they should not invest in too customer specific solutions. A LSP never know for how long time a customer will buy their services and a customer specific solution might not be possible to use for any other customer.

According to Bernon and Cullen (2007), appropriate performance indicators are one part of cost management. Two important cost drivers to measure performance are the overall cost of the return handling and the obtained recovery level (Bernon and Cullen, 2007). The last mentioned is measured by keeping track of the levels for the different disposition options. However, it could be questioned whether PostNord TPL is measuring the return handling for the customers enough and in an accurate way to have a clear view of the overall cost of the return handling. The reason is that PostNord TPL does not measure all the times for the activities individually or the total time from when a return arrives to the warehouse to until it is put back to stock.

According to Jeszka (2015), it is important to have well defined goals and well established performance indicators for the level of savings. For Company A, one of the KPIs is considering the time from receiving a return in the warehouse until it is processed. Since the arrival time of the returns are not registered in the system, the KPI cannot be measured in an accurate way and the value of the KPI mentioned by the Warehouse Manager can be questioned. It is not possible to say whether this KPI is fulfilled or not since the volume of received returns per day is unknown. However, based on the time estimations for Company A in the empirics, the time from the arrival of the return until it is processed is approximately 76 hours and 11 minutes. In the agreement, PostNord TPL has 96 hours to process the returns if at least 3 000 returns are

received. Therefore, it is not possible to say whether the KPI is fulfilled or not since the received return volume per day is unknown.

For Company B, one of the KPIs is considering the time from the arrival of a return until it is put back in stock. Since the arrival time of the returns are not registered in the system, the KPI cannot be measured in an accurate way. Based on the empirics for Company B, it takes approximately 17 hours and 16 minutes from the arrival of the return until it is put back to stock. The KPI for Company B is therefore considered to be fulfilled for the returns that are put back to stock. It is not possible to say whether the KPI is fulfilled considering the returns in the RT2 boxes, the RT3 boxes, and the CC boxes, since this information is not available. However, since Company B is involved in these decisions, it is considered that the time depends on how fast Company B is communicating with PostNord TPL in the decision making. Based on the empirics in this thesis, PostNord TPL has the resources to process the returns within the time frames. With the recommended RFID solution, the KPI could be measured in an accurate way.

PostNord TPL has productivity goals for the employees of Company A and the employees of Company B. Based on the calculated hourly rates[10] for the employees, see table 10 for Company A and table 13 for Company B in section 4.2.2 Inspection, sorting, and disposition, it can be concluded whether the productivity goal is achieved or not for the different customers. For Company A, the goal is fulfilled by seven of nine employees, where one of the employees who not fulfils the goal is newly employed. Therefore, the goal is considered to be realistic. For Company B, none of the employees fulfil the productivity goal. Therefore, the goal is considered to be too high. The reason why the employees not fulfil the goal can be due to the other tasks performed while processing the new returns, like answering emails and processing the returns in the different boxes.

According to Brewer and Speh (2000), Genchev et al. (2011), and van Nunen and Zuidwijk (2004), it is important to measure the volume of returns, type of returned product, monetary value, percent of sales, and resource utilisation related to returns. The productivity goal is considered to be one way to measure the resource utilisation and the measurement is therefore in line with theory. Some of the remaining measurements are considered to be measured as well even though PostNord TPL has not expressed it. The volume of returns is measured through weekly reports to both customers with how many returns that are processed per day and therefore the percentage of sales can be measured as well. The type of product that is returned is not measured today. It could be a good idea to measure the type of returned product in order to achieve a classification in the storage and introduce storage zones. The classification could be one step in order to reduce the congestions in storage. Neither the monetary value is measured. However, it could be questioned whether this indicator is interesting for a LSP since the monetary value is only affecting customer and not the LSP.

Based on the theory and the empirics of this research several important aspects to consider in the overall reverse logistics process have been identified. These are summarised in table 28. It

[10] Times cannot be shared due to company confidentiality.

is also concluded whether these are performed for the customers today and the effect of the recommendations.

Table 28. Aspects to consider in the overall reverse logistics process

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Formal methods to train employees	×	✓	×	✓
Methods for utilising internal knowledge of employees	×	✓	×	✓
Combining volumes	×	×	×	×
Automatisation	×	×	×	×
Appropriate measuring of KPIs	×	✓	×	✓

From the overall reverse logistics process, several problems have been identified. The problems are summarised in table 29.

Table 29. Identified problems in the overall reverse logistics process

Step	Problem	Reference
Entire process	Varying accuracy in return handling	Observations
	Unutilised internal knowledge of employees	Employee 2 for Company A (2017)
	No formal education of new employees	Observations
	Inaccurate measuring of KPIs	Observations

5.6 Supporting resources

According to Bartholdi and Hackman (2016), labour is in general the largest expense in a warehouse especially when handling smaller handling units. In line with theory, labour is the largest expense in the return handling for both customers. In order to reduce the cost of labour, many of the employees are paid by the hour, which increase the flexibility. Since the amount of returns are varying during the year, see figure 22 for Company A and figure 24 for Company B in section 4.2.2 Inspection, sorting, and disposition, PostNord TPL can adjust the number of needed employees depending on the need of a specific day. The recommendation is therefore to keep pay the employees by the hour in as large extent as possible.

The reverse logistics process for both customers consists of a lot of manual work. The employees have big impact of the performance of the return handling and the competence of the employees is therefore important. According to Jeszka (2014), the employees' experience of handling returns impact the performance of the process. In line with theory, PostNord TPL uses dedicated employees to handle the returns. For Company A, The Manager of Inbound has chosen to only have women that handle the inspection, the sorting, and the disposition. According to The Manager of Inbound for Company A, women perform the activities with

higher quality. For Company B, both men and women handle the returns. However, it is Company B who makes the decisions when uncertainty appears. Therefore, lower pressure is put on the employees to make accurate decision and they can focus more on accurate refurbishment.

Richey et al. (2005) stress, that employees should have specific authority and responsibility. PostNord TPL is in line with theory since the employees have different responsibilities and different authorities. They have for example one manager responsible for each customer in the return handling. Therefore, the recommendation is to keep dividing the responsibilities between the employees. Considering authorities, PostNord TPL should keep the Managers of Inbound for both customers in the return handling.

The storage equipment is working well and the space is well utilised for both customers. Due to that small handling units are handled, the layout with single-deep racks is working well. For Company A, the bottleneck in the storage area today is the limitation in how many turret trucks that can operate at the same time without causing congestion. Therefore, the space should not be more utilised in the storage area for Company A. For Company B, the choice of storage location is based on that the SKUs are measured in volume. However, according to the Head of Operations (2017), the measuring of volumes has been inconsistent. Therefore, Company B needs to be informed that the measuring of volumes needs to be improved in order to utilise the space even more.

The number of available turret trucks for Company A is, as mentioned, larger than the number of turret trucks that can operate at the same time without causing congestion. Therefore, there is no need to invest in more turret trucks as long as the layout of the storage area is unmodified. The number of turret trucks for Company B is also considered to be sufficient, since the time frame from when the returns are received at the warehouse until they are put back to stock is fulfilled. The transportation in the warehouse is not extending the overall processing times of the returns for any customer, since the returns are transported to temporary storages. Therefore, the number of forklifts and pallet jacks for both customers are also considered to be sufficient.

The IT at PostNord TPL is working well in general. They are satisfied with Diracom as their WMS, since it can handle all the activities in the warehouse. As mentioned earlier, the recommendation is to introduce RFID combined with unique identification codes to enable scanning in the collection. The implementation of RFID is possible with minor programming adjustments in Diracom.

Based on the findings of the empirics, it can be concluded that proper management is important for a LSP when handling the reverse logistics process. Collaboration and communication is important since the LSP handles several customers with different requirements. The link between the customers and the LSP need to be fast and efficient in order for the LSP to handle the requirements optimal. Management is the connection between the customers and the operational employees. Proper management is also important due to that they often have a more holistic picture of the return handling and possess knowledge from several customers compared

to the operational employees. PostNord TPL has appropriate management however, it could be improved. It has been suggested to require better information and guidelines from the customers and with improved guidelines the management will be improved as well.

Based on the theory and the empirics of this research several important aspects to consider in the supporting resources of the reverse logistics process have been identified. These are summarised in table 30. It is also concluded whether these are performed for the customers today and the effect of the recommendations.

Table 30. Aspects to consider in the supporting resources of the reverse logistics process

	Company A		Company B	
Aspects	**Today**	**After recommendations**	**Today**	**After recommendations**
Employees have special authority and responsibilities	✓	✓	✓	✓
Appropriate storage equipment	✓	✓	✓	✓
Appropriate transportation equipment	✓	✓	✓	✓
Appropriate IT	×	✓	×	✓
Appropriate management	×	✓	×	✓

From the supporting resources, several problems have been identified. The problems are summarised in table 31.

Table 31. Identified problems in the supporting resources

Step	Problem	Reference
Supporting resources	Flexible resources	Area Manager (2017)

5.7 The process framework in the context of e-commerce

The forward flow, the reverse logistics process, and the needed supporting resources in the context of e-commerce can be seen in figure 41. The forward flow in a warehouse is equal in the theory and the context of e-commerce. However, the reverse logistics process in the context of e-commerce for a LSP differ compared to theory. The steps of the reverse logistics process in theory and in the context of e-commerce for a LSP are summarised in table 32 as well as how the steps differ.

Table 32. Comparison between the reverse logistic process according to theory and in the context of e-commerce

Step in theory	Step in new framework	Differences
Authorisation	-	The step does not exist in the context of e-commerce due to the lack of a physical point of contact with consumers.
Collection	Collection	Collection only includes the receiving and unloading of returns in the context of e-commerce.
	Registration and Differentiation	The monitoring and controlling of volumes are especially important for LSPs in the context of e-commerce and are therefore considered to be an individual step combined with the differentiation of returns.
Inspection	Inspection	Inspection is performed equally in theory and the new framework. In the context of e-commerce, the inspection and screening coincide and the consumer can get authorisation in this step.
Sorting	Sorting	Sorting is performed equally in theory and the new framework.
Disposition	Disposition	The disposition is performed equally in theory and the new framework. The difference is that there are fewer disposition options in the context of e-commerce.

The step of authorisation in theory does not exist in the context of e-commerce for a LSP due to the lack of a physical point of contact with the consumer. In the context of e-commerce, the consumer gets authorisation in the inspection since it is the first time the return is inspected. Therefore, the screening and the inspection coincide in the context of e-commerce. Apart from that the consumer gets authorisation in the inspection in the context of e-commerce, the inspection is performed equally compared to theory.

The collection in theory includes the receiving of returns, but also monitoring and controlling of return volumes and an early product differentiation. Due to the importance for a LSP to monitor and register the return volume to be able to share required information with customers, collection in theory is divided into two steps in the context of e-commerce. The two steps are: (i) collection and (ii) registration and differentiation. The collection in theory and the two steps in the context of e-commerce includes the same tasks. However, the collection step in theory is divided in the context of e-commerce to really point out the importance to register the returns for a LSP.

The sorting is performed equally in theory and the context of e-commerce. However, the importance of appropriate identification mechanisms is even greater in the context of e-commerce for a LSP to be able to fulfil the requirements of the different customers. In the context of e-commerce for a LSP, it is not as important to make profitable decisions as theory suggests. It is the customer's responsibility to provide clear guidelines to enable that the most profitable decision is made by the employees of the LSP.

The last step in both theory and the context of e-commerce for a LSP is disposition. It is performed equally, but some of the alternatives do not exist in the new context. The reason is that these cannot be performed by a LSP since they do not perform the production.

The refund to consumers in the e-commerce context of a LSP can be performed after the registration of the returns if the customer has a free return policy. Otherwise, the consumers need authorisation and they can then be refunded after the inspection.

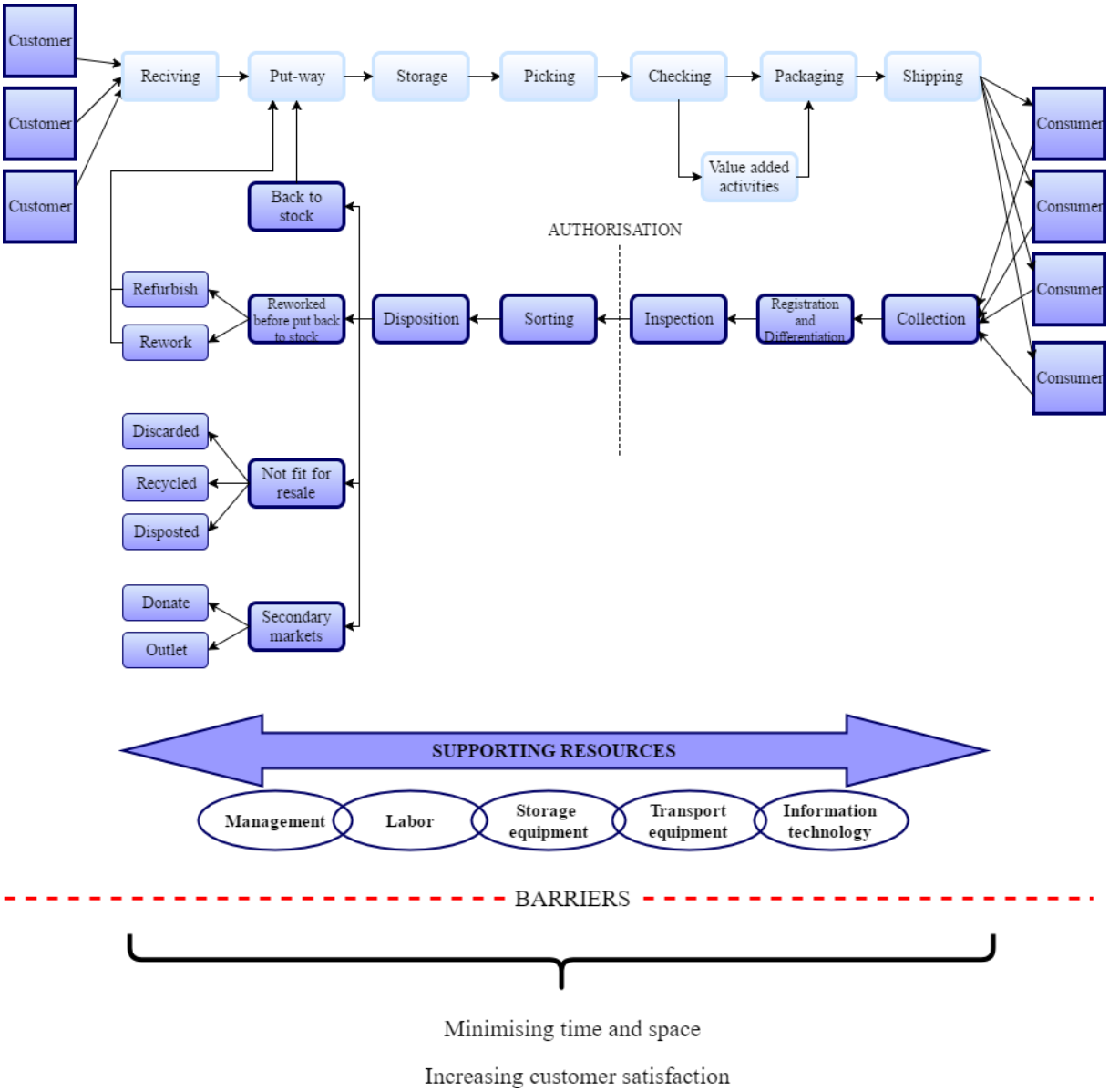

Figure 41. The warehouse operations and the supporting resources in the context of e-commerce for an LSP.

The supporting resources in theory are also needed in the context of e-commerce for a LSP. Since a LSP handles customers' products, the management is especially important and are therefore added as a supporting resource in the context of e-commerce for a LSP. The reason is that the management is the link between the customer and the operational employees that handle the returns.

Several problems have been identified for a LSP in the context of e-commerce. There are some problems that have been pointed out in both the theory and the empirics. However, some problems have only been discovered at PostNord TPL and some problems have only been pointed out by theory. The specific problems for PostNord TPL that will be solved with the suggested recommendations of this thesis have been excluded in the summary of problems since they are not considered to be a barrier, which is considered to be a problem that cannot be solved. The remaining specific problems for PostNord TPL have been categorised into four barriers in the context of e-commerce for a LSP.

Beside the identified barriers from the empirics, theory is identifying two relevant barriers in the context of e-commerce for a LSP. According to Hsiao (2010), Jack et. al (2010), Richey et al. (2005), and Skinner et al. (2008) the reverse logistics process cannot achieve superior performance without appropriate resource commitment. The resources will positively impact its competitive advantage (Hsiao, 2010) and make the process more efficient (Richey et al., 2005). A LSP needs to have appropriate resources to fulfil the requirements of the customer. The difficulty for a LSP is that the LSP never know for how long time a customer will keep buying the services. A LSP do not want to invest in customer specific resources and risk to end up with unusable resources. The barrier for a LSP is therefore the need to have appropriate resources in order to fulfil the requirements of the customer without having to customer specific resources.

According to Krikke et al. (2004) and Rogers et al. (2002) it is important for an LSP to keep track and follow the changing business of e-commerce in order to stay competitive. Due to the importance of a LSP of staying competitive on the market, the changing business is considered as a barrier. The barriers suggested by theory and the barriers from the empirics in the context of e-commerce for a LSP are summarised in table 33.

Table 33. The six suggested barriers

Problem	Barrier
Limitations to forecasting and visibility	Limitations in forecasting and visibility
Better guidelines in Inspection	Homogeneous handling of returns
Individual judgement in decision making	
Difficulties in decision making	
Improved formal disposition options	
Heterogenous refurbishment	
Performance based on common sense	
Varying accuracy in return handling	
The return package is well sealed	Inability to impact the customer and the consumer
Damaged/wrong return label	
Unclear predetermined return reasons	
Flexible resources	Flexible resources
-	Accept customer requirements without to customer specific resources
-	Changing Business

5.8 Trustworthiness of the empirics

The empirics of the case studies are considered to be trustworthy. The quantitative data of the empirics is collected in a structured way and is based on historical data to a great extent. The data is therefore considered to be as accurate as possible. However, all activities in the warehouse are not registered in the system today. For example, the returns are not registered when received in the warehouse. The time for the first temporary storage for both customers can therefore not be based on historical data. Neither can the time for processing one wagon be collected from the historical data. Instead these times are collected from one random sample for each customer. The random sample was made by marking one wagon for each customer when arriving in the warehouse. Every employee, who processed the wagon in the reverse logistics process, marked the wagon with the activity performed and the start and end time for that activity. The sample wagons arrived on a Friday and the weekend is therefore included in the waiting time. Even though only one random sample per customer has been carried out, the results are considered to be representative for the average waiting time. To achieve a more trustworthy result of the waiting time in the first temporary storage more random samples would be needed during a longer period of time to cover fluctuations in waiting time and return volumes. However, this would require more time and resources from PostNord TPL and it was not possible during the case studies. However, based on the time frame of the thesis and the knowledge from the observations, the random samples are considered to be representative for the average waiting time.

All interviews and observations were performed in the same way to ensure the trustworthiness. The researchers had the same individual responsibilities to ensure replicability and reliability. However, there is always a risk when gathering data through interviews and observations. The

interviewed and observed employees can give an impression that the process is working in a different way compared to reality. There is also a risk for misunderstandings. The researchers have tried to avoid the risks by confirming the information with the interviewed and observed employees if any uncertainty has arisen. Validity has also been assured by triangulation of interviews and observations from different perspective.

Finally, the recommendations to PostNord TPL in this thesis have not been tested. Therefore, there is a risk that they are not working as well in practice as in theory. A test period is therefore necessary before implementing the recommendations.

6 Conclusions

The chapter starts with answering the research questions of the thesis. A framework for how LSPs should handle returns in the warehouse for e-commerce customers will be presented. In addition, the barriers of the return handling, how different product and customer characteristics impact the process, and how the return handling of a LSP is contributing to greater value for customers will be elaborated. The next subchapter is presenting the theoretical contribution and the managerial implications of the research. Finally, areas for future research will be presented.

6.1 Conclusions of the research questions

By extending the frame of reference with the empirics of the case studies, the researchers were able to answer the first research questions of the thesis:

"How should a LSP handle returns in the warehouse customers of e-commerce?"

The process framework presented in the frame of reference has been extended to the context of e-commerce by using the empirics of the case studies. The framework for how a LSP should handle returns in the warehouse for customers in e-commerce are presented in figure 42. Aspects to consider in the reverse logistics process are summarised in table 34, which can be used as a support tool to generate a successful reverse logistics process.

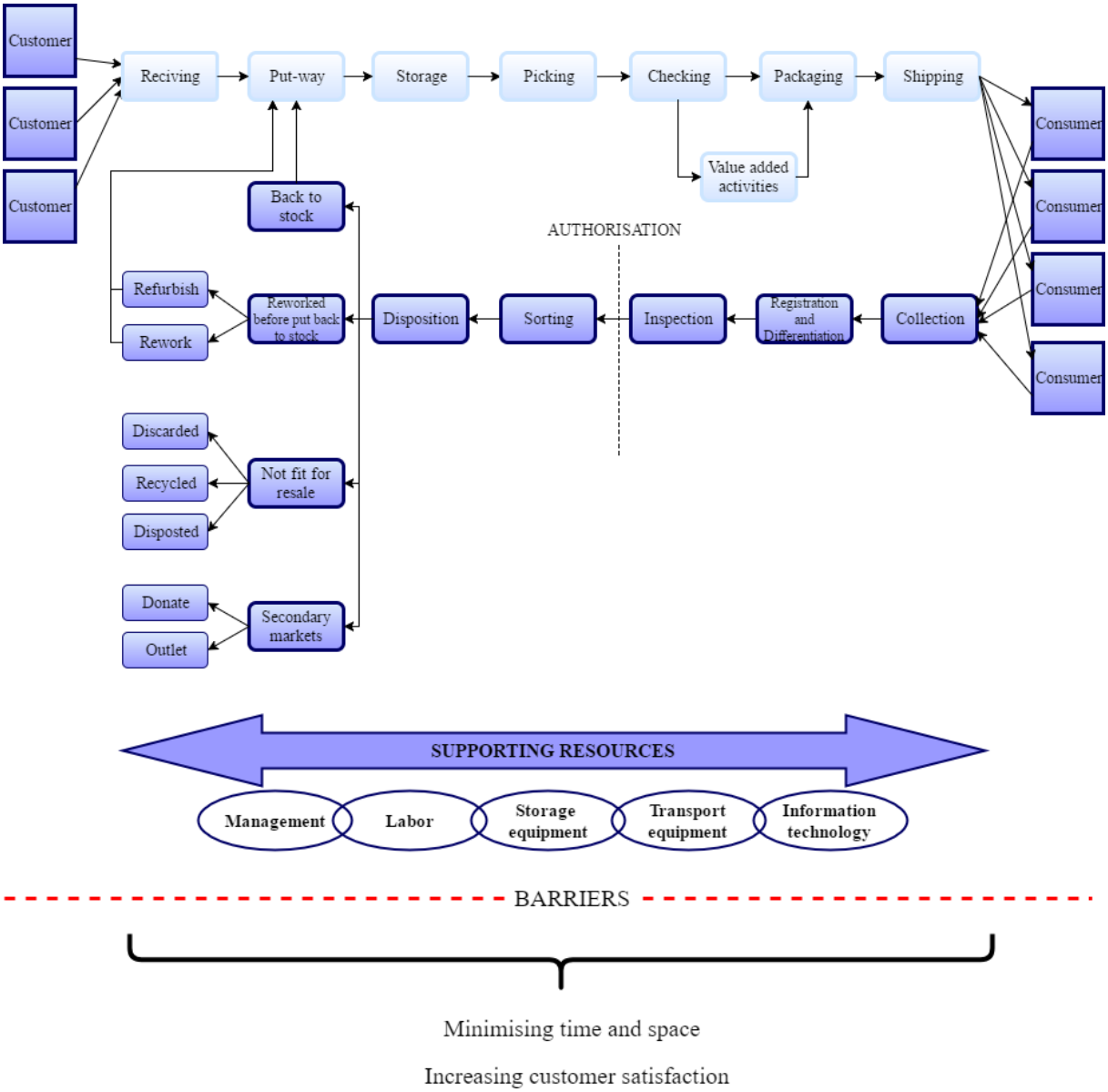

Figure 42. The process framework extended to the context of e-commerce.

The reverse logistics process in the context of e-commerce starts with collection. The collection should include receiving and unloading of the returns. In the context of e-commerce for a LSP it becomes especially important to register and monitor the received returns. Therefore, registration and differentiation should be considered as an individual step in the context of e-commerce. The LSP should register the received returns in their system as early as possible in the process. Since the returns usually are received in wagons or on pallets, the suggestion is to introduce RFID scanning combined with unique identification codes for all articles in order to be able to register all the returns at the same time in the registration and differentiation. That will imply that the customers of the LSP can give feedback to the consumers of the received return and they can offer immediate refund to the consumers if that is requested.

If the returns of different customers are received in the same wagons, the returns need to be sorted during the registration and differentiation. The sorting could be performed manually or automated depending on the resources of the LSP and the received volumes.

During the inspection, the returns need to be unpacked and the employees should thoroughly make sure that it is the right product and size and look for potential defects. In the context of e-commerce, authorisation will take place after the inspection. Therefore, the inspection and the screening coincide in this context. The LSP needs to be able to handle situations with and without authorisation. If a customer has a free return policy there will be no need for authorisation. If authorisation is required by the customer, the LSP should request support in terms of, for example, clear guidelines and instructions from the customer.

In the sorting, the customers of the LSP set the guidelines. The LSP should make sure that the customers offer clear instructions and guidelines to make it possible for the employees of the LSP to choose the disposition option fast and accurate. The disposition options are based on what the customers require. It is important to make sure that the customers offer clear and structured guidelines for how the disposition options should be performed considering time and resources. The available disposition options in the context of e-commerce are: (i) put back to stock, (ii) rework before put back to stock, where the alternatives are refurbish or rework, (iii) secondary markets, where the alternatives are outlet or donate, and (iv) not fit for resale, where the alternatives are discarded, recycled, or disposed.

The employees, that handle the inspection, the sorting, and the disposition, should be allowed to find their own individual working procedure based on fundamental guidelines of the activities. By allowing this, the time required for the activities and the mistakes will be reduced due to that the employees are in control. It is also important for the LSP to have dedicated employees in the return handling, since the knowledge of how to handle returns is developed over time.

It is important that the LSP focus on generating innovative solutions of performing the activities in the suggested framework. The LSP needs to follow the progress of the technology related to return handling in order to stay competitive and offer an effective reverse logistics process to the customers.

Table 34. Aspects to consider in the reverse logistics process

Collection	Receiving of returns
	Unload the returns
Registration and Differentiation	Monitoring and controlling volumes
	Early product differentiation
Inspection	Physical inspection
	Automated testing
	Clear guidelines
	Well-trained staff
Sorting	Clear guidelines
	Appropriate identification mechanisms
Disposition	Disposition option decided early
	Formal disposition options
	Appropriate refurbishment resources
Entire process	Appropriate resources
	Formal methods to train employees
	Methods for utilising internal knowledge of employees
	Combining volumes
	Automatisation
	Appropriate measuring of KPIs
Supporting resources	Employees have special authority and responsibilities
	Appropriate storage equipment
	Appropriate transportation equipment
	Appropriate IT
	Appropriate management

LSPs can use the suggested framework in order to formalise their reverse logistics process for different customers, but there are some difficulties to overcome. The barriers mentioned in theory are developed in the context of a physical store. The case studies have generated enough information in order to extend the barriers to the context of e-commerce and answer the second research question:

"What are the barriers of the return handling in a warehouse and how can LSPs overcome these?"

Six barriers have been identified in the return handling in the warehouse. They are: (i) limitations in forecasting and visibility, (ii) homogeneous handling of returns, (iii) inability to impact the customer and the consumer, (iv) flexible resources, (v) accept customer requirements without to customer specific resources, and (vi) changing business. One identified barrier is the limited sharing of forecasts both in time and extent and limited visibility. It is hard for LSPs to know the volume of returns that will be received and when it will be received. Due to limited visibility, LSPs do not have access to all information, such as the sales numbers. Therefore, it

is hard for LSPs to make forecasts for the customers. To overcome the barriers of limited forecasting and visibility, LSPs need to be flexible in terms of resources. For example, it is recommended to pay the majority of the employees by the hour to be able to match the demand of a specific day.

Another identified barrier is the difficulties in handling the returns homogenous. It is hard both considering the physical handling and the decision making. It is hard for an external party, like a LSP, to make economically beneficial decisions. Therefore, the LSP should request clear guidelines and instructions from the customers in order to overcome the barrier. A good collaboration between the LSP and the customer is important as well in order to have a homogenous and accurate performance in the reverse logistics process.

A LSP's inability to impact the customer and the consumer is also considered to be a barrier. Both the customer and the consumer impact how the return handling can be performed, but the LSP cannot impact, for example, how the consumer returns the product. Different choices made by the customer and the consumer creates unnecessary problems in the return handling of the LSP. The problems cannot be solved in an easy way since they depend on external factors.

LSPs need to accept and fulfil the requirements of the customers in terms of, for example, how the handling should be performed and which disposition options to perform. In order to fulfil the requirements of the customers, pressure is put on the resources and the capabilities of the LSPs. Therefore, to have flexible resources are considered to be a barrier for LSPs. The LSPs need to adjust the resources in both volume and capabilities to be able to fulfil the requirements of each specific customer. The amount of resources required is hard for LSPs to know due to the fluctuations in return volume. However, the resources and the investments should not be too customer specific, since the LSPs never know how long the contract with the customer will last. To fulfil the requirements of the customers without having to customer specific resources is considered as a barrier. It is important to have loyal and dedicated employees in order to perform the reverse logistics process successfully. In addition, it is important to have proper support of IT that can be connected and adjusted to the system of the customers. The layout of the warehouse needs to be easy to adjust depending on the requirements of the customers.

The changing business of e-commerce is considered to be a barrier as well. LSPs needs to keep track of the trends related to e-commerce as well as the customer demands and consumer demands that impact the satisfaction of the reverse logistics process. Examples of trends are environmental requirements and fast refund. When new trends and demands arise, LSPs need to adjust fast in order to stay competitive and retain the customer satisfaction. According to theory, the reverse logistics process should be as standardised as possible in order to overcome the barriers.

To be able to overcome the barriers it is important for LSPs to know how the different products and customers characteristics impact the reverse logistics process. Through the case studies, aspects of characteristics have been identified in order to answer the third research question:

"How do different product and customer characteristics of a LSP change the handling of returns?"

The characteristics of customers impact the reverse logistics process. Different customers have different requirements of return handling, which puts pressure on the process. The different customers follow the same basic steps in the reverse logistics process, but these are modified based on the requirements of the customers. To be able to fulfil the different requirements of the different customers, LSPs need to have very flexible resources and layout in the warehouse.

The characteristics of products impact the reverse logistics process as well. The more complex and different characteristics the products have, the more individual handling is required which implies that more time and resources are needed. The return handling of complex products requires special attention. Therefore, LSPs need to have dedicated employees with high qualifications to handle the returns. The employees will learn how to handle exceptions over time. When the customer and product characteristics are more complex, individual handling for the different customers is required and the employees cannot work across the customer boundaries. The more standardised the products are, the more formalised, easier, and faster process can be used. When the characteristics of the products and the customers are similar, LSPs can achieve economy of scale since greater return volumes are handled in the same way to a greater extent. LSPs can benefit from that the employees can be flexible. If the handling of returns is similar for the different customers, the employees do not need to be dedicated to one customer and can work where the demand is.

Independent of the product and customer characteristics, the return handling of a LSP contribute to greater value for the customers. Through the case studies combined with the frame of reference, aspects have been identified in order to answer the final research question:

"How can the return handling in a warehouse of a LSP contribute to greater value for the customers acting in the e-commerce business?"

According to Delfmann et al. (2002), the role of a LSP is to perform logistic activities on behalf of others. Companies choose to outsource logistic activities to reduce costs and to be able to focus on their core competences. Many companies choose to outsource the return handling for the same reasons. By outsourcing the return handling, companies achieve a more effective, fast, and less costly reverse logistics process compared to if the customer would perform the return handling in-house. The consumers can also get faster feedback and refund if the reverse logistics process is performed by a LSP. Thereby, the customers of LSPs achieve greater customer satisfaction.

Since the purpose of LSPs is to perform logistic activities, which include return handling, LSPs should have more knowledge and competence to perform the return handling compared to the customers. The knowledge of LSPs can be used to create greater value of the return handling for customers. LSPs are probably more flexible than the customers and can adjust to the trends and consumer demands faster. The customer will therefore have a reverse logistics process that is more adjustable to changes compared to if it would be performed in-house.

If LSPs perform logistic activities on behalf of different customers with the same characteristics, economy of scale can be achieved. Thereby, the costs of the return handling for both the LSP and the customers will be reduced. In addition, LSPs are able to invest in technology that would not be beneficial for each customer individually from an economical point of view. To summarise, the customer achieves a more adjustable, effective, and less costly reverse logistics process with faster feedback and refund to the consumer if it is performed by a LSP.

6.2 Theoretical contribution and managerial implications

In this thesis, the return handling of a LSP in the context of e-commerce has been examined. Until this point the majority of the theory related to return handling has been based on the context where a physical point of contact with the consumer is included in the chain. In this context, frameworks for how to handle returns have been developed. However, to the knowledge of the researchers, there is no framework for how LSPs should handle returns in the context of e-commerce. The theoretical contribution of this thesis is therefore to fill this gap. A framework for how LSPs should handle returns in the warehouse for customers operating in e-commerce has been developed. In addition, barriers in the return handling, how the product and customer characteristics impact the return handling, and how the return handling of LSPs can contribute to greater value for customers have been examined in the context of e-commerce.

The return handling is an important activity for LSPs, especially in the context of e-commerce. Since the e-commerce is growing, LSPs need to have an efficient and standardised reverse logistics process in order to stay competitive. Managers of LSPs can use the suggested framework combined with the aspects to consider in the reverse logistics process presented in this thesis as tools in order to structure the return handling. The barriers and other aspects that the managers need to consider in the return handling are highlighted as well as how the resources should be structured. Managers of other companies operating in e-commerce could also find interest in the empirics and conclusions of this thesis, since there is no previous research of return handling in the context of e-commerce.

6.3 Suggestions for future research

The suggested framework in this thesis is based on a literature review as well as a multiple case study with two cases. For future research, it is recommended to perform more case studies in the same context in order to strengthen the framework. It is recommended to choose cases with a larger variance in the case characteristics. The knowledge of the framework and how it is impacted of different requirements and characteristics would then be increased. The suggested framework would then be strengthened or new important aspects to consider would be found.

Several recommendations have been suggested in this thesis in order to improve the return handling or lower the costs. However, how much these recommendations would cost to implement and how the implementations would be executed have not been examined. It is

therefore recommended to continue the research of how to implement these and the related cost. Another recommendation is to further develop the RFID solution suggested in the collection. If the consumer wants to refund the consumer immediately when the RFID register the returns, some risks with the suggested solution are implied. In future research the RFID solution should be further developed in order to guarantee the content of the returns and eliminate the risks of immediate refund.

Finally, the recommendations of this thesis have not been tested. There is a risk that they are not working as well in practice as in theory. Future research in terms of a test period is therefore necessary before implementing the recommendations.

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Appendix

Appendix A - Interview schedules

Area manager

- What is, according to You, the greatest advantage with the return handling of today?
- Does PostNord TPL have a strategy for the return handling?
- What does PostNord TPL want to achieve with the return handling?
- Are there any strategical goals with the return handling?
    - What is being measured in the return handling process?
    - How do You measure the goals?
    - Are there any key performance indicators?
        - If yes, which ones?
- How is the prioritization of the return handling compared to other offerings at PostNord TPL considering, for example, employees, time, economic resources, and education?
- When PostNord TPL acquires new customers, are You looking for similar customers as the ones already existing or does it not matter?
- What is, according to You, the greatest weakness of the return handling of today?

Warehouse manager

- What is, according to You, the greatest advantage with the return handling of today?
- What drives the costs in the return handling of today?
    - What are PostNord TPL doing to reduces these costs in the return handling?
- What does PostNord TPL want to achieve with the return handling?
- Are there any strategical goals with the return handling?
    - What is being measured in the return handling process?
    - How do You measure the goals?
    - Are there any key performance indicators?
        - If yes, which ones?
- How are You thinking considering the contract of employment?
    - Payed by the hour or permanent employee?
    - What is the hourly labour for employees paid by the hour and the employees from Samhall?
- Does the staff get any special education for the return handling and the decisions that needs to be taken during this process?
- What information technology are used in the warehouse of PostNord TPL today (WMS, RFID, barcodes etc.)?
- What information does the customers of PostNord TPL want You to share with them?
    - Can You assist with the wanted information today?
    - How does the possible information sharing look like?
- What is, according to You, the greatest weakness of the return handling today?

Head of operations

- What is, according to You, the greatest advantage with the return handling today?
- How is the return handling process of today working?
- What is the existing return handling process built upon (theory, practices, coincident)?
- Why does the layout of the working stations look the way they do in the return process of today?
- Are their different requirements from the different customers?
    - If yes, which requirements and how does these affect the return handling process and layout?
- What are the biggest challenges and differences between the different customers of today considering the return handling?
- Have Company A or/and Company B given You any special guidelines or requests for how to handle their returns?
    - If yes, how does these guidelines or requests affect the return handling?
- Are there any collaboration between PostNord TPL and the customers, for example, are the customers visiting the warehouse to look at the processes or are they suggesting improvement based on previous experiences?
    - If yes, What collaboration and in what part of the process?
- Are you trying to use processes or methods that works good in the forward flow in the backwards flow as well?
    - If yes, what processes?
- How are You thinking considering the contract of employment?
    - Payed by the hour or permanent employee?
    - Are the employees stationed at the same place with the same tasks always or are there rotations?
        - If there are rotations, to what extend?
    - Is it the same employees handling the returns as handling the incoming new products?
- Are there clear instructions for the employees how to handle and treat the returns?
- Does the staff get any special education for the return handling and the decisions that needs to be taken within this process?
    - Considering:
        - Sorting?
        - Rework the products?
        - Dispose (charity or outlet)?
        - Repack?
    - Should the treatment be the same for all products or are there different instructions?
    - Is the education different for the different customers?
    - Who is educating the employees (PostNord TPL or the customers themselves)?
- What information technology are used in the warehouse of PostNord TPL today (WMS, RFID, barcodes etc.)?

- Is there one system used for all the warehouse activities (receiving, return handling, picking, packing etc.) or are there different systems?
    - If not, does the information sharing between the system work properly?
- Are there any problems, according to You, with the systems today?
- What could be better with the systems used today?
- What information does the customers of PostNord TPL want You to share with them?
    - Can You assist with the wanted information today?
    - How does the possible information sharing look like?
- How is the put-away process working?
    - Do You have shared or dedicated storage locations?
    - How does the storage placement of goods function today?
    - Do You have a WMS that calculates the best placement for storage and best picking routes?
    - Is there special storage for often returned products, for example, close to the packing stations etc.?
    - During put-away are the returned products mixed with the newly arrived goods or are they separated?
    - Is it the same employees doing the restorage of returned products as well as putting in the newly arrived products?
        - If no, when does the exchange from the employees handling returns and the ones doing put-away take place?
        - If yes, is the restorage of returns executed with the same forklifts as the normal put-away process?
- How is the prioritization between new products that needs to be put away and returned products that needs to be put away?
    - Is it the same treatment for both customers?
- What forklifts does PostNord TPL use today (first and second floor)?
    - How many of each type?
    - Are they used for special activities?
        - If yes, which forklifts are used in:
            - Receiving?
            - Return handling?
            - Put-away?
- Do You measure the efficiency of the return handling process?
    - If yes, what are You measuring?
        - How is it measured?
        - Are there any follow-up? How often?
    - Are You measuring other warehouse activities?
        - If yes, what are You measuring?
            - How is it measured?
            - Are there any follow-up? How often?
- What is, according to You, the greatest weakness of the return handling of today?
    - Have You any suggestions for possible improvements?

Manager of Inbound Company A

- What is, according to You, the greatest advantage with the return handling of today?
- How many employees are only working with Company A´s return handling (permanent and hourly paid)?
- What is the existing return handling process built upon (theory, practices, coincident)?
- Why does the layout of the working stations look the way they are doing in the return process of today?
- Are the workstations dedicated to the employees, or are the employees free to pick their own station?
- Are there clear instructions for the employees how to handle and treat the returns?
- Does the staff get any special education for the return handling and the decisions that needs to be taken within this process?
    - Considering:
        - Sorting?
        - Rework the products?
        - Dispose (charity or outlet)?
        - Repack?
    - Should the treatment be the same for all products or are there different instructions?
    - Who is educating the employees (PostNord TPL or the customers themselves)?
- What are the biggest challenges with the employees according to You?
- How are You thinking considering the contract of employment?
    - Payed by the hour or permanent employee?
    - Are the employees always stationed at the same place with the same tasks or are there rotations?
    - If there are rotations, to what extend and considering which working tasks?
    - Is it the same employees handling the returns as handling the incoming new products?
        - If yes, how is the rotation handled? Who is managing the rotation?
- How is the prioritization between the newly arrived goods and the return handling?
- When is the product transferred between the employees handling the returns and the employees doing put-away?
- What computer system is used for handling returns?
- How is the return handling process working today?
    - Which are the critical steps or activities?
    - Do You think the employees have a lot or little implication on how fast, efficient, and the level of quality the return handling has?
- Are there clear guidelines for how the employees should process the returns?
    - If yes, what are the guidelines?
    - If no, is there, according to You, one optimal way of processing the returns?
        - If yes, how should the handling be structured?
- Have Company A given You any guidelines or requests considering how the returns should be handled?

- Are there any collaboration between Company A and PostNord TPL considering how the returns should be handled, for example, are Company A visiting or giving useful information based on experiences?
    - If yes, where in the process and what information?
- What is, according to You, the greatest weakness of the return handling of today?
    - Have You any suggestions for possible improvements?

Manager of Inbound Company B

- What is, according to You, the greatest advantage with the return handling of today?
- How many employees are only working with Company B´s return handling (permanent and hourly paid)?
- What is the existing return handling process built upon (theory, practices, coincident)?
- Why does the layout of the working stations look the way they are doing in the return process of today?
- Are the workstations dedicated to the employees, or are the employees free to pick their own station?
- Are there clear instructions for the employees how to handle and treat the returns?
- Does the staff get any special education for the return handling and the decisions that needs to be taken within this process?
    - Considering:
        - Sorting?
        - Rework the products?
        - Dispose (charity or outlet)?
        - Repack?
    - Should the treatment be the same for all products or are there different instructions?
    - Who is educating the employees (PostNord TPL or the customers themselves)?
- What are the biggest challenges with the employees according to You?
- How are You thinking considering the contract of employment?
    - Payed by the hour or permanent employee?
    - Are the employees always stationed at the same place with the same tasks or are there rotations?
    - If there are rotations, to what extend and considering which working tasks?
    - Is it the same employees handling the returns as handling the incoming new products?
        - If yes, how is the rotation handled? Who is managing the rotation?
- How is the prioritization between the newly arrived goods and the return handling?
- When is the product transferred between the employees handling the returns and the employees doing put-away?
- What computer system is used for handling returns?
- How is the return handling process working today?
    - Which are the critical steps or activities?

    - Do You think the employees have a lot or little implication on how fast, efficient, and the level of quality the return handling has?
- Are there clear guidelines for how the employees should process the returns?
    - If yes, what are the guidelines?
    - If no, is there, according to You, one optimal way of processing the returns?
    - If yes, how should the handling be structured?
- Have Company B given You any guidelines or requests considering how the returns should be handled?
- Are there any collaboration between Company B and PostNord TPL considering how the returns should be handled, for example, are Company B visiting or giving useful information based on experiences?
    - If yes, where in the process and what information?
- What is, according to You, the greatest weakness of the return handling today?
    - Have You any suggestions for possible improvements?

Employees working on operational level for company A and company B

- What is, according to You, the greatest advantage with the return handling of today?
- Have You received any education within return handling?
- Have You received education for how to rework products that has minor faults so that they can be sent back to stock?
- Do You feel that You have the right education and knowledge to take the decisions?
- Are there any especially difficult activities performed during the return handling today?
- What is, according to You, the greatest weakness of the return handling of today?
    - Have You any suggestions for possible improvements?

IT Manager South Region

- Is there a unique identification code on all products today?
    - If not, why and is it something PostNord TPL could have?
    - If yes, to what extend?
- Is it possible to get information of which order a certain product have been shipped on from Diracom, without scanning the return label?
    - If not, why is it not working and what can be done in order to make it possible?
        - If it can be solved, is it a possible implementation and how difficult would it be to implement?

Appendix B - Observations of the collection of goods

Table I summarise the observations of the collection of goods in the warehouse.

Table I. A compilation of the observations of the collection of goods at point A

Date	Weekday	Number of received packages	Number of returns	Number of returns (%)	Number of wagons	Time required (minutes)	Number of man-hours	Participants in the work
31/3 2017	Friday	782	674	86.2	18	32.3	2.0	Head of warehouse operation, Manager of Inbound Company A, Operational employee at inbound activities, Employee working with various inbound and warehouse activities, and Employee handling picking and packing Company A
3/4 2017	Monday	875	769	87.9	21	49.5	2.1	Manager of Inbound Company A, Operational employee at inbound activities, and Operational employee working with quality and claims
4/4 2017	Tuesday	1254	1193	95.1	24	42.2	2.4	Manager of Inbound Company A, Operational employee at inbound activities, Operational employee working with quality and claims, and Employee 1 for Company A
5/4 2017	Wednesday	943	866	91.8	19	61.8	2.5	Manager of Inbound Company A, Operational employee at inbound activities, Operational employee working with quality and claims, and Employee working with various inbound and warehouse activities
6/4 2017	Thursday	837	684	81.7	26	46.3	2.1	Manager of Inbound Company A, Operational employee at inbound activities, and Operational employee working with quality and claims
Mean		938	837	88.6	21.6	46.4	2.2	

$$Average\ sorting\ time\ per\ package\ = \frac{1}{5} * \left(\frac{2.0}{782} + \frac{2.1}{875} + \frac{2.4}{1254} + \frac{2.5}{943} + \frac{2.1}{837}\right) = 0.0024\ hours = 8.58\ seconds$$

Appendix C - Transportation times related to the return handling

In table II can the different transportation times in the warehouse be seen.

Table II. The transportations times between the activities related to return handling in the warehouse

Sample	1	2	3	4	Mean
Collection area (point A) to elevator (point C) (seconds)	41.7	42.2	48	41.6	43.4
Elevator (point C to D) (seconds)	35	29	29	30	30.8
Elevator (point D) to temporary storage (point E1) (seconds)	25.5	28.5	24	30	27.0
Elevator (point D) to temporary storage (point E2) (seconds)	23	21	19	24	21.8
Return handling area of Company A (point F1) to Elevator (point D) (seconds)	25	31	24.5	27.5	27.0
Return handling area of Company B (point F2) to Elevator (point D) (seconds)	22	21	20	24	21.8
Elevator (point C) to put away area Company A (point G1) (seconds)	53.3	62	71	58	61.1
Elevator (point C) to put away area Company B (point G2) (seconds)	30	27.2	23	25.5	26.4
Put away area to storage area by turret truck (seconds)	90	55	98	93	84

Company A

$$Transportation\ from\ collection\ area\ at\ point\ A\ to\ temporary\ storage\ at\ point\ E1 = 43.38 + 30.75 + 27.02 = 101.15\ seconds$$

$$Transportation\ from\ elevator\ at\ point\ C\ to\ temporary\ storage\ at\ point\ E1 = 30.75 + 27.02 = 57.77\ seconds$$

$$Transportation\ from\ return\ handling\ area\ at\ point\ F1\ to\ put - away\ area\ at\ point\ G1 = 27.00 + 30.75 + 61.08 = 118.83\ seconds$$

Company B

$$Transportation\ from\ collection\ area\ at\ point\ A\ to\ temporary\ storage\ at\ point\ E2 = 43.38 + 30.75 + 21.75 = 95.88\ seconds$$

$$Transportation\ from\ elevator\ at\ point\ C\ temporary\ storage\ at\ point\ E2 = 30.75 + 21.75 = 52.5\ seconds$$

$$Transportation\ from\ return\ handling\ area\ at\ point\ F2\ to\ put - away\ area\ at\ point\ G2 = 21.80 + 30.75 + 26.43 = 78.98\ seconds$$

Appendix D - Historic data

In this appendix, the calculations of the historic data are explained.

The percentage of the disposition options for Company A

The data in table III is based on historic data of the different registered return reasons for all returns handled during one year.

Table III. The percentage of the of the disposition options

Back to stock or rework before put back to stock	95.85%
Outlet	1.98%
Charity	2.17%

The processing times in the inspection, the sorting, and the disposition

The processing times in the inspection, the sorting, and the disposition are calculated in the same way for both Company A and Company B. The data in table IV and table V are based on data of each customer from the period 2016-04-01 to 2017-04-01. The employees' efficient working time during a day in the return handling activity have been calculated. If an employee for example, in the morning worked a few hours in receiving or picking and the rest of the day handled returns, the efficient time of the return handling time was calculated. The normal work hours of the employees are 07.00 to 16.00 with one hour break. That time have been withdrawn from the efficient time representational for the time spend in the return handling. The processing time per return is then calculated based on the efficient time and the number of registered returns per day. All days are summarized and a mean is calculated. The processing time per return is also based on the number of processed returns per day and the total required time. Due to company confidentiality, the processing times and number of processed return per hour are disguised. The charity and outlet calculations for Company A are based on the registered number of each alternative over a year.

Table IV. The processing time[11] of the employees performing the inspection, the sorting, and the disposition for Company A

Employee	Employment	Years of working with returns	Working hours per month	Number of returns per hour	Time per return	Outlet (%)	Charity (%)
Employee 1	Permanent	3	Full time	1.49 X	Y	1.93	2.31
Employee 2	Permanent	1.5	75 %	1.26 X	1.15 Y	3.61	2.25
Employee 3	Permanent	1	Full time	1.30 X	1.08 Y	2.72	2.46
Employee 4	Permanent	0.5	Full time	1.30 X	1.03 Y	0.50	1.84
Employee 5	Employed by the hour	1.3	Full time	1.18 X	1.28 Y	1.27	1.84
Employee 6	Employed by the hour	1.5	Full time	1.30 X	1.21 Y	2.31	2.28
Employee 7	Employed by the hour	0.8	Full time	1.32 X	1.09 Y	0.80	2.13
Employee 8	Employed by the hour	1.4	Full time	1.47 X	Y	2.53	2.32
Employee 9	Employed by the hour	0.05	Full time	X	1.31 Y	0.63	1.58

[11] The time is not stated due to company confidentiality.

Table V. The individual procedures and the processing time[12] of the employees performing the inspection, the sorting, and the disposition for Company B

Employee	Employment	Years of working with returns	Working hours per month	Number of returns per time unit	Time per return	Working procedure
Manager of the return and receiving of new products	Permanent	1.5	Full time	Z	1.33 W	Takes one returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.
Employee 1	Permanent	1.5	Full time	1.18 Z	W	Takes one returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.
Employee 2	Employed by the hour	1.4	Full time	1.15 Z	1.24 W	Takes some returns at a time. She starts with removing the plastic bag/cardboard box from the return. The returned order list and the product are scanned and the return reason is noted in the system. The product is folded and sealed in a plastic bag. It is then put in the wagon, which is scanned into the system.

The average number of returns per day

The average number of returns per day are calculated in the same way for both Company A and Company B. The average returns are calculated based on the historic data collected from the period 2016-01-01 to 2017-01-01. The returns are summarised per day for all employees and then the mean of all days is calculated. The results are on average 1003 processed returns per day for Company A and 334 processed returns for Company B.

Unretrieved returns from the postal office for Company A

1.69 percent of the returns are not retrieved from the postal office. The calculations are based on the historic data from the period 2016-04-01 to 2017-04-01. All unretrieved returns get a special code in the system. The occurrence of that code over one year is resulting in 1.69 percent. The total cost for the unretrieved packages from postal office in table VI is based on

[12] The time is not stated due to company confidentiality.

the total required processing time for the inspection, the sorting, and the disposition and the labour per hour.

Table VI. Number of unretrieved packages from postal offices for Company A

Number of not retrieved packages from postal office	Total handled returns	Total percentage	Average process time per return	Total processing time (hours) for the not retrieved packages from postal office	Cost per hour (SE	Total cost for the not retrieved packages from postal office (SEK)
3610	213 121	1.69	00:01:40	100.28	222	22 261.6

The usage of the return reasons for Company B

The calculations are based on the historic data of Company B from the period 2016-04-01 to 2017-04-01. The marked predefined return reason of the arriving returns is registered with a special code in the system. The occurrence of the different codes over one year results in table VII.

Table VII. Predefined return reasons by Company B and the percentage of the usage for the return reasons

1	*Unsatisfied with the product*	9.76%
2	*Too small*	31.64%
3	*Too big*	21.71%
4	*Do not conform with the description*	0.49%
5	*Defect, damaged, scratched, dirty, or creased*	2.51%
6	*Wrong product*	0.77%
7	*The product did not fulfil the expectations*	23.38%
8	*Delayed delivery*	0.17%
99	*No return reason marked or misuse of number six*	8.16%
	Others	1.41%

Waiting time at the temporary storage before put-away

The waiting time at the temporary storage before put-away is calculated in the same way for both Company A and Company B. The calculations are based on one month's historic data for three forklifts drivers put-away data for each customer. The articles and orders for that month was crosschecked for the same articles and orders handled on the second floor. The time from when the articles were handled on the second floor until they were put-away into storage was calculated and summarised for that month. A mean was calculated based on the time and number of handled returns. Weekends are included in these calculations due to that the wagons have to wait even during weekends. The calculations resulted in an average waiting time of 3.3 days for Company A and 13.81 hours for Company B.

Appendix E - Supplementary times in the return handling

The times in table VIII and IX are based on data already discussed in empirics except from the times marked with blue. Those times are based on one sample for each company, where a wagon was marked in every activity through the flow. The times were registered manually in the different activities and put together by the Head of Operations.

Table VIII. The times of the reverse logistics process in the warehouse for Company A

Activity	Time in the activity	Efficient time for one wagon	Efficient time for one return
Arrival at point A	00:00:00		
Collection		00:32:30	00:00:08
Temporary storage at point B	00:32:30		
Transportation B - E1		00:01:43	00:01:43
Storage at point E1	00:34:13		
Average waiting time at E1		73:05:15	73:05:15
Inspection, sorting, disposition, start	73:39:28		
Processing time		2:32:14	-[13]
Inspection, sorting, disposition, stop	76:11:42		
Transportation F1 - G1		00:02:00	00:02:00
Storage at point G1	76:13:42		
Average waiting time G1		79:12:00	79:12:00
Transportation G1 - H1		00:01:24	00:01:24
Put-away H1	155:27:06	0:18:34	00:00:12

[13] The time is not stated due to company confidentiality.

Table IX. The times of the reverse logistics process in the warehouse for Company B

Activity	Time in the activity	Efficient time for one wagon	Efficient time for one return
Arrival at point A	00:00:00		
Collection		00:32:30	00:00:08
Temporary storage at point B	00:32:30		
Transportation B - E2		00:01:36	00:01:36
Storage at point E2	00:34:06		
Average waiting time at E2		01:10:37	01:10:37
Inspection, sorting, disposition, start	01:44:43		
Processing time		01:39:48	-[14]
Inspection, sorting, disposition, stop	03:24:31		
Transportation F2 - G2		00:01:20	00:01:20
Storage at point G2	03:25:51		
Average waiting time G2		13:49:11	13:49:11
Transportation G2 - H2		00:01:24	00:01:24
Put-away H2	17:16:26	00:18:03	00:00:19

[14] The time is not stated due to company confidentiality.

Appendix F - Changes in the warehouse

In this appendix, the calculations of the recommended changes are explained.

Relocation of the collection point

Table X. The saved cost and time of moving the collection location to point J

Moving the collection point	Labour (SEK)	Time required (hours)	Total cost today/ day (SEK)	Total time saved/day (hours)	Total time saved/year (hours)	Total cost saved/day (SEK)	Total cost saved/year (SEK)
Manual movement of the wagons from point A to C	138.90	2.20	305.58	2.20	558.80	305.58	77 617.32

The calculated cost to move the wagons every day in table X is based on that the Samhall employees get hourly paid for the activities performed, which is performed one at a time. In this observation, the employee will move the wagons during 2.2 hours, which is the time it takes until all the wagons are sorted. The activity is performed 254 days a year, which is the amount of days the warehouse receives returns from PostNord Group AB.

$$Transportation\ time\ saved\ from\ changing\ the\ collection\ point\ per\ year = 2.2 * 254 = 559\ hours$$

$$Transportation\ cost\ saved\ from\ changing\ the\ collection\ point\ per\ year = 138.9 * 2.2 * 254 = 77\ 618\ SEK$$

Change of the layout on the second floor

Table XI. Today´s layout on the second floor

	Labour putting the wagons at E2 (SEK)	Time per movement (hours) putting the wagons at E2	Labour moving the wagons to the elevator (SEK)	Time per movements (hours), moving the wagons to the elevator	Number of movement per day	Total time/day (hours)	Total time/year (hours)	Total cost/day (SEK)	Total cost /year (SEK)
Layout second floor Company A	139.8	0.015	222	0.015	14.0	0.4	126.9	76.0	22 962.4
Layout second floor Company B	139.8	0.012	222	0.012	3.0	0.1	21.9	13.1	3 960.8

The calculations in table XI, XII, XIII, and XIV are based on that the Samhall employee transports the wagons from the elevators on the second floor to point F1 and F2, depending on customer. Employees of PostNord TPL then transports the wagons back to the elevator after the inspection, the sorting, and the disposition. The cost for the Samhall employee is SEK 139.8 per hour and the cost for an employee of PostNord TPL is SEK 222 per hour. The activity is performed 302 days a year. The number of movements per day is in average 14 for Company A and 3 for Company B. Only one example for how the numbers have been calculated is shown, but all alternatives and the two customers is based on the same equations.

$$Number\ of\ movements\ per\ day = \frac{1003}{75} = 14\ times$$

$$Time\ per\ movement\ Company\ A = \frac{2 * 27.02}{60 * 60} = 0.015\ hours$$

$$Time\ per\ movement\ Company\ B = \frac{2 * 21.75}{60 * 60} = 0.012\ hours$$

$$Total\ time\ per\ year\ Company\ A = \big((0.015 * 14) + (0.015 * 14)\big) * 302 = \ 126.9$$

$$Total\ cost\ per\ year\ Company\ A = \big((139.8 * 0.015 * 14) + (222 * 0.015 * 14)\big) * 302 = 22\ 963$$

Table XII. Alternative 1 for the layout on the second floor

	Labour putting the wagons at E2 (SEK)	Time per movement (hours) putting the wagons at E2	Labour moving the wagons to the elevator (SEK)	Time per movements (hours), moving the wagons to the elevator	Number of movement per day	Total time/day (hours)	Total time/year (hours)	Total cost/day (SEK)	Total cost /year (SEK)
New layout second floor Company A	139.8	0.012	222	0.012	14.0	0.3	102.2	61.2	18 483.8
New layout second floor Company B	139.8	0.015	222	0.015	3.0	0.1	27.2	16.3	4 920.5

Table XIII. Alternative 2 for the layout on the second floor

	Labour putting the wagons at E2 (SEK)	Time per movement (hours) putting the wagons at E2	Labour moving the wagons to the elevator (SEK)	Time per movement (hours), moving the wagons to the elevator	Number of movements per day	Total time/day (hours)	Total time/year (hours)	Total cost/day (SEK)	Total cost /year (SEK)
New layout second floor Company A	139.8	0.012	222	0.012	14.0	0.3	102.2	61.2	18 483.8
New layout second floor Company B	139.8	0.012	222	0.015	3.0	0.1	24.5	15.1	4 549.7

Table XIV. Comparison of the different alternatives for the layout on the second floor

	A		**B**		**Total**	
	Total time /year (hours)	Total cost /year (SEK)	Total time /year (hours)	Total cost /year (SEK)	Total time /year (hours)	Total cost /year (SEK)
Today	127	22 962	22	3 961	149	26 923
Alternative 1	102	18 484	27	4 921	129	23 404
Alternative 2	102	18 484	25	4 550	127	23 033
Savings					**22**	**3 890**