



CHALMERS
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Packaging in Outbound Spare Part Distribution

A Study at Volvo Group

Master's Thesis in Supply Chain Management

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Abstract

In an increasingly competitive market, companies have realized the importance of their logistics activities being effective and efficient. An area highly impacting the performance of a supply chain is the packaging. At Volvo Group, the transport packaging used consists of returnable packaging called V-EMB, however, there are cases when V-EMB cannot be used. This master's thesis aims to study the outbound transport packaging processes within Volvo Group's Service Market Logistics organization when sending non-V-EMB packaging from central and regional distribution centers to dealers. The purpose is to, by studying the current outbound transport packaging processes, assist Volvo Group in ensuring that their processes are favorable with regard to quality, cost, and sustainability. To fulfill this aim, a qualitative study has been conducted. First, a theoretical framework has been created from existing literature on the area. Further, a survey has been sent out to 14 distribution centers, followed by interviews with seven of them. In addition to this, benchmarking with an external company has been conducted. All empirical findings have thereafter been analyzed with the use of the theoretical framework. The result of the research indicates that all of the studied distribution centers work similarly, however, there are two main differences identified. The first one regards the supply process, as some distribution centers keep their packaging stocks in-house while others outsource them to a supplier. The second difference regards the branding of the packaging, with some distribution centers branding their transport packaging and others using brand-neutral packaging. Regarding quality, cost, and sustainability requirements, all outbound transport packaging processes identified affect the requirements set by Volvo Group positively. However, areas of improvement are possible to identify within the outbound packaging processes, such as increased communication and collaboration between the DCs and standardization of processes.

Keywords: Packaging, Outbound Logistics, Aftermarket Services, Spare Parts, Packaging Waste, Packaging Performance.

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Malin Sjöström, Gothenburg, 2022
Linnea Sundestrand, Gothenburg, 2022

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

APAC	Asia Pacific
CDC	Central Distribution Center
DC	Distribution Center
IPS	Indirect Products and Services Purchase
NA	North America
RDC	Regional Distribution Center
RMEA	Russia, Middle East, and Africa
SA	South America
SDC	Support Distribution Center
SML	Service Market Logistics
V-EMB	Volvo Emballage

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1

Introduction

This chapter introduces the subject of the thesis, by providing a background describing the context and underlying problem to be studied. Further, the chapter presents the aim of the study, as well as the identified research questions. Finally, the disposition of the study is presented.

1.1 Background

In an increasingly globalized market, and a world facing pandemics and conflicts, businesses face new opportunities as well as challenges. Companies have the possibility of expanding their networks and attracting new customers in foreign markets, however, they are also faced with the challenges of increased market competition and supply chain disruptions (Mattsson, 2003; García-Arca et al., 2017). To survive, new distribution channels have arisen and evolved, resulting in larger and more complex supply chains. Furthermore, the performance of a supply chain is significantly impacted by the packaging used, as it affects all logistics activities (Pålsson, 2018). There are different types of packaging levels that are interrelated, these are primary packaging, secondary packaging, and tertiary packaging. The purpose of packaging is to protect and contain, unitize and divide out, communicate and offer convenience, and finally to enable logistics and environmental efficiency and effectiveness. If this is balanced, the environmental impact and costs of a supply chain can be reduced significantly.

Aftermarket services is an important area, which can enable companies to gain an advantage over their competitors (Cohen et al., 2006). The aftermarket contains market-oriented planning, control, realization, and design of the supply and distribution of spare parts (Wagner et al., 2012). This involves activities such as packaging, warehousing, and demand and material planning (Cohen et al., 2006). Customer satisfaction is an important factor for a company's success, with the aftermarket services affecting the loyalty of the customer. Increased customer demand has resulted in aftermarket services needing to be available within a tight timeframe and at a low price to satisfy customers. A company facing opportunities and challenges with packaging activities within their aftermarket services is Volvo Group, which is the main provider of information for the thesis as the research is executed on behalf of the company.

1.1.1 Problem Description

Within Volvo Group, the distribution of spare parts is handled by the Service Market Logistics (SML) organization. Before being sent to dealers and end customers, spare parts are packed in commercial packaging and transport packaging. The commercial and transport packaging are important to Volvo Group from a branding and quality perspective, and when selecting what packaging to use, quality, cost, and sustainability are of great importance. To ensure branding and quality, Volvo Group uses a global packaging pool for transport packaging, including reusable packaging for the distribution of spare parts to customers. The packages in the packaging pool are called Volvo Emballage (V-EMB). However, V-EMB is not used for all flows of spare parts and instead, alternative packaging solutions need to be used. Today, there is no standardized process on how to handle these flows, and the way of working is believed to differ between the different distribution centers (DC). Furthermore, the SML organization has limited knowledge of how the outbound packaging processes are executed at the different locations, and therefore, it is difficult for the company to ensure all packaging processes are optimized with regard to quality, cost, and sustainability.

1.2 Aim

The aim of this thesis is to identify a beneficial outbound transport packaging process when V-EMB is not used. This will be done by studying existing practices within Volvo Group's Service Market Logistics organization when sending non-V-EMB packaging from central and regional distribution centers, to dealers. The result will, by providing recommendations, assist Volvo Group in ensuring that their outbound transport packaging processes are favorable with regard to quality, cost, and sustainability, when using wood, cardboard, and plastic packaging material. This will be achieved by conducting an As-Is analysis of distribution centers selected by Volvo Group and by benchmarking with an external company.

1.3 Research Questions

To fulfill the aim of the thesis, Volvo Group's current processes need to be outlined, and the advantages and disadvantages related to each process identified. Further, the current processes need to be studied with regard to the three main requirements for Volvo Group's outbound packaging: quality, cost, and sustainability. Therefore, two research questions have been formulated.

RQ1: How do the outbound transport packaging processes for the studied central and regional distribution centers differ from each other, and what challenges and opportunities can be identified?

RQ2: How do various packaging processes affect quality, cost, and sustainability requirements for the studied central and regional distribution centers?

1.4 Disposition

The disposition of the thesis is presented in Table 1.1, which provides an overview of the report by summarizing the content of each chapter.

Table 1.1: Disposition of the report and chapter content.

Chapter	Content
1. Introduction	Provides a background to the context of the thesis, and presents the aim and research questions to be answered.
2. Introduction to Volvo Group and SML	Gives an organizational introduction to Volvo Group and the SML organization. Further, areas of focus from Volvo Group's point of view are presented.
3. Theoretical Framework	Presents the findings of the review of literature, which is to be used in the analysis.
4. Methodology	Describes the methodology used to conduct the thesis.
5. Empirical findings	Presents data collected from the survey, the interviews, and the benchmarking.
6. Analysis	Connects the theoretical framework with the empirical findings.
7. Discussion	Discusses relevant findings and reflections made from the empirical findings and theoretical framework.
8. Conclusion	Concludes the key findings of the thesis and answers the research questions. Further, practical contributions as well as recommendations and suggestions for future research are discussed.

2

Introduction to Volvo Group and SML

In this chapter, the organization of Volvo Group and SML is presented, followed by an introduction to the DCs. Further, the outbound transport packaging used at Volvo Group is presented, followed by Volvo Group's current focus areas. The information presented in this chapter has been collected through observations and conversations with representatives from SML.

2.1 Organization

Volvo Group is a multinational company operating in more than 190 markets and has facilities in 18 countries. The company is one of the world's leading manufacturers of trucks, buses, construction equipment, and marine and industrial engines. To separate the different products, the company is divided into several business areas, e.g. Volvo Trucks, Volvo Penta, Volvo Buses, Volvo Construction Equipment, Renault Trucks, and Mack Trucks. Further, the company is divided into three truck divisions, Group Trucks Technology (GTT), Group Trucks Operations (GTO), and Group Trucks Purchasing (GTP). SML is a subunit of GTO, which is responsible for aftermarket logistics and providing spare parts to customers of all of Volvo Group's business areas.

Many of Volvo Group's customers are small family businesses, solely relying on equipment provided by Volvo Group to do business. Therefore, these customers need to be able to rely on Volvo Group's products and services to keep their businesses running. SML aims for spare parts to be delivered within 24 hours all around the world. In 95% of the cases, the spare parts are delivered within 24 hours, however, the target is to reach all customers within 24 hours in 99% of the cases.

2.2 Distribution Centers

SML has three different types of DCs: Central Distribution Centers (CDC), Regional Distribution Centers (RDC), and Support Distribution Centers (SDC). There are six CDCs in total, located in Europe, Asia, South America, and North America. All CDCs deliver the full range of spare parts to RDCs, SDCs, importers, and dealers. Also, certain CDCs are specialized in some of the Volvo Group brands. This is

due to the CDCs being located close to a manufacturing facility producing that specific brand, and the manufacturing facilities being strategically located close to the products' main customer markets. Furthermore, Volvo Group has divided its market into different regions, these being APAC (Asia Pacific), SA (South America), NA (North America), Lyon + RMEA (Russia, Middle East, and Africa), and Ghent + EU. There are 21 RDCs distributing stock and emergency orders to dealers within their region, and compared to CDCs, they do not stock the full range of spare parts. Lastly, there are nine SDCs distributing emergency orders to dealers.

2.3 Outbound Transport Packaging

Volvo Group uses a global packaging pool for outbound transport packaging, called V-EMB, that includes (1) wooden modular containers, (2) a small box system made of plastic, (3) metal and plastic foldable containers, and (4) disposable packaging, see Figure 2.1. The packaging pool is a global returnable system, meaning that the packaging can be sent to dealers anywhere in the world, and is thereafter sent back to Volvo Group to be reused. V-EMB can be used for inbound as well as outbound flows. However, V-EMB cannot be used for all shipments, and instead, alternative packaging solutions are used.

Figure 2.1: V-EMB packaging used at Volvo Group. From the left: wood, plastic, and cardboard packaging.



2.4 Volvo Group's Current Focus Areas

In the following section, focus areas highlighted as important and of interest by Volvo Group for the study are presented.

2.4.1 Quality, Cost, and Sustainability

Volvo Group aims for quality, cost, and sustainability requirements to be balanced when purchasing packaging. It is difficult to find packaging optimal in all three areas, and trade-offs need to be made. SML has set specific goals for each one of these three criteria. For quality, SML has multiple strategic targets set for 2022, which include different parts of the supply chain. The goal for the delivery of spare

parts is to allow a maximum of 900 parts that do not reach the quality requirements for every million parts delivered. Further, to measure quality claims from dealers, SML has a global delivery dashboard that illustrates the number of claims received for each DC. As to cost, SML aims to minimize costs and has set overall strategic goals for 2022 and forward. Each unit within the SML organization needs to take these goals into consideration. Finally, SML is working to become more sustainable in its operations and has set goals to have landfill-free operations, 100% recycling of waste, 30% reduction of CO_2 from freight transport, and climate-neutral operations in 2025. To achieve this, the focus within packaging is to increase the reduction, reusing, and recycling of packaging. Further, Volvo Group has social sustainability goals that are broken down at the different departments.

2.4.2 Standardization

SML is working according to lean principles to achieve safe and effective operations. An important part of the lean principles is working with standardization. The purpose of SML's standardization is to set a baseline from which continuous improvement can occur. By standardizing an activity or process after an improvement has been made, the department can ensure that the improvement will be sustainable. Standardization is applied within processes and working methods, as well as layout, tools, and equipment at the DCs.

2.4.3 Product Sheet

Currently, there are no requirements for the DCs to have product sheets including specifications, such as material and dimensions, for the packaging used within each DC. However, due to future EU regulations, SML wants the DCs to implement product sheets for all their packaging in the future. This should not only be applied to the DCs located in Europe but should be implemented globally.

3

Theoretical Framework

In the following chapter, the theoretical framework for the thesis is presented. The structure for the chapter is as follows: sourcing strategies, packaging and levels of a packaging system, packaging material, packaging performance, packaging waste, reusable packaging, and lastly branding.

3.1 Sourcing Strategies

According to Van Weele (2018), one of the steps of the strategic management process is to decide whether to perform activities in-house or to outsource them. Outsourcing is described by Van Weele (2018) as the transfer of activities to a third party. By outsourcing activities, the company itself can focus on its core competencies. Strategic reasons to outsource are to gain access to resources that are not available within the company or to improve company focus. When deciding on this, the company must consider if the activity is performed competitively by the company and if it helps them achieve competitive advantages. If the activity does not give any competitive advantages, the activity can be outsourced. Further, tactical reasons to outsource are to reduce control and operating costs or to improve performance. Moreover, outsourcing the management of inventory to a supplier is called vendor-managed inventory, and has benefits such as increased information sharing between the two parties, and thus a reduced risk of a bullwhip effect (Disney & Towill, 2003).

In addition to the outsourcing decision, Van Weele (2018) argues that companies need to develop sourcing strategies for their products. The sourcing strategy should be based on an analysis of the current supplier base and future requirements. Questions to consider in the sourcing strategy are how many suppliers to have, if local or global suppliers should be used, and what type of relationship to have with the supplier. Further, the author argues that a company becomes very dependent on a supplier when purchasing from only one and that the supply risk is reduced when having multiple suppliers. However, the transaction costs get higher when increasing the supplier base.

Further, the characteristics of the product as well as the supply market structure determine whether to have local or global suppliers. Local suppliers are favorable when purchasing high-tech products that have continuously changing product specifications, which require personal communication with the suppliers, or when high flexibility and delivery precision are needed. On the contrary, global suppliers are

favorable when purchasing bulk or standardized products, when products are bought in large quantities and economies of scale can be achieved, or when the prices of local suppliers are significantly higher than the prices of global suppliers. Further, the decision whether to use global or local suppliers is dependent on the degree of demand predictability and the total cost of ownership. (Van Weele, 2018)

Finally, Van Weele (2018) argues that the company must decide whether to have a partnership or arm's length relationship with the suppliers. It is stated that a partnership relationship increases the possibility of a company sharing sensitive information with the other company, while an arm's length relationship causes a more competitive situation, where the supplier might be replaced when the customer receives a better offer from another supplier. Arm's length relationships are mainly used when purchasing commodities in large volumes and when there are many suppliers available. Partnerships, on the other hand, are mainly used to achieve for example improvements in logistics by sharing information to reach higher service levels and lower logistics costs, or to increase quality by settling mutual quality requirements to reach zero defects. Van Weele (2018) points out that within the automotive industry, the environment tends to be highly competitive and that large automotive companies set the rules for their suppliers, rather than having true partnerships.

3.2 Packaging and Levels of a Packaging System

Packaging is defined as a coordinated system where goods are prepared for transportation, distribution, storage, retailing and end-use, with the purpose to make sure goods are delivered safely to end customers, at minimal cost (Pålsson, 2018). Packaging aims to protect and contain, unitize and appportion, communicate and offer convenience, and lastly enable logistics and environmental efficiency. If this is balanced, the environmental impact and costs of a supply chain can be significantly reduced.

Packaging can be viewed as a system divided into three interrelated levels, these being primary packaging, secondary packaging, and tertiary packaging (Hellström & Saghir, 2007). The first level, primary packaging, is in direct contact with the goods. Examples of primary packaging are consumer and sales packaging. Consumer packaging takes marketing demands and legislative requirements into consideration, affecting its format and design. The following level, secondary packaging, consists of several primary packages and is often called group or retail packaging. The final level, tertiary packaging, consists of several secondary packages and is often called transport packaging. Examples of tertiary packaging are pallets or roll containers. There is also hybrid packaging, which is packaging that can be used as both secondary and tertiary packaging (Dixon-Hardy & Curran, 2009).

The packaging system is completed at the manufacturer (Pålsson, 2018). Thereafter, it is transported to a warehouse, where it is modified during the picking process. Finally, the modified packaging is transported to a retailer. Thus, the packaging sys-

tem can be considered a central logistics resource, as the packaging follows the goods from the point of filling to the product being consumed (Pålsson & Hellström, 2016).

As the packaging levels are interrelated, the performance of each packaging level affects the performance of the entire packaging system (Hellström & Saghir 2007). Therefore, trade-offs and interactions between the packaging levels are crucial to consider in packaging logistics. Further, the packaging system affects several other logistics resources, such as vehicles, warehouses, and handling equipment (Pålsson & Hellström, 2016). Thus, the logistics and environmental efficiency of supply chains are affected by it.

3.3 Packaging Material

There are multiple different packaging materials used, three of these are wood, cardboard, and plastic (Paine, 1991). These materials have different characteristics and properties that make them suitable as packaging materials. In the following section, wood, cardboard, and plastic are described in detail.

3.3.1 Wood

Wood is one of the primary materials and has been used as packaging material for a long time. The material is easily shaped and joined, and the different variants of wood make it possible to adjust the packaging to the wanted strength. Woods used for packaging are for example logs, roundwood products, and plywood. Wooden material resists damage through crushing, bending, twisting, and stretching, and is resilient enough to yield temporarily and thereafter return to its original shape. Hence, the material is used for containing both large and small packages. However, not all wooden material is suitable as packaging material. Therefore, the desired packaging characteristics need to be considered when deciding what type of wood to use. Furthermore, wooden packaging can never be completely free from defects, which needs to be considered when manufacturing wooden packaging. Lastly, wood is a beneficial packaging material due to its accessibility of raw material, the favorable ratio of cost/strength, and the possibility to manufacture small quantities while maintaining reasonable economics. (Paine, 1991)

3.3.2 Cardboard

Cardboard, or paperboard as Paine (1991) describes it, is together with wood one of the major materials used for packaging. The material is widely used as it fulfills the criteria for successful packaging, as it contains, protects, and preserves the product from outer elements for all three levels of packaging (Kirwan, 2013). At the primary level, the criteria are met by enclosing single unit products, secondary by enclosing a collection of primary packages for storing and distributing, and at the tertiary level by enclosing unit loads of products for distribution in bulk. There are multiple different forms of paperboard material, for example, folding cardboard, rigid boxes, and corrugated and solid fibreboard boxes. Thus, the material is considered particularly

suitable in box or carton form for transport. The material mainly consists of fibers that, in most cases, derive from wood or secondary fibers from recovered paper and boards, with the latter usually used in cheaper grades (Paine, 1991). The characteristics of the material are similar to paper with a strength-to-weight relationship. It can be moderated depending on the finish and the manufacturing process enables the packaging to be cost-efficient (Kirwan, 2013). Cardboards are also considered relatively environmentally friendly as the material is recyclable (Paine, 1991).

3.3.3 Plastic

Plastic packaging is a relatively new material compared to wood and has become increasingly popular since it was introduced (Paine, 1991). It is composed of materials that have been mined from the earth (crude oil) or glass. Compared to other materials, plastic is often light in weight, very versatile, and easily formed into different shapes (Emblem, 2012). The versatility of the material together with the demand of the supply chain has resulted in there existing plastic solutions to almost all packaging problems. Depending on the wanted characteristics, the plastic packaging is composed of different natural polymers or synthetic polymers, which are generally classified depending on the number of branches. The more branches, the sturdier the material will be against strength, moisture, heat, and gasses. Plastic materials are used as shipping containers, thus, the higher material cost to produce plastic packaging compared to wood has resulted in plastic containers mostly being used for returnable containers. Furthermore, plastic can also be derived from bio-based polymers, which originate from plant matter. These types of plastics are, compared to crude oil polymers, made of renewable resources, which makes the plastic more environmentally friendly. However, these types of plastics are still not widely adopted and are only found in niche groups.

3.4 Packaging Performance

By approaching packaging as a system of interrelated levels, packaging performance needs to be evaluated as a system as well (Hellström & Saghir, 2007). Thus, the packaging performance is dependent on the interactions between each level, in addition to the performance of each level separately. Pålsson (2018) argues that trade-offs between packaging features affecting activities such as warehousing, handling, distribution, marketing, and production need to be made, as well as trade-offs affecting different actors within the supply chain. For instance, warehouses might require the packaging to be stackable to increase the efficiency of their operations, and transport requires weight and volume efficiency, while manufacturing might require low packaging costs and retailers features for sufficient replenishment and expensive packaging to promote sales.

According to Pålsson & Hellström (2016), to become effective and efficient when selecting what packaging to use, economic and environmental requirements from several stakeholders within the supply chain need to be considered. Further, as one of the main purposes of packaging is to deliver products safely to customers, quality

will be discussed as a factor affecting the packaging performance, followed by cost and sustainability packaging performance.

3.4.1 Quality

Traditionally, packaging was seen as an important part of the physical product with the purpose of protecting and storing. However, as customer demand increases, the role of packaging has become more important. Today, packaging can provide information and function, thus, companies need to consider what quality means and how it relates to customer satisfaction (Löfgren & Witell, 2005).

Quality can be seen as a subjective term, resulting in it being difficult to define, and having multiple different definitions (Sharma et al., 2013). Hence, Löfgren & Witell (2005) argue for quality being a multidimensional concept, which means that a product might be of high quality in one dimension, but low in another. Garvin (1987) describes quality by using different attributes and defines the concept using eight dimensions: (1) performance, (2) features, (3) reliability, (4) conformance, (5) durability, (6) serviceability, (7) aesthetics, and (8) perceived quality.

(1) Performance regards a product's primary operating characteristics. (2) Feature often refers to secondary aspects of the performance dimension, and peculiarities that are supplements to the product's basic function. (3) Reliability reflects the probability of a product malfunctioning or failing within a specified time period. (4) Conformance is the degree to which a product's design and operating characteristics meet established standards. (5) Durability is the measure of a product's life and has both economic and technical dimensions. Technical durability is the amount of use one gets from a product before it deteriorates. (6) Serviceability is how easy a product is to repair or the speed, courtesy, and competence of the repair. (7) Aesthetics and (8) perceived quality are the most subjective dimensions of quality with aesthetics regarding how a product looks, feels, sounds, tastes, or smells, and perceived quality regarding the indirect basis measure a consumer may use to evaluate the quality of a product. For example, a product's durability can often not be determined at first glance in these situations, and various tangible and intangible aspects of the product will affect the perceived quality (Garvin, 1987). Thus, Löfgren & Witell (2005) argue that good quality is the composite of the different quality attributes that provide the intended function with the greatest overall economy. Further, criticism concerning quality is that all attributes are often seen as equally important, which results in mediocre products. This argument is also highlighted by Garvin (1987), who states that not all eight dimensions should be pursued simultaneously, and if they were, it would result in an unreasonably high price.

3.4.2 Cost

Packaging has a great economic impact on logistics and supply chains (Pålsson & Hellström, 2016). Costs, as well as environmental impact, can be affected by

purchasing and development of packaging, transportation efficiency, and end-of-life handling. It is mentioned that, in economic terms, the packaging itself is not a high-value item, and might therefore not have a direct economic value for a company (Found & Rich, 2007). However, the strategic value of packaging is high as products cannot be transported if the packaging is not available. Not being able to send a product can generate great costs. Further, Pålsson (2018) argues that packaging can generate value by attracting customers through attractive design features and by offering convenience, resulting in higher sales.

According to Pålsson (2018), packaging is of strategic importance to supply chains and their performance. By applying a supply chain approach to packaging, product waste can be reduced, and logistics and transport efficiency increased, leading to higher cost-efficiency. Packaging affects logistics and transport efficiency by impacting warehouse and transport utilization, and production and handling efficiency. It is further highlighted that by having a holistic approach when selecting and developing packaging systems, and by considering the entire supply chain, total cost-efficiency can be maximized.

Pålsson (2018) also highlights that a low level of packaging standardization tends to result in higher logistics costs. Packaging standardization can refer to, for instance, the packaging dimensions and packaging material. Standardized dimensions can contribute to higher utilization of vehicles and can facilitate co-loading and material handling. Additionally, standardization can refer to weight restrictions, to reduce the risk of unergonomic handling of the packaging, and recycling guidelines for packaging waste to ensure there is a high level of recycling.

3.4.3 Sustainability

According to Pålsson & Hellström (2016), packaging initiatives offer significant potential to reduce the carbon emissions caused by a supply chain. Packaging has a direct as well as an indirect effect on the environment (Pålsson, 2018). The direct effect is referring to the environmental impact caused by the production of packaging material, and packaging waste. The indirect impact refers to the impact packaging has on logistics and transport efficiency, as well as the packaging's ability to avoid product waste. The indirect environmental impacts tend to be larger than the direct ones, however, they are often overlooked. Pålsson (2018) further mentions that legislation has been implemented to reduce packaging waste and promote recycling, by putting larger responsibility on global producers. Thus, many companies focus on minimizing their material use and increasing the possibility to recycle packaging. However, to increase environmental efficiencies, companies must focus on the indirect effects as well.

Several logistics decisions throughout the supply chain cause environmental impact due to packaging (Pålsson, 2018). First of all, the quality of the packaging material affects the environmental impact of production and waste. The location of the packaging supplier also affects the environmental impact, as when using a global

supplier, the packaging might need to be sent by sea and road, while when using a local supplier, the environmental impact will be significantly lower. Further, the mode of transport used to ship the goods needs to affect the design of the packaging system to minimize the environmental impact. For instance, if air freight is used, the focus needs to be put on the weight and volume efficiency of packaging to reduce the environmental impact, while if sea or rail is used, volume efficiency will need to be prioritized to maximize the number of goods sent, and thus reduce the environmental impact. The size of the package also affects the environmental impact, as smaller packaging would require more packaging material per product, as fewer products can be unitized in the same packaging, resulting in more material being needed. Thus, the thickness of the material and the packaging dimensions need to be considered.

According to García et al. (2017), the environmental impact of packaging can be minimized by reducing packaging waste and raw material consumption, promoting recycling and returnable packaging, and increasing packaging protection to avoid losses. Pålsson (2018) argues that a balance must be found between not using too much packaging material impacting the environment negatively, and not using too little and facing the risk of products being damaged. To encourage recycling, he mentions that packaging should include as few different materials as possible, and mixed materials should only be used if necessary to fulfill a certain function. The energy efficiency of materials should also be considered. The energy needed to produce the packaging should be put in relation to the number of times the packaging can be used before being recycled. According to Wu & Dunn (1995), by changing the size of the packaging and pallet patterns, companies can make significant savings in warehousing and transport costs, as well as reductions in environmental impact through reduced waste and fewer vehicles required. Further, they argue that an environmentally responsible transport of packaging should include fewer shipments, direct routes, good space utilization, less handling, and shorter movements.

3.5 Packaging Waste

When packaging has been used, it becomes packaging waste (Pålsson, 2018). The management of packaging waste differs depending on the characteristics of the packaging, such as its material, and in which country the waste is handled. Packaging waste is created throughout the supply chain, thus, all actors within the supply chain need a system for waste collection and transport. When considering packaging waste, all three levels of a packaging system, these being primary, secondary, and tertiary, need to be included. Secondary and tertiary packaging tend to become waste when reaching the sales location of the product.

How to manage packaging waste within the European Union is legislated by the European Packaging and Packaging Waste Directive which was published in 1994 (European Commission, n.d.). One of its aims is to prevent packaging waste by reusing, recycling, or recovering packaging. In the report, it is highlighted that the optimal way of preventing packaging waste is to reduce the overall volume of

packaging. By the end of 2024, all countries within the European Union should have established producer responsibility schemes for all packaging. This means that the producers need to take responsibility for what will happen to their packages after being used, and for example, are required to accept the packaging waste back (Aarnio & Hämäläinen, 2008).

To manage packaging waste, the design and selection phase of a packaging system is important to consider (Pålsson, 2018). To ensure the waste collection is facilitated, this phase should ensure that as little material as possible is used, as few different types of material are used, and make sure it is easy to separate different materials.

3.6 Reusable Packaging

There has been a trend within packaging from disposable packaging to recyclable and preferably even reusable packaging (McKerrow, 1996). The main drivers for this trend have been cost benefits and lowered environmental impact. Compared to one-way packaging which generates waste, reusable packaging is a closed-loop process, where the packaging is returned and reused (Pålsson, 2018). Reusable packaging is usually designed stronger, heavier, and more costly than one-way packaging, in order to be reused without lowering the protection it provides. To be able to implement reusable packaging, management of a reverse logistics process is necessary. It is mainly secondary and tertiary packaging that are included in a reusable packaging system.

A reusable packaging system is characterized by its high investment cost, compared to the investment cost of one-way packaging. The higher investment cost is related to the increased robustness needed for reusable packaging. On the other hand, the cost per usage is likely lower for reusable packaging as it can be used several times compared to one-way packaging. Reusable packaging also creates higher operational costs, as the packaging needs to be handled, stored, cleaned, repaired, and managed, while one-way packaging only needs to be handled and stored. Further, reusable packaging also needs more management as it requires a reverse logistics process, and needs to avoid damage, misplacement, and theft. (Pålsson, 2018)

The characteristics of the supply chain determine whether or not reusable packaging is suitable (Twede & Clarke, 2004). To keep costs and the environmental impact low, reusable packaging should be used when the transport distances and lead times are short. Further, handling, sorting, and cleaning of empty packages need to be efficient to minimize environmental impact and costs. Finally, they also argue that reusable packaging is suitable when the supply chain has a strong channel leader. According to Coelho et al. (2020), reusable packaging is commonly used as transport packaging within the Business-to-Business (BTB) market, as it lowers costs in the long term. Reusable packaging that is widely used is for instance pallets, crates, dunnage, and large bags. It is argued that operating in the global market would be impossible without the use of standardized packaging, as standardization facilitates automatization and cost reduction.

From an environmental perspective, in addition to the prevention of waste, impacts such as transport and volume efficiency, packaging material, and material and waste handling need to be taken into consideration before deciding whether reusable or one-way packaging is most beneficial to the environment (Pålsson, 2018). However, Coelho et al. (2020) argue that in general, reusable packaging systems tend to have lower environmental impacts compared to one-way packaging. The environmental impacts considered are material production and disposal, as well as impacts caused by transport.

3.7 Branding

A brand is defined by Gronlund (2013) as a mark, or a class of goods marked as the product of a firm or manufacturer and includes the identification, a name, or some kind of logo or symbol for a company. Further, branding is defined differently by scholars, thus Gronlund (2013) summarizes it to include multiple dimensions such as equity, culture, reputation, essence, character, positioning, image, and identity. The interest from academics and practitioners in understanding the importance of brand equity has increased over the last decade, and a more competitive market has made the brand essential for accomplishing growth (Rao et al., 2004). Brand equity is created by delivering quality products and by creating a strong brand association through appropriate communication and advertising strategies (Longwell, 1994). Hence, a brand can create financial value and generate a cash flow based on customer loyalty, intensive marketing, brand extension, licensing opportunities, and increased marketing efficiency for strong brands (Rao et al., 2004). Packaging relates directly to marketing, communication, logistics and logistics management, sustainable marketing, and branding. It is viewed as an effective advertising tool that can promote sales.

4

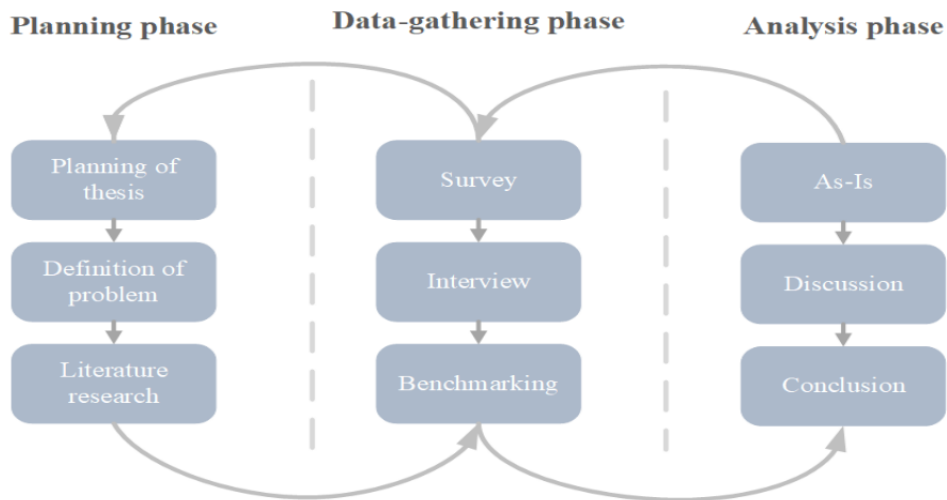
Methodology

In this chapter, the methodology used to conduct the study is described. The chapter begins by introducing the research process and design of the project, followed by the methods used for the collection of data. Thereafter, the method used for data analysis is introduced, followed by a final discussion about the quality and ethics of the research.

4.1 Research Process and Design

According to Bryman & Bell (2015), a popular research method among qualitative researchers is the abductive reasoning approach, which enables for switching between the concept presented in the literature review, and the empirical findings. The approach is preferable as it seeks to explain specific problems in the most natural and manageable way. This study is qualitative, meaning that the data collection is focused on words and the descriptions of human factors, rather than numbers (Creswell & Creswell, 2018). Therefore, the abductive approach was chosen as it enables testing of the theories by examining variables, and it allows for moving back and forth between theoretical and empirical findings (Bryman & Bell, 2015). Further, the research process for the thesis was divided into three phases, which are illustrated in Figure 4.1. The phases are the planning phase, data-gathering phase, and analysis phase.

Figure 4.1: The structure of the research process followed in the thesis.



4.2 Research Planning

The first stage of this thesis was to prepare a project plan, which outlined how the research would be carried out, what to include, and a primary timeframe. At this stage, the paper's overall focus and methodology were decided. Further, the timeframe was expressed through a planning report, which included background, primary purpose, and a short description of the methods that were to be used for theoretical and empirical data gathering. Additionally, the first meetings with Volvo Group were initiated in this phase, and meetings with different representatives were set up to give a context to the problem that was to be studied. The case company presented the scope, and limitations were decided in collaboration with the company. The planning report worked as a first draft of the report and enabled the research to continue into the next phase. A summary of the DCs to be included in the thesis was presented by the company in the planning phase and is presented in Table 4.1.

Table 4.1: A summary of geographical information and specializations of the DCs studied.

Type of DC	Country	City	Region	Specialization
CDC	USA	Byhalia	NA	Mack Trucks
CDC	USA	Columbus	NA	Mack Trucks
CDC	Brazil	Curitiba	SA	
CDC	Belgium	Ghent	Ghent	
CDC	South Korea	Incheon	APAC	Volvo Construction Equipment
CDC	France	Lyon	Lyon	Renault Trucks
RDC	USA	Baltimore	NA	
RDC	India	Bangalore	APAC	
RDC	Argentina	Buenos Aires	SA	
RDC	United Arab Emirates	Dubai	RMEA	
RDC	South Africa	Johannesburg	RMEA	
RDC	Russia	Moscow	RMEA	
RDC	USA	Reno	NA	
RDC	Chile	Santiago de Chile	SA	
RDC	Singapore	Singapore	APAC	

4.3 Review of Literature

To create a theoretical framework, a review of literature was conducted. Literature was retrieved through the Chalmers Library database as well as the open database Google Scholar. Searches in these databases were based on keywords such as: *Packaging*, *Cardboard Packaging*, *Wooden Packaging*, *Plastic Packaging*, *Packaging Performance*, *Packaging Waste*, *Packaging Levels*, *Sourcing Strategies*, and *Reusable Packaging*.

4.4 Data Collection

Three types of data collection methods were applied during the data collection phase, namely a survey, interviews, and benchmarking. Braun & Clarke (2013) point out three methods for collecting qualitative data: interactive data collection methods such as interviews, participant-generated textual data such as qualitative surveys, and secondary data such as printed and online materials. Thus, all methods mentioned were applied. Qualitative data was collected through the survey sent out to representatives at the studied DCs, the conducted interviews with selected representatives, and the benchmarking with an external company.

4.4.1 Survey

To gather data and get an overview of all CDCs and RDCs studied, a survey was conducted. According to Braun & Clarke (2013), a survey consists of several open-ended questions and is self-administrative in comparison to an interview. The conducted survey was sent out to 16 participants, representing the 14 DCs to be studied, and was to be completed within two weeks. After one week, a reminder was sent to the participants that had not yet filled out the survey, and a week later an additional reminder was sent. The first answer was received on February 1, 2022, and the last on March 11, 2022. The answers collected were thereafter used to select which CDCs and RDCs to conduct further interviews with. However, the deadline of the survey was exceeded and therefore, no answers received after March 2, 2022, were included in the selection of RDCs to be interviewed. This excluded CDC Incheon and RDC Chile from the selection. On average, the survey took 57 min and 06 sec to complete, and in total, 13 respondents filled out the survey. RDC Moscow was not included in the result as they did not contribute to the survey as a consequence of Volvo Group's decision to halt all activities within Russia due to the current war in Ukraine.

According to Braun & Clarke (2013), it is suggested to use a maximum of 30 questions in a survey to reduce the risk of "question fatigue". Further, they recommend ensuring questions are written as short, clear, unambiguous, and simple as possible, and in an appropriate language. Thus, the conducted survey consisted of eleven questions that had been chosen with consideration and formulated as simply and clearly as possible. Three additional questions also asked the respondent to provide pictures to exemplify the answers. Furthermore, Braun & Clarke (2013) also recommend piloting the survey to make sure it "works". Thus, the survey was sent to two test persons at Volvo Group to receive feedback, before being sent to the final respondents. The questions included in the survey are summarized in Appendix A.

The survey included mainly open-ended questions, however, a few closed questions were included as well. Braun & Clarke (2013) recommend avoiding closed questions, however, they argue that they can be used when they are considered the best way of asking short and clear questions, which is the reason for including two closed questions. The survey had a qualitative approach as it, compared to quantitative

surveys, gives the respondent the possibility of providing answers in their own words, as described by Braun & Clarke (2013). This provides the researcher with more thorough and detailed information to be used in the comparison and selection of DCs for further interviews. Other advantages of qualitative surveys that were highlighted are the possibility of collecting large amounts of data within short time periods, the experience of a survey being less daunting than an interview, and its suitability for collecting sensitive information. It is further highlighted that a survey, due to this, is ideal for student and resource-lite projects.

Compared to other qualitative methods, qualitative surveys give access to more perspectives than is possible within the same timeframe for an interactive method, such as an interview (Braun & Clarke, 2013). Further, compared to interactive qualitative methods, qualitative survey data tends to be more focused on the studied topic, and tend to provide more standardized responses. Therefore, it was considered a suitable way of collecting general data from all CDCs and RDCs, before proceeding with more in-depth interviews with selected DCs.

Braun & Clarke (2013) highlight three formats for surveys: hard copy, email, and online. Some of the advantages mentioned about the online survey format are its quick and easy distribution, its advantage for geographically dispersed participants, the possibility of using images, and potentially very quick data collection. Due to the geographical spread of the CDCs and RDCs as well as the collection of photos related to the questions, the survey was performed online. For online surveys, Braun & Clarke (2013) mention that specialist software needs to be used. In this thesis, Microsoft Forms was used to perform the survey, as access to it was provided by the company.

One of the main drawbacks of a survey is the decreased flexibility (Braun & Clarke, 2013). As the questions are predetermined, the answers are constrained as they cannot be extended. Further, there is a risk of the respondents misunderstanding the questions, which might make the responses useless. In the conducted survey some of the asked questions were misunderstood by several respondents, and the entire questions were therefore excluded from the results. Finally, there is also a risk, especially for online surveys, of the participants forgetting to answer and complete the survey, even though reminders are sent out.

4.4.2 Selection of RDCs

To select which RDCs to conduct more in-depth interviews with, the criteria presented below were used. The criteria were applied to the answers provided by the respondents in the survey. CDC Incheon was added to the study at a later stage and RDC Chile exceeded the deadline of the survey. Therefore, the two DCs were not included in the original criteria selection. All of the CDCs are predetermined for future interviews due to their size and scope, however, they are included in the selection as the CDC results for criteria one and two affect the selection of RDCs, as all geographical regions and criteria were to be covered in the interviews.

Criterion 1: Geographical region

To make sure different geographical environments were covered, all geographical regions defined by Volvo Group needed to be covered by either a CDC or RDC in the interviews.

Criterion 2: Quality, cost, and sustainability

As the study is focused on quality, cost, and sustainability requirements, all of the three criteria needed to be covered by at least one CDC or RDC prioritizing it. Further, quality and sustainability are considered important areas by Volvo Group and therefore, RDCs prioritizing these criteria were thereafter prioritized.

Criterion 3: Standardization

Standardization is important to Volvo Group, hence, DCs with a standardized outbound packaging process were prioritized in the selection of RDCs.

Criterion 4: Product Sheet

Product sheets will have a higher priority within Volvo Group in the future and therefore, RDCs having implemented product sheets were prioritized.

4.4.3 Interview

To get a better understanding of what the outbound transport packaging processes at the CDCs and selected RDCs look like, interviews were conducted. According to Bryman & Bell (2015), interviews is the most widely employed method in qualitative research. For the interviews, a semi-structured method was chosen. This is because it enables the flexibility to adjust the questions according to the information retrieved. A semi-structured interview is characterized by open questions allowing for the respondent to further elaborate and discuss, with the questions being covered in an interview protocol. Thus, the interviewer is given the freedom to change, add or skip questions depending on the respondent's responses (Bryman & Bell, 2015). However, all questions in the interview protocol should preferably be asked similarly, for example, in the same order.

The first stage of the interview process was to conduct an interview protocol. This was done to create an agenda for the interviewers and is presented in Appendix B. Adams (2015) mentions the importance when creating an interview protocol to budget enough time to allow drafts, edits, and multiple iterations to ensure the protocol correlates with the research questions. Further, the protocol used in this study was divided into different themes to separate the questions and facilitate for the interviewers to ensure the questions correlate with the research questions as recommended by Adams (2015) and Galletta & Cross (2013). Moreover, the iterative approach helped ensure the questions were formulated to allow for elaboration in the respondents' answers and placed to facilitate a more profound understanding of the outbound packaging process. Further, closed-ended questions were mixed with open-ended questions to enable a gateway to get more specific answers, as rec-

ommended by Adams (2015). The last stage in the development of the interview protocol was to test it in a pilot. This was done by sending the pilot to the supervisor at Volvo Group and the supervisor at Chalmers University of Technology. The purpose of the pilot interview was to test the questions. After the interview protocol was finalized, one respondent was sent the questions in advance as it was requested by the respondent.

The second stage was to conduct the interviews. Due to Covid-19 and the geographical disparity of the respondents, all interviews were conducted remotely via the video conference platform Microsoft Teams. All interviews were conducted in pairs, with one person asking the questions and the other taking notes of key points and assisting when needed. This approach is recommended by Adams (2015), who advocates for dividing the responsibilities, allowing for subsequent transcription, which enables an early analysis and a better understanding. Further, all interviews except two were recorded and transcribed to ensure no data was lost. However, Adams (2015) highlights a drawback with recording interviews, as if the topic is sensitive, it can lead to the respondent holding back their answers. The interviews that were not recorded were so after wishes from the respondents. Lastly, Bryman & Bell (2015) state another drawback with interviews, as the transcription of interviews is rather time-consuming, time needs to be allocated and planned for the task.

The interviews were conducted between March 2, 2022, and March 10, 2022, with employees representing the different CDCs and RDCs. All respondents from the CDCs and RDCs were decided using snowball sampling provided by SML representatives. Contact with respondents was all established through email. For CDC Byhalia and CDC Columbus, the same representative was assigned. The representative works at CDC Byhalia but stated that the answers apply to Columbus as well. Therefore, CDC Columbus will hereinafter be excluded from the study, but the answers for CDC Byhalia are assumed to apply to CDC Columbus as well. The respondents' locations, roles, dates and lengths of the interviews are presented in Table 4.2. Further, after the interviews, some additional questions were sent to the respondents to be answered through email. The additional questions are presented in Appendix B.

Table 4.2: Information about the interview respondents and the characteristics of the interviews.

Subject(s)	Base	Role of interviewee(s)	Date	Time (min)
Respondent 1	CDC Byhalia/Columbus	Packaging Engineer	March 3, 2022	58
Respondent 1,2 & 3	CDC Curitiba	Commercial Packaging Engineer, Intern, Logistics Assistant	March 7, 2022	40
Respondent 1 & 2	CDC Ghent	Packaging Engineers	March 2, 2022	46
Respondent 1	CDC Lyon	Packaging Manager	March 9, 2022	44
Respondent 1 & 2	CDC Incheon	Head of DC Seoul, CS System Specialist	March 8, 2022	43
Respondent 1	RDC Bangalore	Customer Service Manager	March 4, 2022	45
Respondent 1	RDC Dubai	Operations Manager	March 10, 2022	43

4.4.4 Benchmarking

Benchmarking is defined by Bogetoft (2012) as a managerial tool for improving performance by identifying and applying best-documented practices. This is done by comparing the performance of an organization's products and processes with external competitors and best-in-class companies, or internally by studying similar operations within the own firm. In this thesis, benchmarking was conducted with an external company. The purpose of the benchmarking was to identify gaps to be used in the identification of favorable outbound packaging processes.

The benchmarking process for the research followed the Xerox benchmarking process described by Waters (2003). The first step included prioritizing what to benchmark. This was decided together with Volvo Group and resulted in the benchmarking activity focusing on the processes when using wood, plastic, and cardboard one-way material in the outbound transport packaging process.

Step two was to identify a comparable company. Volvo Group predetermined and initiated contact with a company within the same industry and with similar operations. However, the company is not a direct competitor of Volvo Group. Thus, the benchmarking conducted can be classified as industry benchmarking (Waters, 2003). The company was preferred by Volvo Group as it has a similar business structure, and is a large global company with distribution centers located all around the world. Waters (2003) argues that even if two companies have different requirements and competitive environments, there is still a lot to be learned from each other.

Therefore, the benchmarking company was considered suitable for benchmarking. The external company will hereinafter be referred to as Global AB to maintain its anonymity.

Step three was to decide what data and information collection method to be used. A qualitative data collection was decided. One semi-structured interview with three respondents from Global AB was conducted. The respondents were chosen using snowball sampling provided by Volvo Group and Global AB. An interview protocol was created and is presented in Appendix C. The respondents were working within the inbound flow in the European market, thus, their answers are based on that perspective. The interview process followed the same criteria and structure as described in section 4.4.3, was conducted on April 5, 2022, and lasted for 45 minutes. The interview was held in Swedish as this was the preferred language of the respondents.

Step four was to determine performance gaps between the two companies' outbound packaging processes, with extra attention being paid to characteristics considered favorable and the identification of relevant process enablers. The data analysis method used is further described in section 4.5.

Furthermore, there are five additional steps in the Xerox benchmarking process that were not conducted in this study as these go beyond the research scope. However, for transparency, they are mentioned in short: step (5) project future performance levels, (6) communicate findings and gain acceptance, (7) establish functional goals, (8) develop action plans, (9) implement and monitor, and (10) re-calibrate benchmarks.

4.5 Data Analysis

For analysis of the collected data, thematic analysis was used. Braun & Clarke (2006) describe it as a method for identifying, analyzing, and reporting themes and patterns of meaning within qualitative data, in relation to a research question. They propose that it is one of the most commonly used methods for qualitative data analysis, and highlight flexibility as one of its main benefits. Further, they mention that thematic analysis is an accessible analysis method as it does not require as detailed theoretical and technological knowledge as other methods do. In this study, qualitative data was collected through a survey, a review of literature, and several interviews. The data collected was summarized and the interviews were transcribed shortly after they had been held. All data have thereafter been studied and several themes and areas of analysis identified. The final themes identified were supply process, transport packaging, quality, cost, and sustainability, and distribution system.

4.6 Research Quality

Creswell & Creswell (2018) describe two criteria relevant to quality research, which were used to evaluate the quality of the research methods implemented. The two

criteria are validity and reliability.

4.6.1 Validity

Creswell & Creswell (2018) describe qualitative validity as determining if the research findings are accurate from the standpoint of the researcher, the participant, or the reader. Multiple methods are available to validate a research result, hence, Creswell & Creswell (2018) argue for using numerous approaches. One approach to strengthen a study's validity is to triangulate different data. Therefore, the study used multiple data sources, such as literature, internal papers, a survey, and interviews. Further approaches to ensure research validity are to member check data to confirm the information is interpreted and presented correctly (Creswell & Creswell, 2018). The data gathered in the interviews have all been sent to the respondents in the form of a first draft of the As-Is analyses. However, not all respondents have given feedback, and in total, only three of the six As-Is analyses have been member-checked. However, all respondents have been informed that if no input were given, this would be interpreted as the information in the As-Is being correct. Furthermore, the answers in the survey were checked during the interviews, as the interview questions were formulated based on the answers provided in the survey.

4.6.2 Reliability

Reliability is described by Creswell & Creswell (2018) as a way for qualitative researchers to confirm that the chosen approach is reliable. One approach to ensure research reliability is to document the research's different steps and protocols used. The methods for this qualitative research have been thoroughly described in this chapter, where the methods, analysis strategy, as well as information regarding the respondents of the different DCs are presented. Further, Creswell & Creswell (2018) argue for the importance of recording and transcribing interviews. Both authors of this thesis participated in all interviews conducted, and all interviews except two were transcribed and checked by both to avoid mistakes or misconceptions. Further, the survey result was documented and inspected by both authors.

4.7 Research Ethics

The research has been based on the All European Academies' (2017) four principles of research integrity. This was to ensure that responsibility was taken for the thesis' impact on its participants and to explore the ethical concerns described by Bryman & Bell (2015). The four principles are reliability, honesty, respect, and accountability. Reliability has been ensured in Chapter 4, where the process is described, and Chapter 6, where the empirical findings are analyzed. Honesty has been considered by the researchers' transparency throughout the thesis work and Chapter 5, where the final result is presented. Respect has been met by dialogue with the respondents, ensuring they are aware of how their information will be used and keeping the respondents' names anonymous. The last principle, accountability, has been achieved as the authors have taken full accountability for and during the thesis work.

5

Empirical Findings

In this chapter, the empirical findings from the survey are presented, followed by the selection of RDCs to be included in the interviews. Finally, the empirical findings from the interviews and the benchmarking are presented.

5.1 Survey

In the following section, the questions asked in the survey are presented one by one, with a summary of the answers provided to each question. For an overview, see Appendix D.

5.1.1 What packaging material do you use?

The first question asked in the survey was what packaging material each DC uses when V-EMB is not used. The respondents could select one or several different materials when answering. Cardboard was the most commonly used packaging material, often in combination with either wood, plastic, or both. Cardboard was used by all the DCs in the form of corrugated boxes, or pallets made out of cardboard. For wooden packaging, pallets and crates were the packaging types used, and for plastic packaging, totes and bags were used. See Figure 5.1 for examples of packaging solutions used at the DCs.

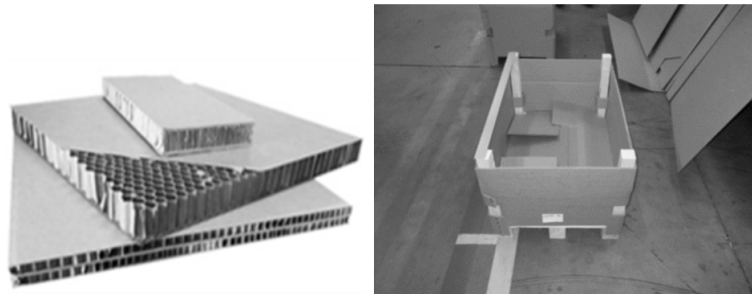
Figure 5.1: Examples of alternative packaging used at the DCs. From the left: wooden crate, plastic tote, cardboard box, and wooden pallet.



DCs that use all three materials are CDC Byhalia, RDC Bangalore, RDC Singapore, RDC Reno, CDC Incheon, and RDC Chile. Three DCs responded that they only use plastic and cardboard packaging, these were CDC Curitiba, CDC Ghent, and CDC Lyon. Further, one respondent, RDC Baltimore, responded that they only use plastic and cardboard packaging. Finally, RDC Buenos Aires, RDC Johannesburg, and RDC Dubai only use cardboard packaging. However, RDC Dubai is unique

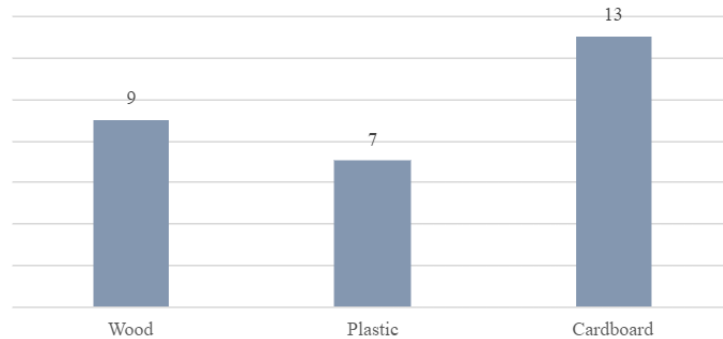
by being the only DC using honeycomb cardboard boxes, see Figure 5.2. Further, CDC Ghent does not use solid cardboard boxes, instead, the cardboard packaging is divided into different components, such as lid and body, with similar dimensions to V-EMB “*We have different kinds of one-way packaging that have the same dimensions as our V-EMB*”, see Figure 5.2. A similar solution for cardboard packaging is applied at CDC Lyon.

Figure 5.2: Location-specific packaging solutions. From the left: RDC Dubai’s honeycomb box, CDC Ghent’s cardboard solution.



All of the answers received are summarized in Figure 5.3.

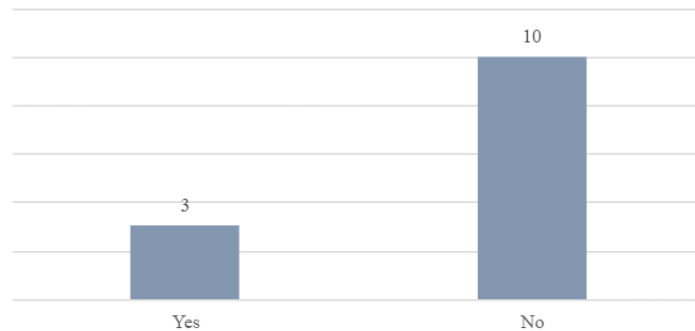
Figure 5.3: Summary of the materials used for alternative packaging at the studied DCs.



5.1.2 Do you have a product sheet?

Regarding product sheets, a majority of the DCs answered that they do not have one. Only three DCs answered that they have a product sheet, these being RDC Bangalore, CDC Byhalia, and CDC Incheon. The question was closed and the respondents could only choose either yes or no. The result is illustrated in Figure 5.4.

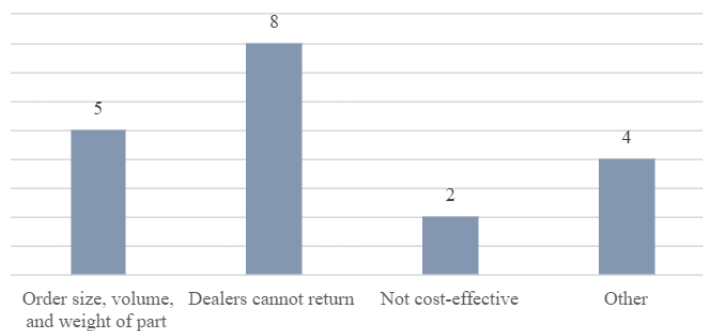
Figure 5.4: Summary of the DCs having and not having a product sheet for their transport packaging.



5.1.3 What is the most common reason for not using V-EMB?

The respondents were asked what the most common reason for not using V-EMB is. The answers were summarized into four categories, these being (1) order size, volume, and weight of part, (2) dealers cannot return, (3) not cost-effective, and (4) other. The question was open, meaning that the respondents wrote down the answers in their own words. Thus, the respondents were not limited to answering only one reason why they do not use V-EMB. The result is presented in Figure 5.5. As can be seen, (1) order size, volume, and weight part is about as common as (2) dealers cannot return. RDC Reno, RDC Johannesburg, CDC Curitiba, and CDC Byhalia answered both these reasons, while some DCs only answered one of them. RDC Baltimore was the only one answering order size, volume, and weight of part, while RDC Bangalore, RDC Singapore, RDC Buenos Aires, and CDC Ghent only answered dealers cannot return. Two DCs answered that V-EMB was not cost-efficient for them, these being RDC Dubai and CDC Incheon. The fourth category, other, includes reasons answered by only one DC. Examples are RDC Dubai answering ergonomics, or CDC Lyon answering that they are not authorized to use V-EMB for the Renault Trucks network.

Figure 5.5: Summary of the reasons for not using V-EMB.

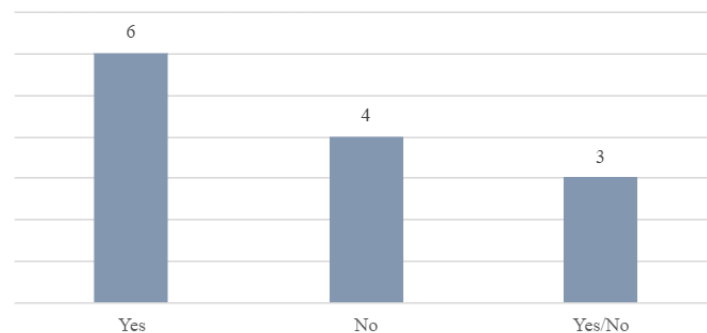


5.1.4 Is the packaging branded?

The answers to the question if the DCs brand their alternative packaging are presented in Figure 5.6. It is possible to tell that some DCs brand their packaging, while others do not. Further, some of the DCs provided answers saying that they brand some of the packaging. Six DCs answered yes to branding all of their packaging, these were RDC Reno, RDC Chile, RDC Bangalore, CDC Curitiba, CDC Ghent, and CDC Lyon. CDC Lyon brands all of their packaging with the label of Renault Trucks, and similarly, CDC Ghent brands all of the one-way packaging with either Volvo Group or Renault Trucks. Four DCs answered that they do not brand any of their transport packaging, these were RDC Bueno Aires, RDC Dubai, CDC Byhalia, and RDC Singapore.

Furthermore, RDC Johannesburg responded that the one-way material purchased from local suppliers is not branded, while the packaging that was reused from CDC Ghent is branded. This resulted in the answer to the question being both yes and no to the branding of the packaging “*The packaging we purchase from a local vendor is not branded, but we do have parts that come from Ghent already branded with Volvo, Renault, or Penta e.g. windscreens.*” Also, CDC Incheon and CDC Baltimore answered both yes and no. CDC Baltimore, for example, brands their plastic boxes, but not their cardboard packaging.

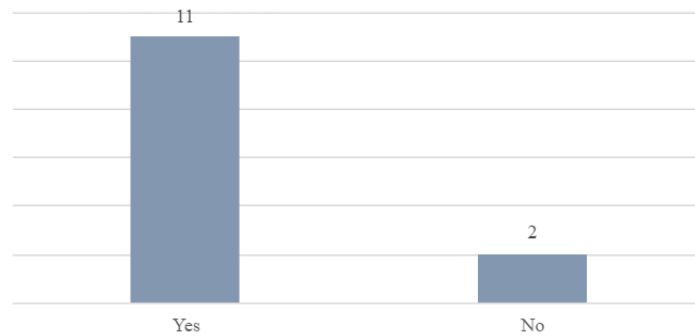
Figure 5.6: Summary of the DCs branding or not branding their transport packaging.



5.1.5 Is the outbound packaging process standardized?

Another question asked was if the outbound packaging process implemented within the DC is standardized, meaning that it is the same for all different transport packaging when not using V-EMB. The result is presented in Figure 5.7. As seen in the figure, a majority of the respondents answered that the process is standardized. RDC Buenos Aires and RDC Johannesburg were the only ones not having a standardized process.

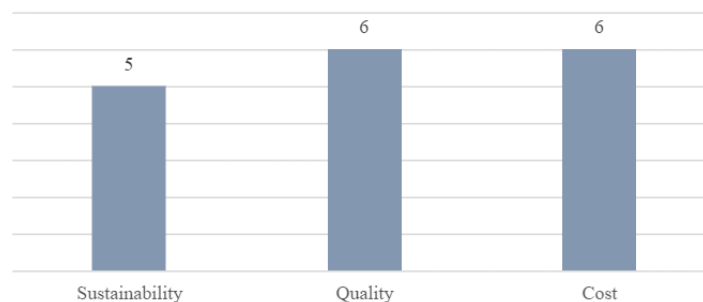
Figure 5.7: Summary of the DCs with a standardized and not standardized outbound packaging process.



5.1.6 When purchasing packaging, which criterion is prioritized?

Finally, the respondents were asked which criterion is prioritized when purchasing packaging. They were limited to the three criteria quality, cost, and sustainability. The respondents were able to select either one or several of the criteria. The result is illustrated in Figure 5.8, which indicates that all criteria are considered almost equally important. Two DCs selected two criteria, these being RDC Bangalore prioritizing sustainability and quality, and RDC Singapore prioritizing quality and cost, however, a majority of the DCs prioritized only one. RDC Reno, RDC Johannesburg, and CDC Curitiba prioritized cost, while RDC Baltimore, CDC Byhalia, and CDC Lyon prioritized only sustainability. RDC Dubai, CDC Incheon, and RDC Chile prioritized quality, while CDC Ghent was the only one selecting all three criteria.

Figure 5.8: Summary of the prioritized criteria at the DCs out of quality, cost, and sustainability.



5.1.7 Selection of RDCs

Answers to the four criteria presented in Chapter 4 are summarized in Table 5.1.

Table 5.1: Illustration of RDCs fulfilling and not fulfilling the identified criteria, and thereby qualifying or not qualifying for interviews.

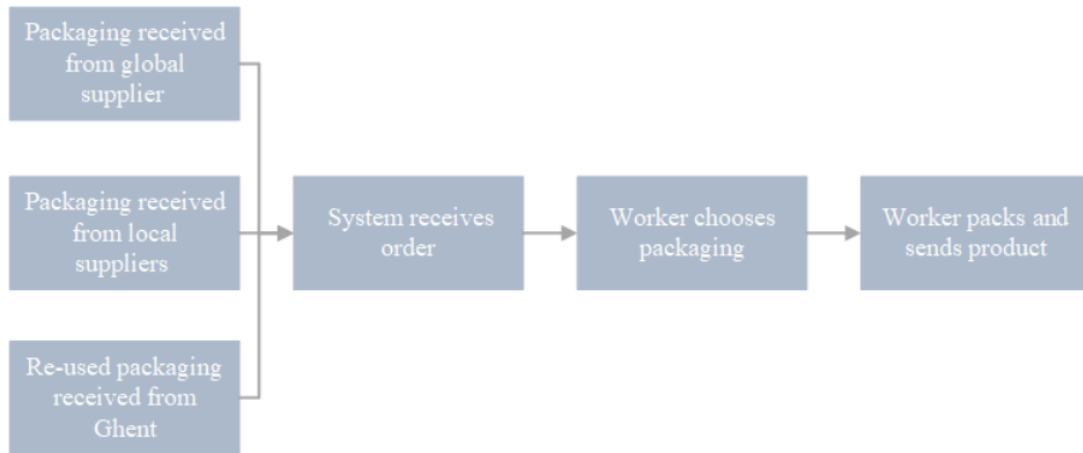
Location	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Result
CDC Byhalia	NA	Sustainability	Standardized	Yes product sheet	
CDC Curitiba	SA	Cost	Standardized	No product sheet	
CDC Ghent	Ghent	All	Standardized	No product sheet	
CDC Lyon	Lyon	Sustainability	Standardized	No product sheet	
RDC Baltimore	NA	Sustainability	Standardized	No product sheet	
RDC Bangalore	APAC	Sustainability & Quality	Standardized	Yes product sheet	Qualify for interview
RDC Buenos Aires	SA	Cost	Not standardized	No product sheet	
RDC Dubai	RMEA	Quality	Standardized	No product sheet	Qualify for interview
RDC Johannesburg	RMEA	Cost	Not standardized	No product sheet	
RDC Reno	NA	Cost	Standardized	No product sheet	
RDC Singapore	APAC	Quality & Cost	Standardized	No product sheet	

5.2 Interview and As-Is Analysis

The interviews resulted in an As-Is analysis for all CDCs and the two RDCs selected in section 4.1. The As-Is analyses presented include supply process, transport packaging, and quality, cost, sustainability.

5.2.1 CDC Byhalia

CDC Byhalia mainly distributes Mack Trucks and Volvo Trucks products. The outbound packaging process is standardized, and when choosing one-way packaging, they prioritize cost first, followed by quality, and last sustainability. An illustration of CDC Byhalia's outbound process is presented in Figure 5.9.

Figure 5.9: Illustration of CDC Byhalia’s outbound transport packaging process.

Supply process

The DC has multiple suppliers. Today, there are three suppliers delivering cardboard boxes to the facility. However, due to current issues in the supply chain that have resulted in longer lead times and a decrease in delivery accuracy, the DC is looking at expanding its supplier portfolio. Furthermore, all outbound packaging is kept in stock in-house.

Transport packaging

The DC is using two different types of one-way packaging: cardboard boxes, and wooden crates. None of their one-way packaging is branded. The decision to not brand is because of the area needed within the DC to keep packaging stock for two different brands. Further, the reason for using one-way packaging is because of issues with getting the V-EMB back to the facility, which has resulted in high costs. There are product sheets for all one-way packaging, which include information regarding the components of the material and how much of the material is virgin or recycled.

Quality

Quality is considered the second most important criterion for one-way packaging. Good quality is defined as packaging that protects the product and does not break during transport. Bad quality is defined as packaging that cannot handle high humidity, takes up a lot of space during transport, and easily breaks. To maintain good quality, CDC Byhalia is working on quality projects. Further, the Quality Department is involved in giving feedback regarding the packaging. A challenge for the DC is to get better feedback from external suppliers, as they currently do not answer the DC within the set time frame. CDC Byhalia has KPIs for measuring the quality of its transport packaging.

Cost

The DC considers the packaging material, and transport and service cost when purchasing one-way packaging. The aim is to have as low a cost as possible. However, the quality of the packaging should never be jeopardized. The purchasing cost is negotiated by the Indirect Products and Services Purchase (IPS) Team.

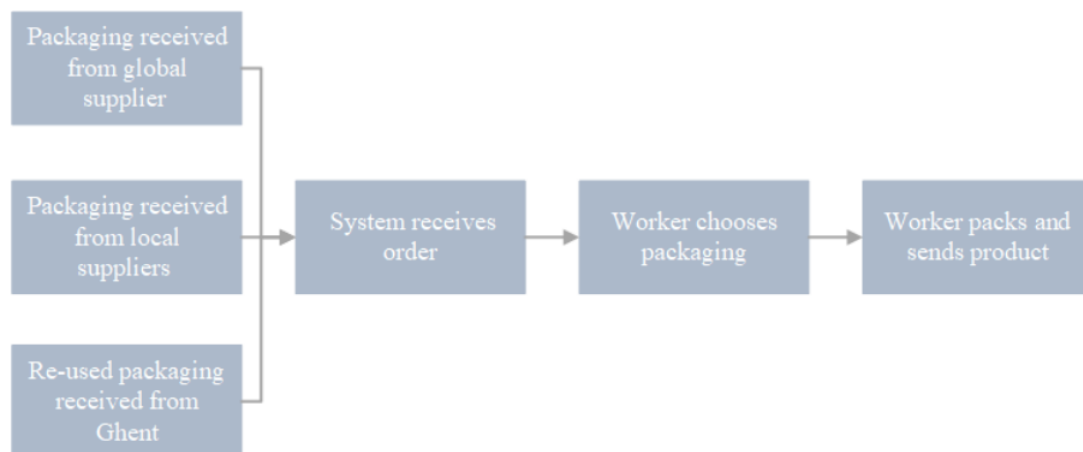
Sustainability

One-way packaging from CDC Ghent is reused, although not all cardboard boxes can be reused. When purchasing new one-way packaging, reusability is not considered. CDC Byhalia has considered using more sustainable packaging, however, no material fulfilling the cost and quality requirements has been found. The packaging must, for instance, withstand the harsh American transportation climate and the high humidity.

5.2.2 CDC Curitiba

CDC Curitiba follows a standardized outbound packaging process. They prioritize quality, followed by cost, and sustainability. However, they believe this will change in the near future, in favor of sustainability. An illustration of CDC Curitiba's outbound process is presented in Figure 5.10.

Figure 5.10: Illustration of CDC Curitiba's outbound transport packaging process.



Supply process

Most of the suppliers are located in Brazil. CDC Curitiba has one main supplier for cardboard, and one for wooden packaging, but their largest volume is the refill flow from CDC Ghent. They are keeping the packaging in stock in CDC Curitiba and have a safety stock of approximately two weeks.

Transport packaging

For transport packaging material, wooden pallets and corrugated boxes are used, similar to the ones of CDC Ghent. All transport packaging is branded to keep the brand strong, as the customers in South America are sensitive about branding. As mentioned by Respondent 1 *“Our standard is to brand all boxes with the Volvo logo and Volvo label. We have this standard to keep the Volvo brand strong and because the South American customers are very sensitive about branding”*. They have product sheets specifying the dimensions, weight, and thickness of the cardboard packaging. In the future, they will have product sheets for all types of packaging material.

Quality

CDC Curitiba has set requirements for the packaging received from suppliers, stating what quality they demand. When receiving the packaging, they have worked continuously with customer feedback to improve the packaging until they receive no claims. Thus, the quality is measured in the number of claims. Further, the DC currently does not have a standardized packaging process, which is highlighted as a drawback as all decisions lay on the shop floor employees.

Cost

CDC Curitiba does not have a budget for transport packaging material, but they try to always get good deals. They negotiate with suppliers and get support and coaching from the IPS Team. When calculating the cost of the packaging, they are not sure whether the transport costs of delivering the packaging to the DC are included or not. They highlight that, by not branding their transport packaging and instead using standard boxes, it could be possible to reduce the cost.

Sustainability

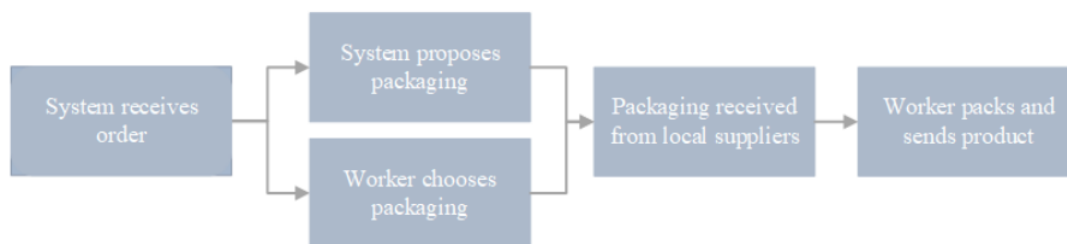
To reduce waste, the packaging received from CDC Ghent is reused, however, the purchased one-way packaging is not bought with reusability in mind. The one-way packaging is of good quality and is possible to reuse, but there is no obligation for the dealers to reuse it. They have also chosen to disregard plastic as it is considered worse for the environment, as mentioned by Respondent 1 *“Regarding plastic, we didn’t think about plastic because it is worse for the environment and also more complicated to develop and design.”* Furthermore, during 2022, they are working on projects with sustainability in focus. For example, they are working to change their wooden crates into packaging made of 90% cardboard and only the base made out of wood, as wood is considered worse for the environment compared to cardboard. However, it is highlighted that the sustainability work in South America is not as evolved as in Europe and the USA, which makes sustainability difficult to prioritize. Regarding social sustainability, they are working according to the ergonomic guidelines provided by Volvo Group. A KPI for how many boxes from

Ghent that are reused is used to measure sustainability, as well as a CO_2 tool that measures how much CO_2 they are saving by choosing either wooden crates or corrugated boxes.

5.2.3 CDC Ghent

CDC Ghent is Volvo Group's largest CDC and distributes worldwide. Their outbound packaging process is standardized and they prioritize quality first, followed by cost, and last sustainability when considering their one-way transport packaging. However, it is believed that this order of prioritization will be changed in the near future, as mentioned by Respondent 1 *"I think the prioritization will change, as I will be the one responsible for the outbound packaging. I already have some suppliers who are working more sustainably, and we will have a team designated for improving sustainability."* An illustration of CDC Ghent's outbound process is presented in Figure 5.11.

Figure 5.11: Illustration of CDC Ghent's outbound transport packaging process.



Supply process

CDC Ghent only has local suppliers, located close to the facility. They have one supplier for cardboard and one for wooden packaging. The suppliers were chosen due to them offering the best prices and services. The services provided by these suppliers are high delivery frequency and agility. Delivery frequency and agility are important to CDC Ghent, as a loss in packaging would impact the process negatively in terms of lost customer deliveries, as highlighted by Respondent 1 *"If we do not have packaging available, it will have a negative effect on our customers as products are not delivered on time. Using another packaging would create higher costs as they are often more expensive and larger in size."* Further, no one-way packaging is kept in stock in-house, instead, the suppliers keep the safety stock at their premises and deliver it to CDC Ghent on a daily basis. The reason for the safety stock being kept at the suppliers' premises is the space that would be needed to stock the one-way packaging in-house. The packaging orders are placed every evening and delivered at noon the following day.

Transport packaging

Two different types of packaging are used as one-way packaging, these being corrugated cardboard boxes, and wooden crates and pallets. The packaging is branded

depending on the type of product that is being sent. Volvo Trucks products are sent using branded packaging, while other products are sent using brand-neutral packaging. The branding of Volvo Trucks is to strengthen the brand image. By not branding the cost is believed to decrease, however, it would only be a small decline in cost. No other advantages are believed to be achieved by using brand-neutral packaging. Moreover, CDC Ghent currently has no product sheet for its one-way packaging. However, the information can easily be retrieved from the suppliers as the two parties have daily contact.

Quality

Quality is considered by ensuring that the chosen transport packaging keeps the product safe and that the product arrives at its final destination without any damage. This is measured in the number of claims received.

Cost

The costs considered for transport packaging are the purchasing price of the packaging and related costs such as transport cost and the cost of the supplier keeping the safety stock at their premises. Further, the costs of emergency orders and the cost of developing new packaging are considered as well. The procurement process of the transport packaging is handled by the material planning team.

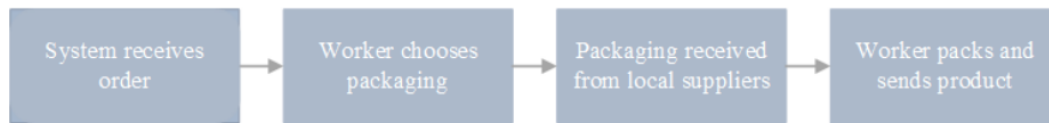
Sustainability

The one-way transport packaging used is not reused in-house and is not bought with this in mind. However, it is possible for dealers to reuse the packaging if they want to. Further, CDC Ghent is working on implementing recycled material, such as recycled wood and cardboard as much as possible. They do not have any measure implemented today for measuring the sustainability of the packaging and do not consider social sustainability in the choice of one-way transport packaging.

5.2.4 CDC Lyon

CDC Lyon is one of the largest CDCs and they mainly distribute Renault Trucks products. Their outbound packaging process is standardized and their main priority for one-way packaging is sustainability, followed by cost, and quality. However, the prioritizing of sustainability is mentioned to mainly be the personal opinion of the respondent. An illustration of CDC Lyon's outbound process is presented in Figure 5.12.

Figure 5.12: Illustration of CDC Lyon’s outbound transport packaging process.



Supply process

All suppliers providing one-way packaging to CDC Lyon are located within a distance of 50 km from the facility. The suppliers keep all one-way packaging in stock at their premises and the short distance to the facility enables them to deliver packaging to the CDC on a daily basis. There are two suppliers providing cardboard packaging and one supplier providing wooden packaging. An important criterion for CDC Lyon when choosing these suppliers was their flexibility.

Transport packaging

CDC Lyon uses two types of packaging, cardboard boxes built of three components (body, lid, and corners), and wooden crates and pallets. The packaging is all branded due to requests from customers and the Marketing Department. It is mandatory to use cardboard packaging instead of V-EMB as a positive business case regarding the return of V-EMB is missing, as mentioned by Respondent 1 “*Today, it is mandatory to use cardboard packaging. The business case for V-EMB is not very good. The process of returning the V-EMB to us is very complex for our customers.*” CDC Lyon has product sheets for all one-way packaging which contain details such as material components, labor costs, and price, as mentioned by Respondent 1 “*We know the quality of the packaging material, and measure its water resistance. For example, we know what type of quality paper is used for a certain material, we have all the information in the specific sheets.*”

Quality

To ensure the quality of the one-way packaging, the IPS Team, Quality Department, Packaging Department, and Material Management Department visit all suppliers every six months to review the packaging. For example, wooden pallets are controlled regarding the percentage of water the material contains, as a too high water percentage might transfer water to cardboard boxes stacked on top of the wooden pallet. Further, weekly meetings are held to discuss quality issues. To measure quality, the DC measures the number of cardboard components scrapped and the number of packages that are damaged and need to be replaced by new components.

Cost

CDC Lyon includes labor and material costs when studying the cost of one-way packaging. The DC pays for the suppliers to manufacture and keep the one-way

packaging component in stock at their premises. Further, the DC is believed to have lowered its costs due to the commitment to reusing one-way packaging, as less new packaging needs to be purchased. The purchasing process for the one-way packaging is handled by the IPS Team.

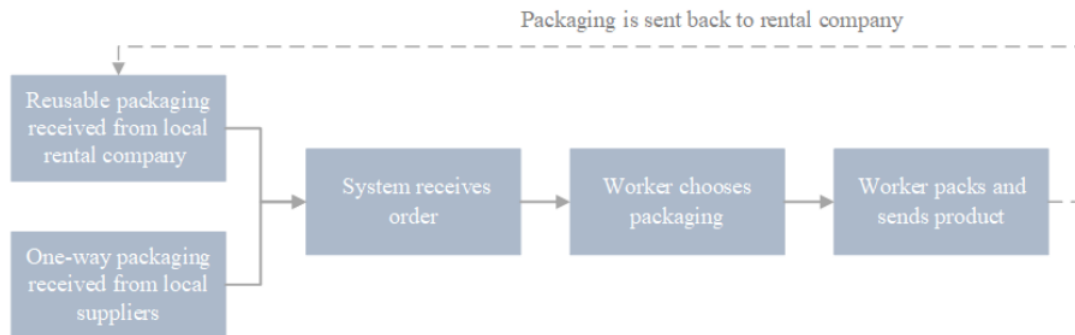
Sustainability

To consider sustainability, cardboard and wooden packaging are being reused. The suppliers clean and fix the used packaging before CDC Lyon reuses it. By doing this, the facility has been able to decrease costs, as for every 100 tons of packaging waste that is reused, there are 100 tons less packaging that needs to be bought. Further, 80% of the cardboard boxes used are made of recycled material and the corners are made of 60% recycled material. To measure sustainability, the DC measures CO_2 emissions for transport and packaging and is using a KPI to measure the weight of the packaging components reused.

5.2.5 CDC Incheon

CDC Incheon specializes in the Volvo Construction Equipment brand and distributes mainly to local dealers for both Volvo Construction Equipment and Volvo Trucks. They follow a standardized outbound packaging process and are prioritizing quality and sustainability equally, followed by cost. An illustration of CDC Incheon's outbound process is presented in Figure 5.13.

Figure 5.13: Illustration of CDC Incheon's outbound transport packaging process.



Supply process

CDC Incheon is only using local suppliers, located within South Korea. These are chosen by the IPS Team, based on quality and cost. Since 2021, they have stopped using V-EMB for local dealers due to the cost being too high, as mentioned by Respondent 1 “*At first we used V-EMB for the return process from dealers, but for cardboard and wooden boxes we could not return because the cost got higher than when recycling the packaging material.*” Instead, they are using a rental company that provides them with reusable packaging similar to V-EMB. When the packaging has been sent out to dealers, the rental company collects the packaging from the dealers, and CDC Incheon can reuse it. However, they still use V-EMB for RDCs or

dealers that have a contract with V-EMB, but the amount of V-EMB used is lower than the packaging provided by the rental company. Further, for one-way packaging, they are using one supplier for wooden packaging, and another one for cardboard packaging. To not occupy space, CDC Incheon has minimal stock in their own DC. Each day, they start with one day's inventory, as mentioned by Respondent 1 *"We keep a minimum stock in our warehouse because we want to free up warehouse space."*

Transport packaging

For transport packaging, they are using cardboard boxes and wooden cages. The rental company has a product sheet where the specifications for all materials are stated, however, CDC Incheon has not yet received it. For the one-way packaging, they have a product sheet. It is not necessary for the transport packaging to be branded, however, they try to always brand it. The cardboard boxes are always branded, while all wooden boxes are not.

Quality

The packaging used is standardized, and very stable and strong. Due to this, it is highlighted that damages do not often occur. However, if damage occurs, the rental company will handle it as a discrepancy order. CDC Incheon measures quality by tracking claims from the dealers. To improve quality, they are communicating with the packaging suppliers.

Cost

CDC Incheon uses a standard cost structure and has contracts where the cost is based on the number of uses. The IPS Team is deciding the material price and chooses suppliers based on cost and quality. When measuring cost, they consider the savings in packaging cost. Due to the cost of having their own return system using V-EMB, they have chosen to use a rental company that handles this system, and in some cases one-way packaging.

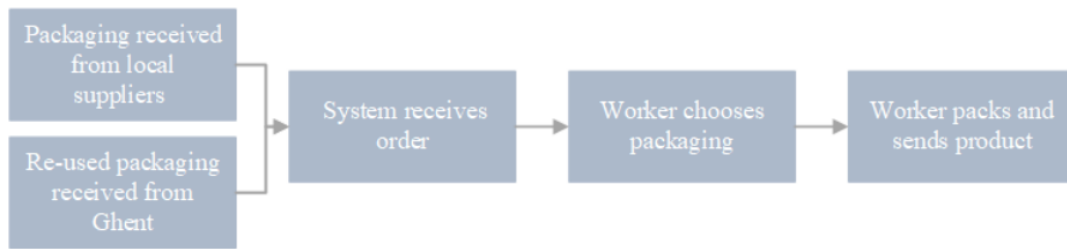
Sustainability

They are affected by the strong global requirement within Volvo Group to consider sustainability and are following the Korean environmental regulations. The implemented return system, using a rental company, is better for the environment as the packaging is reused about ten times, instead of using only one-way packaging. Sustainability is not measured by CDC Incheon, as mentioned by Respondent 1 *"Frankly speaking, we don't have a packing material KPI for sustainability. We only consider the cost-saving for the packaging material."*

5.2.6 RDC Bangalore

RDC Bangalore has a standardized outbound packaging process that has been influenced by other DCs as a result of the manager's previous work experiences. In their decisions regarding one-way packaging, RDC Bangalore prioritizes quality first, followed by cost and sustainability. An illustration of RDC Bangalore's outbound process is presented in Figure 5.14.

Figure 5.14: Illustration of RDC Bangalore's outbound transport packaging process.



Supply process

RDC Bangalore is only working with local suppliers. They have two suppliers for cardboard boxes and keep wood in-house to construct wooden crates themselves. All suppliers have been approved by Volvo Group and are contracted to the DC. RDC Bangalore has all transport packaging in stock in-house. When the DC places an order, the supplier will deliver within three to five days.

Transport packaging

Cardboard boxes and wooden crates are used as one-way packaging, with the packaging always being branded. Not branding would lead to discrepancies as the workers cannot identify the product within the box. Furthermore, RDC Bangalore has product sheets for all transport packaging, however, there is uncertainty as to what information is included, as mentioned by Respondent 1 “*There is a lot of information included in the product sheet, although I have not gone into detail. At the time of contract, our IPS manager will ensure that all criteria are fulfilled.*”

Quality

RDC Bangalore has daily quality meetings discussing claims and the reasons for these claims. In addition to this, they do quality checks when receiving packaging material from suppliers and have quarterly meetings with dealers to discuss problems. Further, the number of claims is used as a quality measure. A disadvantage highlighted with the one-way packaging is the fact that it cannot hold weight as well as V-EMB. This has caused problems with the handling of the packaging, as it can result in damaged products. However, this is something that RDC Bangalore is working to improve by having full truckloads, and consolidating and sending packages using milk runs. They do not want to increase the use of one-way packaging

in the future as V-EMB is contributing to better quality. However, to decrease the one-way packaging used they would need to secure a good dealer network that enables them to get the V-EMB back, which they do not have today, as mentioned by Respondent 1 *“If we have a functioning dealer network we prefer to use V-EMB, as the packaging is better protected. However, when we do not have an agreement with the dealer, and they do not send the V-EMB back to us, additional costs arise that no one wants to bear.”*

Cost

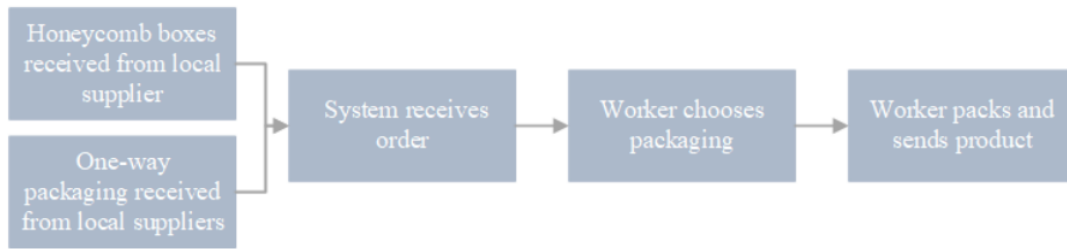
In RDC Bangalore, it is the Business Controller, Operations Manager, and IPS Team that are involved in calculating costs. Therefore, no answer to what specific costs are included when calculating it was provided by the respondent. However, RDC Bangalore studies the costs that have occurred and uses them to make decisions regarding for example quality. For instance, when making decisions on paying a higher price for transport packaging they can lower the costs related to quality issues, which in the end results in a lower total cost. Further, they set monthly targets and try to identify what improvements can be made to reduce costs.

Sustainability

The packaging from suppliers has labels ensuring that they are made from recycled material. Furthermore, RDC Bangalore is working to reuse the packaging received from CDC Ghent every week, as a way of minimizing waste and lowering costs. The packaging received from CDC Ghent makes up approximately 20% of the one-way packaging used. Moreover, sustainability is measured in terms of energy, CO_2 emissions, and waste. To reduce CO_2 emissions, the DC consolidates shipments for all dealers, rather than sending shipments every day. Lastly, social sustainability is taken into consideration. However, the packaging has not been adapted to improve the ergonomics of the workers. Rather, new tools and equipment have been implemented to handle unergonomic packaging.

5.2.7 RDC Dubai

RDC Dubai has a standardized outbound packaging process. They prioritize quality first, followed by an equal prioritization of cost and sustainability. The reason for prioritizing quality is related to their primary goal of delivering qualitative parts at the right time. An illustration of CDC Dubai's outbound process is presented in Figure 5.15.

Figure 5.15: Illustration of RDC Dubai’s outbound transport packaging process.

Supply process

For the honeycomb boxes, RDC Dubai uses one supplier which is local, located in Dubai. This supplier has been selected because it is the only supplier in the country producing honeycomb boxes. For cardboard boxes, they use multiple suppliers. Regarding safety stock, they keep inventory for two weeks in the distribution center.

Transport packaging

RDC Dubai is using honeycomb boxes and small cardboard boxes as transport packaging. They have chosen to replace V-EMB with honeycomb boxes whenever possible and have a product sheet where the features of all packaging are specified. To remain flexible and minimize inventory, they are using brand-neutral packaging which has been accepted by all dealers, as mentioned by Respondent 1 “*When branding, we lose our flexibility. First of all, we need to have inventory for each brand, which is an additional cost. Second, if one box goes out of stock we do not have the flexibility to use a box of another brand. So from the beginning, we decided not to brand our packaging, which is well accepted by the dealers.*” The honeycomb boxes are suitable for the dry climate in Dubai and the respondent is uncertain whether the boxes can withstand a more humid climate. It is highlighted that they, in case of a humid climate, could be in need of plastic wrapping.

Quality

When receiving packages from the supplier, random quality checks are made to ensure that the packaging is intact and strong enough. When having larger problems in the past, they have invited the suppliers to the facility to do some tests and come up with a solution. RDC Dubai also collects feedback from random dealers, asking them to take photographs and provide feedback on the quality of the shipments received. They measure quality in the number of claims.

Cost

When calculating costs, RDC Dubai considers purchasing price plus the savings related to lower transport weight. When implementing the honeycomb boxes, freight cost was one of the main drivers. Freight cost is a major factor in RDC Dubai’s

cost structure, and by using honeycomb boxes weighing 40 kg less than V-EMB, they can reduce it. Further, they have reduced costs by not using a return system where return freight needs to be paid, and where packaging might get lost and not returned. They have through this business case measured the packaging cost of honeycomb boxes compared to V-EMB and had a positive business case for honeycomb boxes. Moreover, by not branding the packaging, they reduce inventory costs by not having to store packaging for each specific brand.

Sustainability

Today, RDC Dubai is not reusing the packaging sent to dealers, however, they know that many of the dealers are reusing the packaging. They are studying the possibility to implement a return process for honeycomb boxes from local dealers. Regarding social sustainability, the ergonomics and safety of the employees were one of the reasons for implementing honeycomb boxes as they weigh about 40 kg less than V-EMB and do not have as sharp edges that can cut the employees' fingers. Further, the honeycomb boxes have separate sleeves and bases, which minimizes the need to bend or stretch when packing them. Social sustainability is measured through a health survey which is sent out to the employees twice a year. Environmental sustainability is not measured.

5.3 Benchmarking

The findings from the benchmarking interview are presented in the following section. The section begins by introducing the distribution system for transport packaging, followed by the transport packaging used at Global AB. Finally, quality, cost, and sustainability requirements are presented as well as benefits and improvement points.

5.3.1 Distribution System

Global AB has two distribution flows for packaging. One is a returnable packaging pool, where the packaging is returned from the dealers and cleaned at the packaging pool facilities before being reused. The packaging pool system is regional, meaning that the reusable packaging is only sent within the different regions of the company. Thus, products that need to be sent across different regions or long distances within one region are always sent in one-way packaging. Global AB has chosen this setup due to difficulties getting the reusable packaging back when sending long-distance deliveries, and due to uneven distribution flows. Having an uneven distribution flow results in pool packaging being stuck for a long period of time, as the dealer must await the right number of products to send the packaging back. This is due to it not being allowed to send products using the pool packaging if the order does not exceed a certain volume, which would result in long lead times, diminishing the purpose of the returnable flow to be fast. Currently, very few dealers send deliveries exceeding the minimum volume of products required to use pool packaging, and calculations made by Global AB show that it is more cost-efficient to use one-way packaging in these cases.

5.3.2 Supply Process

The one-way packaging used by the company is all kept in stock in-house. However, the DCs have restrictions on how long they are allowed to stock the packaging and are not allowed to build buffers due to the company working according to the lean philosophy. Further, Global AB is working with multiple suppliers, with the different suppliers being located close to the manufacturing facilities in each region.

5.3.3 Transport Packaging

Global AB mainly uses cardboard as one-way packaging material, although wooden pallets and plastic boxes are used as well. The wooden pallets can be reused, but they are not bought with reusability in mind. Global AB has a product sheet for their outbound transport packaging and all one-way transport packaging is branded with the company name. Global AB has several different brands. However, all products from sub-brands are sent in transport packaging branded with the main company logo. This is because the main company is the one providing logistics services for all brands. Lastly, the respondents from Global AB do not see any actual benefits of branding the transport packaging as the primary packaging is already branded.

5.3.4 Quality, Cost, and Sustainability

All of the three criteria quality, cost, and sustainability are considered important, and Global AB cannot differentiate the three concepts. They highlight that each criterion affects the others, for example, bad quality might cause damage to the product, which is followed by unnecessary expenses and is not beneficial for the environment.

Quality

Global AB measures quality in terms of the number of claims received. However, they do not find this measure to be accurate, as it is very difficult to trace where in the distribution process the product has been damaged. Global AB highlights that the packaging often gets blamed for causing damage to the product, but that in reality, the damage might have been caused by the handling of the packaging. Damage may occur as it is loaded and unloaded several times during transit, or the product might have been damaged during production. Therefore, they do not find the number of claims to represent the quality of packaging. Instead, they now take the explanation of the damage into account as well. They want to know when the damage has occurred, and request pictures of the damage to properly measure the quality of the packages.

Cost

Global AB considers it more cost-efficient to use one-way packaging when having long-distance deliveries than to use their reusable packaging. Further, they have implemented a return flow for their one-way pallets. The one-way pallets are of

the same quality as the ones included in the packaging pool but have no weight limit, which the packaging pool pallets have. By implementing a return flow for the one-way pallets as well, the company has saved a lot of money. Further, they are working on re-designing their one-way packaging to better fit the measurements of a container, which will increase the fill rate and thereby also the cost of transport.

Sustainability

The best way for Global AB to positively affect the environment is by ensuring the product reaches the customer without damage. Last year, they implemented a KPI measuring CO_2 emissions, however, they have stopped using this KPI. It is highlighted that for a KPI to be useful, it must be measured regularly and it must be possible for the company to improve the KPI between the times of measuring it. Global AB measured sustainability on a monthly basis but found that they could not affect the KPI between the times of measurement, as they were working on projects to improve sustainability that had a longer time horizon than one month. Therefore, they have now implemented a KPI measuring the number of projects and initiatives affecting sustainability instead. These projects include both primary and transport packaging. Regarding social sustainability, Global AB has weight restrictions for their packaging and restrictions regarding how much weight one worker is allowed to lift. Further, their pallets have removable sides which reduce the need for the worker to bend over and work in an unergonomic position.

5.3.5 Benefits and Improvement Points

Global AB highlighted benefits such as their current packaging solutions being well functioning and integrated into the company's distribution flows. Another benefit mentioned is the reuse of standardized pallets from production, which has lowered the company's packaging costs. An area of improvement mentioned by Global AB is the design of their one-way packaging. They are currently in the process of changing their one-way packaging according to a so-called container footprint. A container footprint means that the packaging is adapted to the dimension of a container, which will allow for a higher fill rate during shipping. The new footprint is already implemented for the inbound flow, and implementation for the outbound flow would allow for more collaboration between the inbound and outbound distribution, as the packaging received in the inbound flow can be reused for the outbound flow.

6

Analysis

In the following chapter, the result from the As-Is analyses and the benchmarking are analyzed. First, the supply process and transport packaging will be analyzed. Following that, quality, cost, and sustainability, and finally a benchmarking analysis will be presented.

6.1 Supply Process

A difference identified between the DCs' supply processes is whether to outsource the one-way packaging stock or to keep it in-house. A majority of the DCs keep the one-way packaging stock in-house, however, the stock levels differ between the DCs. Having the packaging in stock in-house could decrease the need for local suppliers with fast deliveries and high delivery accuracy. Further, as the DCs keeping the packaging stock in-house store larger packaging volumes, it is possible to purchase larger quantities from global suppliers, that in general have longer lead times but lower purchasing prices (Van Weele, 2018). Two DCs keep their packaging stock at their suppliers' facilities. Van Weele (2018) describes situations similar to the one of the two DCs as outsourcing, as the DCs let a third party keep the stock. The author argues that there are different reasons for outsourcing that can be either tactical or strategical. It is highlighted in the interviews that the main reasons for choosing this setup are tactical, as they aim to lower costs by freeing warehouse space. Further, to be able to outsource successfully, Van Weele (2018) describes a need for collaboration and a partnership. Both DCs that outsource have daily contact with their suppliers and work with the suppliers to develop new packaging solutions, which indicates that the relationship could be collaborative. Furthermore, a benefit of outsourcing the packaging stock is the reduced risk of a bullwhip effect due to the DCs and suppliers continuously sharing information with one another (Disney & Towell, 2003). However, outsourcing also makes the DCs more dependent on the suppliers, as discussed by Van Weele (2018).

Another difference identified is the location of the suppliers in relation to the DCs. The suppliers can be either local or global. In this study, global refers to all suppliers located outside the country in which the DC is located. Van Weele (2018) points out several reasons for using either local or global suppliers. He argues that local suppliers are preferred when flexibility and high delivery precision are needed, or when personal communication with the supplier is required. DCs keeping their packaging stock at the supplier's facilities use local suppliers, which assumably is related to the

need for flexibility and delivery precision as well as continuous communication with the suppliers. Further, the DCs having low in-house stock levels are also in need of high delivery precision, as low delivery precision is followed by longer lead times and increased costs. Van Weele (2018) argues that global suppliers are preferred when procuring standardized products in large quantities and when the prices of the local suppliers are significantly higher than the ones of global suppliers. The DCs using global suppliers all keep their packaging stock in-house, and one of them is keeping a safety stock of about two weeks. Thus, they are presumably purchasing larger quantities than the DCs having smaller safety stocks.

A final similarity identified for the supply processes is the number of suppliers used. A majority of the DCs have a limited number of suppliers, with most having one supplier for cardboard packaging and one for wooden packaging. According to Van Weele (2018), the benefits of having a small supplier base are related to lower transaction costs and the possibility of allocating time to each supplier to increase collaboration. In the interviews, collaboration is highlighted as important when developing new packaging solutions, which according to the statements of Van Weele (2018), would have been difficult with a more extensive supplier base. However, a drawback highlighted is the increased dependency on the supplier used, which Van Weele (2018) argues can be reduced by increasing the supplier base.

6.2 Transport Packaging

The most commonly used packaging material in the studied DCs is cardboard, which confirms the statement by Paine (1991) that it is one of the primary materials used for packaging. Kirwan (2013) discusses cardboard being cost-efficient, and Paine (1991) states that cardboard material is beneficial for the environment compared to other packaging materials, which is confirmed by the answers received in the interviews. Following cardboard, wood is the most common material used for packaging at the DCs. Paine (1991) claims that wood, in addition to cardboard, is one of the most significant materials used for transport packaging. Some of the DCs are, in addition to using pure wooden packaging, using wood to increase the durability of their cardboard packaging, which is in line with Paine's (1991) descriptions of the benefits of wood as a material. Finally, plastic is the least used material at the DCs. Some DCs emphasize that plastic material is not as environmentally friendly as the other materials and that sustainable plastic is too expensive compared to wood or cardboard. Emblem (2012) argues that due to plastic being more expensive than cardboard and wood, it is often limited to returnable flows, which might explain why it is not preferred as a one-way material by the DCs.

Regarding the branding of the transport packaging, there is an equal division between the number of DCs that brand, and the number of DCs that do not brand their packaging. The reasons highlighted for branding the packaging are the customers demanding it and maintaining a strong brand. Gronlund (2013) highlights the brand's importance to a company's growth and customer loyalty, which is in line with the arguments provided in the interviews. The DCs that do not brand

their transport packaging highlight reasons such as increased flexibility and reduced packaging stock levels as they do not need to keep separate packaging stocks for the different brands. Further, they argue that the product is already packed in primary packaging which is branded. Therefore, they consider the benefits of branding to be achieved without branding the transport packaging. This is in line with the study by Hellström & Saghir (2007), who argue that primary packaging considers marketing demands, while the main purpose of tertiary packaging is to be used when transporting the product.

6.3 Quality, Cost, and Sustainability

The results from the interviews indicate that most of the DCs have regular meetings to discuss quality. These meetings vary between internal meetings and external meetings with suppliers and dealers. The meetings can be either proactive, where the aim is to prevent future quality issues, or reactive, where the aim is to solve current quality issues. This can be viewed as the DCs relating the quality of the packaging to customer satisfaction, which is in line with the study of Löfgren & Witell (2005). Further, the way the DCs currently work with quality is assumed to be essential in fulfilling the purpose of packaging, as described by Pålsson (2018).

Regarding cost, a majority of the DCs are using standardized packages, which is highlighted by Pålsson (2018) as a means of achieving lower logistics costs. Found & Rich (2007) argue that packaging is not a high-value item and therefore does not have a direct economic value. However, the strategic value of packaging is high, as a shortage of packaging could result in problems downstream in the supply chain. This problem is considered by the DCs, which highlight the importance of high inbound delivery precision. Further, some DCs point out that the quality of the packaging is highly related to the cost, as low-cost packaging can cause a decline in quality, which can result in the product getting damaged. A damaged product incurs additional costs to the company since they in those cases receive claims, and need to send new products to the customers.

The final criterion is sustainability, which is not as prioritized as quality and cost by the DCs in this study. According to the Packaging Waste Directive which was published in 1994 (European Commission, n.d.) all companies within the European Union have a producer responsibility towards their packaging. Thus, one of the aims of the Packaging Waste Directive is to reduce waste by reusing, recycling, or recovering packaging. Many of the DCs highlight that they are reusing packaging, and some are purchasing packaging made of recycled materials, which, according to the directive, will help to reduce packaging waste. Furthermore, most DCs use one type of material for each packaging, which Pålsson (2018) argues can facilitate the recycling of the packaging. However, there are exceptions, with some DCs wanting to improve sustainability by redesigning their wooden pallets into pallets made of wood and cardboard, as they consider cardboard to be more sustainable. According to Pålsson (2018), this will result in difficulties in the recycling process, as the materials need to be separated to be recycled. Finally, García et al. (2017) argue

that a higher quality of the packaging material can minimize losses, and thereby lower the environmental impact. However, Pålsson (2018) argues that a balance needs to be found between a high packaging quality where a lot of material is required to keep the product safe, and a lower quality where less material is needed but there is a risk of the product being damaged.

6.4 Benchmarking

By comparing Global AB with the DCs, three gaps between the way of working at Volvo Group and the way of working at Global AB are identified. These gaps are presented one by one in the following order: distribution system, branding and quality, cost, and sustainability.

6.4.1 Distribution System

One of the identified gaps concerns when to use one-way packaging. At Global AB, one-way packaging is used when products need to be sent long distances, or when the possibility of getting the packaging back is limited. This means that one-way packaging will be used when sending a product across different regions, for example when sending a product from Europe to Asia. Thus, the returnable packaging used at Global AB is only used within the different regions, and not across them. Volvo Group on the other hand has a global system for their returnable packaging and uses it even when sending long-distance deliveries. However, similar to Global AB, Volvo Group prefers one-way packaging if there are difficulties for the customer to return the packaging. Further, respondents from Global AB argue that even if it is possible to use returnable packaging globally, the lead time of the packaging will increase to such an extent that it will counteract the desired lead time. Twede & Clarke (2008) argue that a return flow for packaging is suitable when having short transport distances as well as lead times, thus, Global AB fulfills the arguments for using returnable packaging while Volvo Group does not. Further, Global AB argues that it would not be sustainable for them to have a global return system, as the flow of products is uneven, due to different customer demands, and they would need to return empty packaging. However, Coelho et al. (2020) argue that in general, reusable packaging has a lower environmental impact than one-way packaging when considering the production of the one-way packaging and the impact caused by transport. Finally, both Volvo Group and Global AB argue for it being too expensive to set up a return flow for all dealers.

6.4.2 Branding

A second gap identified is the branding of the packaging. Global AB brands all of its one-way packaging. However, all of their packaging is branded with the name of the main brand, even the packages used for the sub-brands. Volvo Group on the other hand has taken another approach, and the DCs that do brand their one-way packaging always do it according to which brand is being sent, this means that the sub-brands are not branded Volvo Group. Rao et al. (2004) argue that

a brand can create financial value through customer loyalty and a strong brand. Therefore, Global AB's choice to not brand according to the sub-brands could affect the brands negatively in the long term. Further, this could lead to a decrease in quality, as Löfgren & Witell (2005) argue for aesthetics being a subjective dimension of quality, affecting how a customer may evaluate the quality of a product. However, as highlighted by some DCs, branding the packaging with different labels would result in an increase in warehouse utilization as packaging stock for multiple brands would be needed, which can lower cost-efficiency and contribute to increased logistics cost (Pålsson, 2018).

6.4.3 Quality, Cost, and Sustainability

The final gap regards how Volvo Group and Global AB are working with quality and sustainability. The DCs at Volvo Group measure quality in the number of claims. Global AB has a similar solution, however, they do not find this measure reliable as it does not specify where in the distribution process the damage has occurred. Therefore, they do not consider this measure when evaluating the quality of the packaging. In comparison, the DCs within Volvo Group use this measure in their quality improvement work. Löfgren & Witell (2005) argue that not having a measure for quality could be damaging to the company as it could lead to higher costs. However, they do not mention what type of measure to implement. Further, Global AB does not measure sustainability as they have not found an effective way of measuring it. They measured it previously but have stopped due to it not being possible for them to affect sustainability in their day-to-day work, and instead, have chosen to work with long-term sustainability projects. This contradicts the statements by Pålsson & Hellström (2016) who argue for packaging having significant potential to reduce the carbon emissions caused by the supply chain. Many of Volvo Group's DCs did measure sustainability in terms of CO_2 emissions from the packaging or the number of reused one-way packages. These are both ways of measuring sustainability in the day-to-day work.

7

Discussion

In this chapter, three themes that provide insight into the outbound packaging processes at the studied DCs and that will help answer the research questions will be discussed. The themes identified are external contextual factors, internal contextual factors, and quality, cost, and sustainability.

7.1 External Contextual Factors

The global supply chain is currently dealing with disruptions as a consequence of the Covid-19 pandemic and is experiencing longer lead times and lower delivery accuracy. Hence, complications in the global distribution are believed to continue and worsen in the years to come, which would negatively affect Volvo Group's distribution systems and SML's outbound packaging processes. To deal with these disruptions the DCs' could increase their supplier bases, to compensate for the increased lead times and decreased delivery accuracy. By doing so, the DCs could become less vulnerable, as they would have more suppliers to ensure packaging is delivered in time and in the right quantity. Further, by increasing their supplier bases the DCs' dependency on their current packaging suppliers could be lowered and their bargaining power increased and hence, contributing to lower packaging costs, as the purchasing team can bargain for better deals with regard to cost. However, consequences of a large supplier base could be increased transaction costs and transparency control issues. The DCs would have to invest more resources to ensure ethical principles are followed at each supplier, as ethical labor issues might lead to bad publicity and a loss in revenue. Moreover, the increased transaction costs might still be less damaging for the company and generate less costs than if the company starts to experience packaging shortages due to having few suppliers. If the DCs experience packaging shortages the consequences might be products not being delivered in time, or higher transport costs due to express shipments, which in the end might result in lost customers. This indicates that even though packaging does not have a direct economic value, it has a strategic value and is important for Volvo Group to prioritize. However, challenges with having a large supplier base could be a decrease in security as the DC would become a smaller customer to the supplier, which could result in the DC not being prioritized if there were to be a shortage of packaging. This could lead to the DC needing to go to other suppliers which could have a higher price and longer lead times, resulting in an overall higher indirect cost. Moreover, the current war in Ukraine has also affected the supply chains and could also contribute to longer lead times in the near future. Thus, it is also a factor that

should be considered when the DCs decide on their supplier strategies.

Furthermore, the DCs are located all around the world on different continents and countries and are therefore affected by climatic differences. For example, RDC Dubai is located in a dry and warm climate, while CDC Byhalia is located in a humid and warm climate. This results in the honeycomb boxes used in RDC Dubai not being suitable for CDC Byhalia, as the material does not withstand moisture. Further, the transport climate is rougher in the USA, resulting in packaging needing to be more robust. This makes the honeycomb boxes inappropriate as cardboard is more sensitive than wooden material. However, it is highlighted by RDC Dubai that honeycomb boxes can be used in other climates as well if they are wrapped in plastic, which would protect the packaging from moisture. On the other hand, this is assumed to increase packaging costs as more material would be needed, and it could also affect the sustainability and recyclability of the packaging negatively as two different materials would be needed. Therefore, it can be assumed to be reasonable that different packaging is used at DCs experiencing different climates. However, if two DCs are located in similar environments they could benefit from having similar packaging solutions if connected in the same distribution network.

Finally, the location of the dealers in relation to the DCs is also believed to affect the packaging process. For example, in CDC Incheon, a majority of the dealers are located within the country which results in the dealers all being located in proximity to the DC, as South Korea is a relatively small country. This enables the DC to use a rental company to handle their returnable packaging to reduce costs as they do not need to manage the return flow and activities such as cleaning or collecting the packaging themselves. However, a returnable system like this could be difficult to implement in other DCs. CDC Ghent, for example, is also located in a relatively small country, however, its customers are spread out all around the world, making it difficult to use a rental company. This would make it necessary for the rental company to be present all around the world in the same countries as the DC's dealers, which could reduce the cost-benefit of using a rental company. Moreover, CDC Curitiba and CDC Byhalia are both located in large countries geographically. This means that even if their dealers are located within the same country as the DC, the geographical distance might be large, making it difficult to use a rental company to save money. Therefore, it is assumed that the setup with a rental company is not suitable for the other DCs studied.

7.2 Internal Contextual Factors

In addition to the external contextual factors, two internal contextual factors affecting the design of the outbound packaging processes have been identified. The first internal contextual factor that is believed to affect the packaging processes is the number of brands kept in stock at the DCs. Some of the DCs have multiple brands in stock, while other DCs are limited to a few brands. For the DCs handling a large number of brands, brand-neutral packaging is assumed to be beneficial as it can de-

crease stock levels as the same transport packaging can be used for all brands, rather than keeping packaging stocks for each of the different brands. Reducing stock levels can lower costs as inventory costs will get lower, and it also makes it possible to build future distribution centers smaller as less space is needed for packaging inventory. This would occupy less land area and could thereby increase biodiversity and affect the local environment positively. Further, many of the DCs reuse the packaging received from CDC Ghent. This reuse is assumed to benefit from brand-neutral branding as it allows the DCs to reuse the packaging for any of their brands, and not only for the specific brand printed on the transport packaging. This would affect cost positively as the DCs would not be in need of purchasing as much new packaging. However, brand-neutral packaging might have a negative effect on marketing and customer satisfaction. CDC Curitiba, for instance, highlights that branding is important to their South American customers, and CDC Lyon argues that the Renault Trucks branding is important to their customers. Therefore, it can be assumed that brand-neutral packaging might affect the customers' perceived quality of the products negatively. On the other hand, the commercial packaging at Volvo Group is always branded according to the different brands. Hence, it is possible to assume that the primary packaging fulfills customer demand, making the branding of the transport packaging unnecessary.

The second internal contextual factor affecting the outbound packaging process is the distribution system for the returnable packaging, V-EMB, which affects the distribution system for one-way packaging. Global AB and Volvo Group have chosen different distribution systems for their reusable packaging solutions. Global AB uses a regional system, while Volvo Group uses a global system for their returnable packaging. The benefits of having a regional packaging pool could be a lower cost due to the packaging being sent shorter distances, resulting in lower transport costs and lower packaging costs. This is due to the shorter distances allowing for faster circulation of packaging, and therefore, less packaging may be needed in the packaging pool. Further, only having a regional system could result in better control of the packaging flows as the dealers are located closer to the DCs, which makes it easier to get an overview of the distribution system and facilitates contact with the dealers. On the other hand, a benefit of implementing a global packaging system is the facilitation of transporting packaging between different regions, allowing for a more united flow. However, the need for packaging is assumed to vary between different regions, which means that shortages might occur in certain regions when having a global packaging system. In those cases, one-way packaging might be used instead, which would create an overall higher cost as there is a need for more reusable packaging as well as one-way packaging compared to a regional packaging system, where the reusable packaging does not get stuck in a region. Further, the setup of a global system for reusable packaging most likely requires more resources to manage, and it might therefore not be cost-efficient.

7.3 Quality, Cost, and Sustainability

The third theme regards the three criteria quality, cost, and sustainability, and the trade-offs between each of the criteria. To begin, it is possible to tell that most of the DCs seem to be working quite similarly with quality, cost, and sustainability. Most of the DCs prioritized quality above cost and sustainability. From the survey, the prioritization was rather equal between the three criteria, however, in the interviews, the result shifted. Many of the DCs first highlighted that they prioritize sustainability, but when answering questions regarding their packaging processes, quality and cost appeared to be considered more important than sustainability. Some DCs, such as CDC Lyon, pointed out that sustainability was chosen in the survey due to personal opinions, rather than the DC actually prioritizing it. The reason for the DCs pointing out that sustainability is important is assumed to be related to the fact that Volvo Group has set ambitious goals of becoming more sustainable in the future. The DCs might therefore know that they are supposed to improve this and are therefore answering sustainability. However, all of the DCs considered sustainability even if it was not prioritized. For example, they discussed the reusability and recyclability of their transport packaging, and some measured sustainability as well. One future goal of Volvo Group, related to sustainability, which very few of the DCs have implemented yet, is product sheets. The product sheets that the DCs have today do not contain all the necessary information. To cope with future regulations on sustainability, Volvo Group must be able to provide details on which types of materials they are using in their packaging. Therefore, they wish to implement product sheets in the future. However, as the information regarding what to be included in the product sheet seems to be unclear for the DCs, the management needs to set clear guidelines and timeframes for the DCs to be able to allocate time and create product sheets that fulfill the future EU regulations.

Finally, regarding sustainability, it would be reasonable for DCs located in European and North American countries to prioritize sustainability more than DCs located in other regions, due to countries within Europe and North America working proactively with sustainability questions. However, this was not reflected in the result, for example, CDC Ghent and CDC Byhalia did not focus on sustainability. On the other hand, RDC Bangalore is, when studying the result, assumed to be the DC working the most with sustainability. The reason for this could be explained by the size of the DC, as it can be assumed to be easier to implement new changes at smaller DCs compared to larger ones. Furthermore, many of the smaller DCs reuse packaging from CDC Ghent, making it easier for them to facilitate sustainability work.

Regarding quality, which is the most prioritized criterion, the DCs work similarly. They have regular meetings, internal as well as external with suppliers and dealers, to discuss quality issues. Further, a majority of the DCs measure the number of claims received. These regular meetings are assumed to take advantage of the fact that most of the DCs use local suppliers. Having local suppliers or local dealers is assumed to benefit communication as it mitigates issues that could arise due to

different time zones, geographical distances, cultural differences, or language barriers. Therefore, in general, the way the DCs are currently working with suppliers and quality is assumed to positively affect their performance. However, the quality performance might depend on what is being discussed in the meetings. Working reactively and discussing quality issues that have already occurred might reduce the risk of the same problem occurring once again, however, working proactively and collaborating on reducing the risk of future problems that have not yet occurred is assumed to have even greater potential.

Similar to quality, the DCs are working similarly with their cost performance. When purchasing packaging, most of the DCs pointed out that quality is related to cost. In the interviews, it was highlighted that if the quality is poor, the packaging might get damaged resulting in a broken product as well. In these cases, the company needs to send a new product to the customer, resulting in a higher total cost for the company, as well as an increased environmental impact as a new product needs to be sent. By increasing the quality of the packaging, the purchasing price of the packaging might get higher and a larger environmental impact might occur during the pre-production and production phase as more raw material is needed, nonetheless, in turn the total costs and environmental impact will likely decrease as there will be no additional shipments due to damages. However, a balance must be found as there is no need for the packaging to be of too good quality as it makes it unnecessarily expensive and not sustainable, contradicting the previous argument. Thus, it is assumed that the DCs are not only working on cost performance by simply getting the lowest purchasing price. On the other hand, they are also working on their cost requirements by considering in which situations it is suitable to use V-EMB or one-way packaging. The most common reason for not using V-EMB was when they did not have a dealer network to receive it back, or when it is not economically beneficial due to for instance order sizes. This affects cost performance positively as reusable packaging is more expensive to purchase than one-way packaging, which means that V-EMB that is not received back from the dealers causes a lot of unnecessary costs, compared to sending them one-way packaging instead.

8

Conclusion

The aim of this thesis was to identify a favorable outbound packaging process at Volvo Group, with regard to quality, cost, and sustainability, when V-EMB is not used. This included identifying how the outbound packaging processes at selected DCs differ from each other, and what challenges and opportunities that can be identified. Further, it included identifying how these packaging processes affect quality, cost, and sustainability requirements.

The findings of the thesis indicate that the DCs studied have similar outbound transport packaging processes regarding what packaging materials they use, how many suppliers they have, and their purchasing and handling processes, when using cardboard, wood, and plastic material. However, two areas have been identified where the DCs differ from each other. The first area is the supply process, where some DCs keep the transport packaging in stock in-house, while other DCs outsource their transport packaging stock to a supplier. According to literature, a challenge of keeping the packaging stock in-house is the increased inventory cost, while a challenge related to outsourcing the packaging stock to a supplier is the increased dependency on the supplier. Opportunities related to keeping the packaging stock in-house are the reduced need of using only local suppliers and the suppliers constantly having a high delivery precision. On the other hand, opportunities of outsourcing the packaging stock are the possibility of increased collaboration with the supplier to develop new packaging and manage inventory, as well as the reduced risk of a bullwhip effect as information on stock levels is shared with the suppliers.

The second area of difference regards transport packaging, with some DCs branding all one-way transport packaging, and other DCs branding some, or none of their one-way transport packaging. A challenge with branding all one-way packaging is the decreased flexibility as the same packaging cannot be used for different brands, while challenges related to not branding is the risk of decreased customer satisfaction. However, an opportunity for brand-neutral packaging is cost reductions, as separate packaging does not need to be used for each brand. An opportunity related to branded packaging is the perceived quality of the customers increasing, and the company's brand being strengthened.

Furthermore, the findings indicate that different parts of the packaging processes identified at the DCs affect quality, cost, and sustainability requirements positively. Quality is affected positively by most of the packaging processes including regular meetings, internal as well as external, to discuss quality. These meetings are

facilitated by a majority of the DCs using a few local suppliers, which enables communication between the DC and the supplier. Thus, Volvo Group's requirement of having a low number of damaged parts can be assumed to be achieved from the packaging processes identified. From a cost perspective, the packaging processes identified are beneficial, as they only use one-way packaging when they do not have a dealer network to return V-EMB, or when it is not economically beneficial to use V-EMB due to for example order size. Furthermore, plastic is the least common material used for one-way packaging by the DCs, which is beneficial from a cost as well as sustainability perspective, as cardboard and wood are considered better options. Finally, from a sustainability point of view, many of the packaging processes identified reuse one-way packaging received from CDC Ghent which is good as one of the sustainability requirements of Volvo Group is to reuse packaging. In addition to this, the use of local suppliers is beneficial as it shortens transportation distances. Thus, overall, the outbound packaging processes identified at the DCs affect the quality, cost, and sustainability requirements set by Volvo Group positively, but there are possible improvements to be made at each one of them.

8.1 Practical Contribution

This research has contributed to an improved understanding of how DCs are currently working with one-way packaging, and how the outbound packaging processes affect quality, cost, and sustainability requirements. This is of relevance for companies in general, and Volvo Group specifically, to identify improved ways of working with regard to quality, cost, and sustainability, and realizing which trade-offs that are needed to be made between the three criteria. The result indicates that overall, the DCs studied work similarly to each other, with minor differences depending on contextual factors such as the size or location of the DC. These contextual factors imply that a completely standardized process across the DCs might be difficult to implement, and will not benefit quality, cost, and sustainability requirements. However, increased collaboration between the DCs could benefit the impact on the requirements. As the DCs within Volvo Group have not previously collaborated or shared information on how they are working with each other, improvements can be made by collaboration between the DCs rather than having a silo mentality.

8.2 Recommendations

To continue developing the outbound packaging processes implemented within Volvo Group, a number of recommendations and suggestions for future research are identified. First, as the result of this study might not represent all DCs, the company is recommended to continue studying the packaging processes at the rest of the DCs as well. This is to get a better picture of what all processes look like in order to identify all relevant challenges and opportunities. Second, a more detailed mapping of each DC is recommended to get input from multiple sources within the DC. Further, a third recommendation is to facilitate for the DCs to share information and ideas, and collaborate on improving the outbound packaging processes. Additionally, as a

fourth recommendation, the company is recommended to help the DCs in creating product sheets for their one-way packaging and to set standards for what to be included in the product sheets. Currently, some DCs have product sheets, but they are not standardized, and everyone does not have access to them. Finally, a fifth recommendation is to implement measurements for sustainability at the DCs and to help them in working more sustainably. Volvo Group has set goals of becoming more sustainable which is well known at the DCs, but they do not know how to achieve this or how to measure their sustainability impact. This area includes aspects such as using as few different types of material as possible for each packaging or implementing measurements such as CO_2 emissions or the number of reused packages.

Suggestions for future research include areas such as vendor-managed inventory and branding. These topics are briefly studied in this thesis, but more in-depth studies are recommended to properly evaluate the benefits and drawbacks of the different strategies. Further, a suggestion is to investigate whether it is possible to have a higher level of standardization. It might not be suitable to have similar processes everywhere, nevertheless, a suggestion is to identify suitable aspects of the processes that can be standardized. It is also recommended to conduct further studies on what measurements are appropriate to use to measure quality, cost, and sustainability in an outbound process. Finally, a recommendation for future research at Volvo Group is to study the supplier strategies and evaluate if transactional or partnership relations are beneficial for each DC when looking at direct and indirect economic value.

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A

Appendix - Survey Template

General information

1. What distribution center are you located in? (If you represent more than one, the survey needs to be answered twice)

Questions regarding the outbound packaging process

1. When you are not using Volvo packaging (V-EMB), what packaging are you using instead? Please describe the alternative transport packaging, e.g. material, attributes etc., and attach photos to exemplify below (*Only consider packaging material made in cardboard, wood and plastic*).
2. Do you have a product sheet for each type of packaging material used, specifying the content of the material etc.?
3. How many different packaging types (not including V-EMB) do you have in your outbound process?
4. What is the most common reason for not using V-EMB in the outbound process?
5. Is the packaging material used in the outbound process branded in some way (Volvo, Renault Trucks, Mack Trucks etc)?
6. Please describe the process when V-EMB is not used and attach a simple photo/drawing/illustration to summarize the different decision points of the process, such as supplier selection, material selection etc. below.
7. Who is purchasing the packaging material?
8. Is the process standardized? (Meaning the same for all different transport packaging when V-EMB is not used)
 - (a) Yes
 - (b) No

A. Appendix - Survey Template

9. When purchasing transport packaging (not including V-EMB), which criteria is prioritized:
 - (a) Quality
 - (b) Cost
 - (c) Sustainability
 - (d) Other
10. What type of labels are attached to the packaging material in the outbound process? Please provide photos below.

B

Appendix - Interview Protocol and Additional Questions

General questions

1. Could you please tell us about yourself and your role and responsibilities within the company?
 - (a) What is your position/responsibility within the company? How long have you been working within the company?

Outbound packaging process

Material

1. Do you consider sustainable alternatives of the wood, plastic, and cardboard materials when purchasing?
 - (a) Do you consider the recyclability when choosing the material? If so, how?
2. What are the pros and cons of using the material (wood, plastic, cardboard) mentioned in the survey?
3. Have you gotten any feedback from dealers or transportation companies about the packaging used? If so, what?
 - (a) What has been the feedback regarding the chosen packaging material from workers at the DC?
4. How many percent of all deliveries are not using V-EMB, only considering cardboard, wood and plastic?
5. When not using V-EMB, how many percent off all shipments are delivered within 24h?

Product Sheet

6. Do you have a product sheet for the outbound transport packaging?
 - (a) If yes, what information is included in your product sheet?
 - (b) If yes, do you have a product sheet for each packaging material that is used in the outbound packaging process?
 - (c) If not, why do you not have a product sheet?

Branding

7. What is the reason for branding/not branding the outbound transport packaging? Pros/cons?
 - (a) How do you brand your outbound packaging?
 - (b) What would happen if you would start branding/not branding the products? (Quality, cost, sustainability?)

Quality

8. How does your team define packaging quality? What is considered good/bad quality?
9. How are you working with quality today?
10. What are your targets and guidelines regarding quality?
11. How do you measure quality? E.g. KPI?

Cost

12. How does your team define packaging cost? What costs are included?
13. How are you working with cost today?
14. What are your targets and guidelines regarding cost?
15. How do you measure cost? E.g. KPI?

Sustainability

16. How does your team define packaging sustainability??
17. How are you working with sustainability today?

18. What are your targets and guidelines regarding sustainability?
19. How do you measure sustainability? E.g. KPI?

All parameters

20. How do you balance quality, cost, and sustainability requirements?
21. Are there any trade-offs? If so, explain?
22. How do you deal with these trade-offs?
23. Why have you chosen to prioritize the chosen criteria?
24. Please exemplify how these criteria are used in the decision process?

Outbound process

25. In the survey you stated that the outbound packaging process when V-EMB is not used is standardized. Please describe this process?
26. Who is in charge and develops this process?
27. Do you have the material in stock?
28. How do you plan/purchase to be able to deliver within 24h?

C

Appendix - Interview Protocol for Benchmarking

General questions

1. Could you please tell us about yourself and your role and responsibilities within the company?
 - (a) What is your position/responsibility within the company?
 - (b) How long have you been working within the company?

Outbound packaging process

Material

1. What type of distribution system do you have for the packaging? Do you have a return flow of the material so it can be reused or do you use one-way material? Please explain.
2. What types of one-way packaging do you use? We are only interested in wood, cardboard and plastic material.
 - (a) Which one is most common? Why is this the most common?
 - (b) What are the pros and cons of using the material?
 - (c) Is the packaging you use reusable? Can the dealers reuse the packaging?
3. Is the packaging material branded? Why/why not?
4. Do you have product sheets?

Parameters

5. What do you prioritize: quality, cost or sustainability when purchasing packaging material?
 - (a) Why have you chosen to prioritize the criteria?

6. How do you balance quality, cost, and sustainability?
 - (a) Are there any trade-offs? If so, explain?
 - (b) How do you deal with these trade-offs?
7. Do you measure quality, cost, and sustainability somehow? E.g. KPI?
8. Do you regard social sustainability when purchasing packaging?
9. How do you work with packaging quality today?

Process

10. Could you please describe the outbound packaging process?
 - (a) Do you keep the material in stock?
 - (b) Do you have multiple suppliers for the packaging?
 - (c) Are the suppliers local?
 - (d) Why did you choose these suppliers?
 - (e) Are there any services included in the cost?
11. Is the outbound packaging process standardized at the different distribution centers?
12. What are the drawbacks with your current outbound packaging process? Are there any improvement points? (Only considering cardboard, wood and plastic transport packaging)
13. What are the benefits with your current outbound packaging process? (Only considering cardboard, wood and plastic transport packaging)

D

Appendix - Summary of Survey Answers

		Q1	Q2	Q3	Q4	Q5	Q6
RDC	Reno	Wood, plastic, cardboard	No	Small orders Dealers cannot return	Yes	Yes	Cost
RDC	Bangalore	Wood, plastic, cardboard	Yes	Dealers cannot return End-customers cannot return	Yes	Yes	Sustainability, Quality
RDC	Singapore	Wood, plastic, cardboard	No	Dealers cannot return	No	Yes	Quality, Cost
CDC	Curitiba	Wood, cardboard	No	Small orders Cannot send to end-customers	Yes	Yes	Cost
RDC	Dubai	Cardboard	No	Cost saving in freight and ergonomics	No	Yes	Quality
RDC	Buenos Aires	Cardboard	No	Dealers cannot return	No	No	Cost
RDC	Baltimore	Plastic, cardboard	No	Order size, volume and weight of part	Yes/No	Yes	Sustainability
RDC	Johannesburg	Cardboard	No	Dealers cannot return Order size, quantity and weight	Yes/No	No	Cost
CDC	Ghent	Wood, cardboard	No	Dealers cannot return Customers cannot return	Yes	Yes	Sustainability, Quality, Cost
CDC	Byhalia	Wood, plastic, cardboard	Yes	Small shipments Loss of VEMB	No	Yes	Sustainability
CDC	Lyon	Wood, cardboard	No	Not authorized to use V-EMB in Renault Trucks network	Yes	Yes	Sustainability
CDC	Incheon	Wood, plastic, cardboard	Yes	More efficient and economic than V-EMB Don't need to manage recycling of V-EMB themselves.	Yes/No	Yes	Quality
RDC	Chile/santiago	Wood, plastic, cardboard	No	X	Yes	Yes	Quality

Note: X = No answer.



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