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Assessing the Environmental Performance of a Consumer Health Supply Chain

Insights from one major firm in Europe

Master's thesis in the Master's Degree Programs Supply Chain Management and Quality and Operations Management

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SUMMARY
There is an increased pressure globally on organizations to engage in a sustainable future. With increasing number of freight transports and considering that logistics activities are some of the main sources of carbon emissions, the company LifeSci wants to reduce their negative environmental impact by optimizing their logistics activities. To investigate how actors in the consumer health industry can assess environmental performance and prioritize among improvement efforts, a case study was conducted in this thesis. The case study was focused on the product B-Ointment and its supply chain from Germany to Sweden. In order to approach an assessment of environmental performance, the so-called Environmental Performance Evaluation Framework was established based on the SCOR model. The framework also includes metrics that have been based on the most anticipated and highlighted areas within environmental sustainability in logistics activities; emissions, waste reduction, recycling and energy. The majority of literature have been found to cover mostly emissions, even though all areas are emphasized to be equally as important in order to reduce environmental impact from logistics activities on a global and overall level. The consumer health- and cosmetics industry is a fast-moving industry with a lot of actors and complex supply chains. As a result of complex supply chains, the transparency along the value chain is often compromised and therefore makes it difficult to visualize their actual environmental impact. For LifeSci and similar actors in the industry, it has been concluded that measurements are kept on a business general level without any connection to specific products or supply chains. Further, environmental efforts have been concluded to be carried out on a centralized level, which means that it might give a better overview of the efforts. However, it might also lead to inefficient or ineffective implementation of the efforts. In the consumer health- and cosmetics industry, cost is always a crucial factor, which has been found to also impact the amount of investments in improving environmental sustainability. For LifeSci, considering their centralized efforts and general level of measurements, further potential improvements have been suggested to reduce impact from their logistics activities. Environmental efforts connected to emissions have been concluded to be an improvement area, along with expanding their overall efforts with at least one of the other areas of waste reduction, recycling and energy.

Keywords: Environmental Sustainability, Sustainable Logistics, Environmental Performance Indicators, SCOR, Environmental Performance, Emissions, Waste, Recycling, Energy

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We are incredibly grateful to have gotten the opportunity to dig deeper into the subject of sustainability in supply chains, and for all the new things we have learned and experiences along the way.

Natalie Eriksson & Deniz Yordanov
Gothenburg, May 20

Table of Contents

1 Introduction

This chapter aims to introduce the project and will therefore start by introducing the background of this thesis. The background description will present general facts of the company, the cosmetics industry and environmental aspects of logistics activities. The background section will be followed by the master thesis's aim and research objectives. Lastly, the delimitations of the thesis will be discussed.

1.1 Background

With increased global attention towards sustainability and sustainability management (Galizia et al., 2016), the pressure for engagement from organizations in a sustainable future has increased as well (Kleindorfer et al., 2005). Specifically, there is a pressure of measuring the environmental footprints from activities that involve pollution, emissions, recycling, remanufacturing and reusing (Kleindorfer et al., 2005). There is also environmental legislation and regulation that needs to be considered and that serves as a driver for environmentally sustainable solutions (Green et al., 2012). Further, the continuous growth of global supply chains continues to increase the number of freight transports (Abbasi and Nilsson, 2012). In particular, logistics- and transportation activities are some of the main sources of carbon emission, but also have negative impact on pollution, noise and waste (Abbasi & Nilsson, 2012).

LifeSci is a well-established life science company that has been around for over 150 years with well-known products in all their four business segments of *consumer health*, *pharmaceutical*, *animal health* and *crop science*. They have globally dispersed production and distribution sites, which is why their supply chain has a significant impact on the environment. LifeSci considers environmental sustainability an important element in their daily business and wants to reduce their environmental impact by optimizing their logistics activities across the company. Specifically, the company wants to evaluate their environmental performance connected to logistics activities within their consumer health segment. However, Hervani et al. (2005) state that measuring environmental performance in supply chains with multiple actors can be difficult when it comes to attributing certain performance results to a specific activity or entity within the supply chain.

Gunasekaran et al. (2004) mention that environmental performance measurements are remarkably discussed in literature with some conceptual frameworks to evaluate the environmental performance. Still, the authors also mention that there is a lack of empirical research within this field. In later years, the literature and theory around environmental performance have been boosted with several types of research, reporting guidelines and initiatives for reduction of environmental impact. However, there are no clear directives on how to evaluate and address the environmental impact of the logistics activities in a supply chain within the consumer health industry. Instead, due to the dependence of the industry context, there are only suggestions of what might be relevant to consider in the evaluation of the environmental performance. Meaning, it can leave companies confused about which approach to take on.

LifeSci operates in over 130 countries and has a large brand portfolio with over 170 consumer brands in their consumer health segment, where each and one of the brands have several products in their respective product portfolio. Therefore, there is a difficulty to assess environmental impact connected to different supply chains and segments. However, the company has around 70 products that are strategically important on a global level, whereas one of them is the B-Ointment. As an attempt towards assessing their environmental impacts from logistics activities, the organization considers this product as a good representation of their supply chains and therefore want to evaluate the environmental impact from the supply chain of the B-Ointment.

1.1.1 LifeSci Company Overview

LifeSci is a well-established life science company with more than 150 years of experience and roughly a revenue of 43,545 million euro. The company's operating sites are distributed all over the world with approximately 117 000 employees working to develop and provide products for humans, animals and plants health. Their ambition is to increase human life quality by helping prevent, mitigating and curing different types of diseases.

LifeSci is divided into four different segments. Firstly, the pharmaceuticals segment includes prescription products. Secondly, the crop science segment includes solutions for pest and high-value seeds. Their third segment, animal health, includes products for both farm and companion animals. Their last company segment, consumer health, consists of non-prescription products, over-the-counter (OTC) and cosmetics products and will be the focus of this thesis. LifeSci's consumer health segment has a large product portfolio with products related to allergy, dermatology, nutritionals, cough and cold. In general, all these products could be purchased by end customers through online retailers, pharmacies or supermarkets.

LifeSci's consumer health segment has production sites, R&D locations and warehouses all over the world and the headquarter is located in Switzerland. Further, as stated before, B-Ointment is in focus of this master thesis. B-Ointment is offered to a large number of countries all over the world and is produced at the production site in Germany. Although, the scope of the study has been limited to only cover deliveries to Sweden. These limitations have been made since it is assumed that the supply chain from Germany to the end customers in Sweden represents a general supply chain of LifeSci's consumer health products. Further, the findings are believed to potentially be applied and relevant for other products and network combinations in LifeSci's supply chains as well.

LifeSci considers environmental sustainability as a necessary element for their long-term profitability. The company is therefore committed to the United Nations Sustainable Development Goals and have the aim to increase their efforts to meet for instance goal 13, which is to combat climate change and the company's environmental footprint (United Nations, 2020). To do so, they have recently implemented a strategic goal considering the environmental aspect. LifeSci's goal is to be carbon neutral by 2030 and hence need to reduce their greenhouse gas emissions. LifeSci's plan to achieve this goal is by e.g. implementing measures for their energy efficiency and optimizing their logistics activities. Furthermore, they also want to switch to electrical solutions which originate from 100 percent renewable energy but also compensate for their accounted emissions, if it seems difficult or impossible to reduce or avoid these.

1.1.2 The Consumer Health Segment and Cosmetics Industry

In the consumer health segment of LifeSci, there are several product categories such as nutritional supplements, OTC products and cosmetics products. The B-Ointment product category is both covering and registered as an OTC and cosmetics product, depending on the formulation. According to Niazi (2009), OTC drugs refers to drugs that are available for purchase without a prescription. However, the product B-Ointment considered in this thesis is registered as a cosmetics product.

According to Chan (2018), the nature of the cosmetics industry is generally characterized by a fast-moving market where consumers are demanding products that are popular today. Brown (2014) states that once the cosmetics companies have generated demand for their products, they need to ensure that the products are available for purchase immediately, and available for as long as they are highly demanded and popular. The author states that the process of handling the products therefore is critical, and requires reliable transportation, storage and distribution processes. Nevertheless, Chan (2018) states that it is crucial in the cosmetics industry to manage the supply chain efficiently and effectively to gain a competitive advantage.

Brown (2014) argues that the fast pace of the cosmetics industry creates a number of challenges in supply chain and logistics management. One aspect that the author emphasizes is the increasing importance of visibility of the logistics- and transportation activities, since the transparency throughout these activities generally is quite low. Brown (2014) also mentions that third-party logistics (3PL) providers need to handle high volumes of product, manage restrictions and regulations, understand temperature and ensure on-time delivery at a competitive cost. Therefore, transparency might not always be prioritized by these 3PL providers. Further, Brown (2014) also highlights the importance of warehouse management in the cosmetics industry, since there often are restrictions and storing conditions such as refrigeration that need to be considered and carefully planned.

According to Bom et al. (2020) the sustainability impact occurs along the entire supply chain of cosmetics. The authors emphasize the selection of raw materials most, since they find the definition of sustainable cosmetic products to be controversial to some extent. Specifically, the authors elaborate that raw materials and products are considered sustainable when compared to other products rather than being analyzed by itself using a holistic view. However, Bom et al. (2020) argues that assessment of sustainability is extremely necessary in order to facilitate decision making and evaluate sustainability impact of a company in the cosmetics industry.

1.1.3 Sustainability and the Environmental Aspect of Logistics Activities

Sustainable development means meeting the needs today without compromising future generations ability to meet their needs (Brundtland Commission, 1987). To capture the whole idea and concept of sustainability, the *triple bottom line* (3BL) is often mentioned in literature (Slack et al., 2016; Borglund et al., 2017). The term 3BL includes *people, planet* and *profit,* and captures the societal, environmental and economic aspects of sustainable development (Slack et al., 2016; Borglund et al., 2017). Normally, organizations tend to only focus on the economic aspects of sustainability, but as mentioned earlier, there is an increasing pressure on organizations to include all three dimensions of the 3BL.

Logistics- and distribution management is crucial within a supply chain and normally consist of six interrelated activities, namely *transportation, storage, warehousing, material handling, security* and *order handling and communication* (Slack et al., 2016). However, definitions of logistics activities might differ. LifeSci includes load preparation, transportation, storing and warehousing as their logistics activities and will hence be the definition used in this master thesis as well. Logistics activities have been proven to have several negative impacts on the environment, e.g. through pollution, emissions, noise and waste (Abbasi & Nilsson, 2012). Further, logistics activities such as storage and movements can be responsible for up to 75 percent of all the carbon emissions emitted during the whole supply chain (Graham et al., 2018). The environmental impact and complexity further increase as organizations are part of several supply chains simultaneously and as these supply chains are spread across the globe (Hervani et al., 2005). Specifically, for a company with global dispersed production and customers it could mean increasing logistics activities and hence a higher environmental impact.

Abbasi and Nilsson (2012) emphasize that there are several challenges throughout the supply chain that organizations meet when trying to transform logistics activities towards more environmentally sustainable alternatives. Firstly, there is a challenge of complexity rooted in the many ways logistics activities can affect the environment. Secondly, the cost aspect is, according to Abbasi and Nilsson (2012), a huge challenge since there is a dilemma of increased costs when trying to reduce environmental impact. Further, Mcintyre et al. (1998) state that it is challenging to establish environmental performance indicators (EPIs), since these are often influenced by contextual factors such as legislation, company size, corporate culture etcetera. Therefore, according to Hooper and Greenall (2005), there is also no general summary or agreement of the most relevant EPIs within environmental sustainability, due to the context dependency.

1.2 Aim and Objectives

Consequently, to fill the gap in research with lack of context specific frameworks to assess the environmental impact of consumer health supply chains, and considering that the specific supply chains are different in terms of complexity and structure, in this study we aim to increase our understanding of how companies can reduce the negative environmental impact of their consumer health logistics activities with two specific objectives:

- The first objective of this master thesis is to investigate how organizations in the consumer health industry can assess environmental performance of their supply chains.
- Further, the second objective of the thesis is to identify improvement areas and prioritize based on the current environmental efforts at LifeSci, but also with regards to environmental sustainability efforts carried out by similar actors in the consumer health industry.

1.3 Delimitations

In literature, sustainability is often considered to cover the so-called 3BL, which consists of *planet, people and profit.* However, the thesis will only examine the *planet* part of sustainability connected to the supply chain, and thus only the environmental aspects. Since LifeSci has an initiative to reduce their environmental impact by optimizing their logistics areas, this thesis will only consider the logistics activities of the supply chain. Further, the thesis will only cover first tier suppliers and customers, whereas the focus will be from incoming goods to LifeSci's facilities to outgoing goods to customers. Thus, the thesis will be based on LifeSci as a focal point, in order to focus the scope on the organization and their point of view. Furthermore, the case study from LifeSci will be based on the product B-Ointment since it would not fit into the project's timeframe to include additional products.

1.4 Disposition of the Thesis

The thesis consists of seven chapters and ends with references and appendix. The first chapter presents the background of the problem and the aim and delimitations of this thesis. A background description is also provided here to give a brief introduction to the thesis. The second chapter brings up the theory used by introducing the established EPEF based on the SCOR model, performance measurements and EPIs. The chapter also presents the four most highlighted environmental areas; emissions, waste, recycling and energy. Further, the third chapter of the thesis discusses the methodology used in the thesis and includes the research strategy and design considered during this study, but also the research methods and quality assurance of the study. The fourth chapter introduces the case product, B-Ointment, and some overall knowledge about the product and its supply chain. In the fifth chapter, the empirical findings obtained from the data collection is presented and analyzed. This empirical chapter is based on the structure of the EPEF and analyzed the areas highlighted in the EPEF from LifeSci's point of view. Further, the sixth chapter includes a discussion of the empirical findings and the literature and is divided into eight main fields. Lastly, the seventh and final chapter concludes and summarizes the findings of this study and brings up practical implications and suggestions for further research.

2 Theoretical Framework

Following chapter will start by presenting the established framework used for assessing environmental performance. Thereafter, the contents of the framework, such as the SCOR model and performance measurement, will be described. The chapter will continue by explaining the four most highlighted environmental areas; emissions, waste, recycling and energy and its associated EPIs.

2.1 Environmental Performance Evaluation Framework

The Environmental Performance Evaluation Framework (EPEF) of this thesis have been based on findings in literature regarding the SCOR model and metrics for assessing environmental impact. Further, the EPEF is developed to help assess the environmental performance of a product line or a specific product within the consumer health industry. Below, the EPEF is presented through the business processes *enable, source* and *deliver.* The business process *plan* has been used as a base for the *plan and decision areas* columns. Further, the business process *make* has been excluded from the framework since this process is mainly connected to creating the product or service, and therefore out of scope for this thesis.

The definition of the business process *source* in the EPEF covers all activities before the make process, e.g. from first tier supplier to inventory before manufacturing. Activities related to procurement of material and components but also keeping inventory of these are therefore included in the EPEFs *source* process. The *deliver* process begins right after the *make* process and covers all activities until the product enters the retailer. The process *deliver* therefore includes activities such as preparation, inventory and transportation between the manufacturing plant and warehouse or retailer. The figure 2.1 below illustrates the boundaries and extent of our definition for each of the included business processes *enable, source* and *deliver.* As per the figure, the *enable* process covers the entirety of the scope, in order to create an over understanding of the product context. Meanwhile, the *deliver* process covers a greater extent than the *source* process.

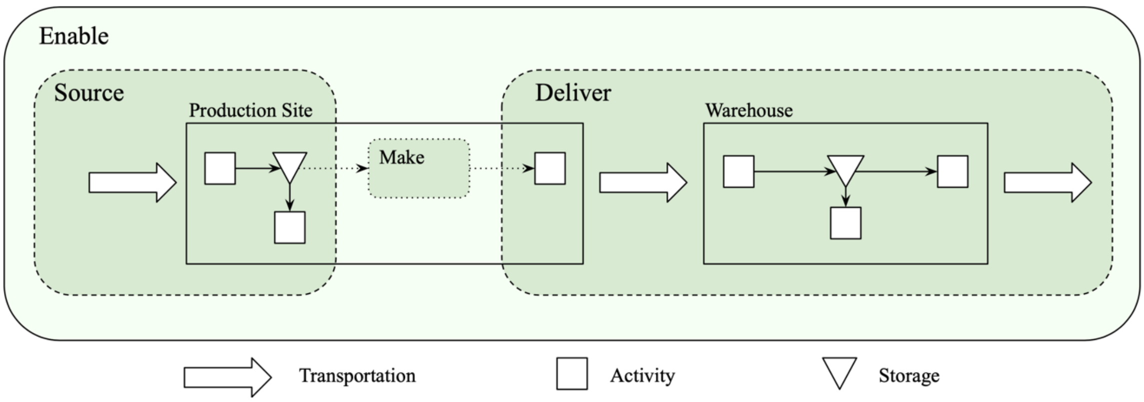

Figure 2.1 - Visualization of the scope of the EPEF.

The *enable* process has been separated from the other processes since this business process is connected to an overall level of the product and the context of evaluation. Initially, it is important to gain an understanding of the context for a chosen product in order to be able to evaluate the EPIs in the second part of the framework. The product context areas of the *enable* process have been based on level 2 categories of the SCOR model, and the evaluation questions have been based on suggested practices for each element. Firstly, the *enable* process starts with an evaluation of how competitors are performing environmentally, and what targets and efforts choose to highlight. Secondly, regulatory compliance is evaluated by looking at what external regulations there are that need to be considered when evaluating the product in the second part of the EPEF. Thirdly, the business rules are evaluated based on the constraints or rules that apply for the logistics of the product, that also set the frame for evaluation of the EPIs in the second part of EPEF. Lastly, the environmental targets are evaluated in order to understand what the organization prioritizes and what types of goals there are generally, that can be connected to the product itself. By investigating and evaluating the context of the product in the first part of the EPEF, the frames and guidelines are set for evaluating the EPIs in the second part. Furthermore, the evaluation questions are based on the main environmental areas (emissions, waste, recycling and energy) that have been found to be most distinctive when measuring environmental performance.

Table 2.1 - Environmental Performance Evaluation Framework.

Process	**Product Context Areas**	**Evaluation Questions**
Enable	Competitors	Which efforts and targets do competitors highlight?
	Regulatory Compliance	Which external regulations can be connected to the product regarding…. … emissions? … waste? … reduce, reuse and recycling? … energy?
	Business Rules	What constraints or rules within the organization must be considered for the logistics of the product?
	Organizational Environmental Targets	What strategic environmental targets are there regarding… … emissions? … waste? … reduce, reuse and recycling? … energy?

Process	Planning and Decision Areas	Activity	Evaluation EPIs
Source	Select Carrier - Vehicle Type - Transportation Mode - Source of Fuel	Transport Material to Inventory	GHG emissions Other air emissions Fuel consumption
	Schedule Sourcing - Frequency - Packaging Material	Prepare Transport of Material	Vehicle utilization degree
		Receive Material	Solid waste generated Recycled waste Reused waste
	Inventory Optimization - Source of Energy - Level of Technology - Inventory Level	Store Material	Energy consumption Energy efficiency Energy-linked emissions
		Dispose Material	Hazardous waste Recycled waste
Deliver	Select Carrier - Vehicle Type - Transportation Mode - Source of Fuel	Transport Product to Warehouse	GHG emissions Other air emissions Fuel consumption
	Schedule Delivery to Warehouse - Frequency - Packaging Material	Prepare Transport to Warehouse	Vehicle utilization degree Solid waste generated Recycled waste Reused waste
		Receive Product	Solid waste generated Recycled waste Reused waste
	Warehouse Optimization - Source of Energy - Level of Technology - Inventory Level	Store Product	Energy consumption Energy efficiency Energy-linked emissions
		Dispose Product	Hazardous waste Recycled waste
	Schedule Delivery to Customer - Frequency - Packaging Material	Prepare Transport to Customer	Solid waste generated Recycled waste Reused waste
	Select Carrier - Vehicle Type - Transportation Mode - Source of Fuel	Transport Product to Customer	GHG emissions Other air emissions Fuel consumption

As figure 2.1 visualizes, the business processes *source* and *deliver* are more specifically connected to the operational parts of the supply chain. The *source* and *deliver* part of the EPEF are therefore designed in a different way. The first column in the framework aims to guide in which part of the supply chain the environmental performance is evaluated e.g. before or after the *make* process. Both *source* and *deliver* includes a number of planning areas e.g. selection of carriers, where decisions of such as vehicle type and source of fuel need to be made. The planning and decision areas are presented in column two. Further, column three shows the different activities these planning and decision areas influence. The activities are inspired from the level 3, process elements, presented in the SCOR model. Continuing the example of *select carrier,* the activity associated and influenced by *select carrier* is the actual transportation of the material and components. The last and final column, *evaluation EPIs*, is a summary of the most representative EPIs in literature. In the case of selection of carriers*,* GHG emissions, other air emissions and fuel consumption are applicable evaluation EPIs.

When the enable process in the EPEF has been investigated and the context is set, the framework can be used to identify the activities in column three in the second part of the EPEF. Next step in the assessment process is to, for each evaluation EPI, ask four questions. Firstly, if the EPI is measured or not. Secondly, on what kind of level the EPI is measured. Thirdly, how often the EPI is measured. And lastly, if there is any follow up of the EPI.

With the information from the EPIs evaluation and the context set from the *enable* process, the framework will help identify improvement areas but also eventually suggest prioritization among the improvement areas.

2.2 SCOR - Model

The Supply Chain Operations reference model, also known as the SCOR model, is a well-known framework with the purpose to facilitate improvements of companies' supply chains (Supply Chain Council, 2012). According to Sellitto et al. (2015), the model is used by a large number of different companies, and more specifically they use it to evaluate supply chain performance.

The Supply Chain Council, founder of the model, wanted to create a framework which standardized all the processes from identifying demand to end customer delivery and hence make it possible for different companies to compare and share best practices (Supply Chain Council, 2012). The SCOR model is thus not sector-specific nor does it provide companies with the 'right' solutions, but instead introduce standardized processes, metrics and best practices for companies to adapt in order to improve their performance (Supply Chain Council, 2012). According to Li et al. (2011), the model can therefore be considered as a strategic tool to achieve good performance in the supply chain. Girjatovičs et al. (2018) imply that an increasing number of organizations have adopted the framework and that their performance has had significant improvements.

Further, the model consists of four main parts: *standardized business processes*, *performance metrics*, *best practices* and *job skills* (Sellitto et al., 2015). Moreover, according to the model, a supply chain can be divided into four different levels of detail (Supply Chain Council, 2012). However, the SCOR framework only considers the three first levels since the fourth level depends on the sector, location, systems etcetera. (Supply Chain Council, 2012).

The following section will present the standardized business processes relevant for this master thesis and how they follow the level structure.

2.2.1 Business Processes

As mentioned in the previous section, the standardized business processes in the SCOR model aim to describe all activities from aggregated customer demand to order fulfillment (Girjatovičs et al., 2018), see figure 2.2 below.

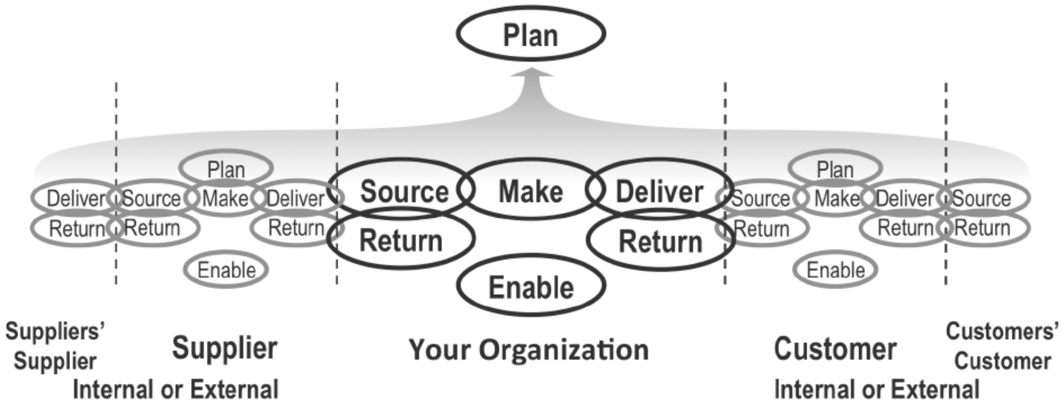

Figure 2.2 - The SCOR-model's six processes. Source: Supply Chain Council (2012).

Since the process types are well-defined and sector-neutral, it is possible to use them to describe both complex and more simple supply chains with the same set of processes (Girjatovičs et al., 2018). The six defined high-level process types are: *Plan*, *Sources*, *Make*, *Deliver*, *Return* and *Enable* (Supply Chain Council, 2012; Girjatovičs et al., 2018). Furthermore, the Supply Chain Council (2012) implies that the processes also can be divided into level-2 and level-3. Level-2 is defined as process categories and for *source* it can e.g. be divided into *source stocked product*, *source make-to-order product* or *source engineer-to-order product* (Supply Chain Council, 2012). Further, each level-2 category can then be divided into a number of process elements, e.g. each step of *source stocked product*, which is a part of level-3 (Supply Chain Council, 2012). Still, the Supply Chain Council (2012) emphasizes that the choice of process level depends on the project. Overall, level-2 process diagrams usually identify structural problems while level-3 process diagrams often help identify decision points (Supply Chain Council, 2012). However, even though the model is used by a large number of companies, all aspects of the model may not be useful or applicable by everyone and everything may not be covered by the model (Girjatovičs et al., 2018).

The process *make,* defined as the activities related to create and produce a company's product or service, is not within the scope and is therefore excluded from the framework. Further, the process *return* includes activities associated with the return flow and is not included either. The remaining four processes will be described further below.

Plan

The *plan* block covers all activities which includes plans to operate within the supply chain (Supply Chain Council, 2012). For example, it can include gathering resource information and requirements. It can also be activities such as identifying demand and resource gaps and how these should be solved (Supply Chain Council, 2012).

Source

The *source* process is associated with all activities related to ordering and receiving materials, components or products (Sellitto et al., 2015). Such activities can involve scheduling deliveries, receiving deliveries, storage and transferring products (Supply Chain Council, 2012). Scheduling deliveries is about deciding and managing when to receive the material/components from the different contractors. These decisions are often determined by some kind of purchase plan or pull systems. Furthermore, receiving products includes activities associated with the product entering the company (Supply Chain Council, 2012). Finally, transfer of products relates to the movement of entered products to suitable storage areas. Transfer of products also include repackaging and staging the products (Supply Chain Council, 2012).

Deliver

The block *deliver* is associated with activities needed to fulfill customer orders (Supply Chain Council, 2012). Such activities can e.g. include consolidating orders, scheduling delivery, building loads, picking and packing and transportation of the goods (Supply Chain Council, 2012). More in depth, consolidating orders is the activity which evaluates the cost optimization and decides what to deliver together. Determining delivery date is about scheduling when to ship the products to customers and reserve products in the inventory (Supply Chain Council, 2012). Further, building loads are associated with activities to create effective loads and selecting transport mode. Selection of carriers is similar but is instead focusing on carriers for cost optimization. Pick and pack of products is activities related to preparing the product for transportation, e.g. create picking order, sorting products and delivering the package to the shipping area (Supply Chain Council, 2012). Further, transportation of products is the movement of the products from production site to customer site. Lastly, the block *deliver* also includes the process element, receive product, which is activities related to when the product enters the customer site (Supply Chain Council, 2012).

Enable

The *enable* block associates with activities needed to manage the supply chain (Supply Chain Council, 2012). Managing business rules, regulatory compliance, performance etcetera are examples of activities within the *enable* process (Supply Chain Council, 2012). More in depth, managing business rules is about managing the parameters which defines and constraints the business. Further, the business rules are used to influence the business to achieve the wanted outcome (Supply Chain Council, 2012). Managing regulatory compliance is about identifying, evaluating and coordinating policies in order for the company to follow regulations (Supply Chain Council, 2012). Lastly, managing performance relates to activities such as reporting performance, finding root causes, prioritizing different causes, improvement programs and supplier performance assessments (Supply Chain Council, 2012).

2.2.2 Green SCOR

Since environmental performance has become an essential part of organizations, the Supply Chain Council has decided to expand the SCOR model to also include strategic environmental metrics, also called the Green SCOR (Supply Chain Council, 2012). The model includes five main metrics which can be used to measure and improve the organization's environmental footprint (Supply Chain Council, 2012). The metrics are; *carbon emissions*, *air pollutant emissions*, *liquid waste generated*, *solid waste generated* and *percent of recycled waste* (Supply Chain Council, 2012). Each metric can also be adopted by five of the processes e.g. *plan* carbon emissions, *source* carbon emissions, *make* carbon emissions, *deliver* carbon emissions and *return* carbon emissions (Supply Chain Council, 2012). The metrics can be divided to even lower levels (level-2 or level-3) and then summarized to a total (Supply Chain Council, 2012). The benefit of being able to use the metrics on all levels is that it ties chosen metrics, e.g. the emissions, to specific processes and it is therefore easier to improve the organization's total performance (Supply Chain Council, 2012). Another benefit of the Green SCOR is its hierarchy, which enables the strategic target to be divided into process-specific targets but also to identify reasons for non-fulfillment of goals (Supply Chain Council, 2012). Lastly, similar to the other SCOR metrics, the environmental metrics is well defined and standardized and are therefore enabling organizations to compare and learn from other organizations (Supply Chain Council, 2012).

Even though the Supply Chain Council (2012) sees a great potential in the Green SCOR, the model has still not been used to a wider extent and some of the performance measurements could require some modification.

2.3 Performance Measurements

Sureeyatanapas and Tawwan (2018) state that performance measurements generally are recognized as a crucial part of organizations in order to reach business success. The authors mean that the process of measuring performance helps promote continuous improvement, presents achievement of corporate goals and ensures that the organizations environmental performance meets or goes beyond legislative requirements. However, Beamon (1999) argues that qualitative evaluations such as *good* or *poor* are difficult to utilize in a meaningful way, and therefore implies that quantitative performance measurements are used more often since the data already is available. Further, the author emphasizes the importance for organizations to ask themselves the questions of what to measure, what level to measure on, how often to measure and how often to follow up and reevaluate metrics in order to plan the performance measurements and develop a correct performance measurement system. Specifically, Barber (2008) states that such uncertainty and changing emphasis of what to measure has led to various models such as the SCOR model, in order to minimize the effort of implementing and developing performance measurement systems. In order to prioritize and emphasize the importance of some indicators above others, key performance indicators are often used, which later have been developed into environmental performance indicators as well.

2.3.1 Key Performance Indicators

According to Cai et al. (2009), there are always a few performance measurements which are more critical than others. These measurements are, according to Shahin and Mahbod (2007) and Themistocleous and Rupino da Cunha (2019), called key performance indicators (KPIs) and are associated with the business strategic targets in some way. Parmenter (2015) says that KPIs are the most essential performance measurements of an organization since they help to evaluate how well the organization fulfill their business purpose. Hence, according to Themistocleous and Rupino da Cunha (2019), there is no doubt that KPIs are the most important success factors for an organization.

Further, Chae (2009) means that KPIs enhance the visibility to correct certain problems to reach the performance targets. Ammara et al. (2016) argue that when KPIs are properly adapted they could also lead to cost- and resource saving opportunities. Furthermore, there has been a discussion regarding the right amount of KPIs and according to Chae (2009) many companies tend to have too many indicators. Chae (2009) also argues that it is better to have just a few than too many in order to be able to manage and measure these properly. In contrast, Shahin and Mahbod (2007) argue for prioritization among KPIs instead of decreasing the amount, which Shahin and Mahbod (2007) find especially important in large and complex organizations where there are a lot of critical KPIs.

2.3.2 Environmental Performance Indicators

Connected to the description of KPIs above, Jamous and Muller (2013) mention that EPIs help organizations to measure their impact on the environment, including ecosystems, land, air and water. Perera et al. (2013) define EPIs as a way of measuring, analyzing, reporting and communicating the organization’s environmental performance compared to criteria set by the management. In addition, the authors mention that EPIs clearly show how the organization performs in reducing its environmental impact both internally and externally. Further, Perera et al. (2013) mention that EPIs can help organizations focus on long-term effects of a policy in an area or a country. However, Hervani et al. (2005) and Altuntas and Tuna (2013) mention that even though there are a lot of approaches towards establishing common EPIs, it is still difficult for organizations to determine which ones to use and when and how to measure them.

According to Perera et al. (2013) and Scherpereel et al. (2001), the purpose of EPIs is to compare environmental performance over time, highlight optimizing performance, evaluate performance among firms but also to act as communication tool for environmental reports. In order to reach desired results, Perera et al. (2013) suggest that chosen EPIs need to have certain characteristics and qualities. Specifically, the authors mention that chosen EPIs need to be understandable by non-scientists and be relevant for the environmental objectives of the organization. Furthermore, Perera et al. (2013) state that EPIs should be measurable, verifiable, reliable, comparable and be combined with an overall evaluation of the company’s operations, products and services.

2.4 Evaluation EPIs of the EPEF

Jamous and Muller (2013) state that EPIs normally are organized in frameworks that are defined by environmental standards and regulations. According to Veleva et al. (2003), *Global Reporting Initiative (GRI)* is a voluntary initiative that sets guidelines for organizations' reporting of environmental performance. The authors mention that these guidelines have been revised through open processes involving various stakeholders, and that they suggest almost 100 possible EPIs. However, Veleva et al. (2003) also emphasize that it is the organization's choice whether to include a set of EPIs or not. Perera et al. (2013) argue that GRI also works as a framework, since it sets out principles and indicators for metrics and reporting of environmental performance.

Sureeyatanapas and Tawwan (2018) mention that ISO 14031 is one of the most well-known standards for environmental performance evaluation, that can easily be adopted by any organization without limitations of size or type of industry. Additionally, Sureeyatanapas and Tawwan (2018) define ISO 14031 as a kind of standardized framework which enables comparison with others and facilitates communication of environmental performance in a systematic way. Furthermore, Perera et al. (2013) add the fact that ISO 14031 mainly is based on the *Plan-Do-Check-Act* business process improvement model, which Scherpereel et al. (2001) argue makes the framework more accessible for developing environmental management systems. However, Sureeyatanapas and Tawwan (2018) argue that most performance evaluations in ISO 14031 still are multidimensional and qualitative, such as e.g. waste, and still rely on subjectivity which means that the evaluations may differ depending on personal interpretation. Nevertheless, both Sureeyatanapas and Tawwan (2018) and Scherpereel et al. (2001) state that there are over 100 exemplified EPIs in the framework, which adds to the complexity of the framework since the organizations need to select relevant EPIs themselves. Sureeyatanapas and Tawwan (2018) and Scherpereel et al. (2001) both argue that organizations also can end up monitoring too many EPIs and get distracted from their main focus. Lastly, Scherpereel et al. (2001) state that there is not clear guidance for prioritization of EPIs in the ISO 14031 framework.

The main categories of EPIs suggested in Green SCOR, GRI and ISO 14031 have been distinguished to cover the main categories of emissions, waste, recycling and energy. The categories are also the main metrics in the EPEF and will be presented below. Each section will also include a table with the most anticipated EPIs from different sources.

2.4.1 Emissions from Transportation Activities

According to Braithwaite and Knivett (2009), the term *carbon footprint* has grown to become a common expression of the need to be concerned about environmental impacts of both production and consumption. The author also elaborates that evaluating emissions or modeling carbon implications of transportation networks have become increasingly popular. The World Resource Institute (2009) concludes that up to 80 percent of the overall supply chain emissions are from all other organizations of the chain than the focal firm itself. Therefore, Tuni et al. (2018) argue that environmental performance needs to be addressed with a holistic approach, encompassing the whole supply chain, rather than looking at a single company level.

Braithwaite and Knivett (2009) mention that there are a lot of data sources on pollutant emissions, but that there is a lack of expert agreement on the true emissions that are included for different elements in supply chains. Further, the authors state that experts not agreeing on a standard library of emission rates can enable doubters to question the output of any analysis. Still, Braithwaite and Knivett (2009) also argue that this points to the fact that local differences should be considered, which may allow organizations to select different environmental performance indexes depending on the entity or process in focus. Further, Schneider et al. (2010) emphasize pharmaceutical companies tend to focus on reductions in greenhouse gas (GHG) emissions since this is considered a *low hanging fruit.* The authors elaborate by explaining that immediate positive results of the reductions can be achieved from operational improvements in the organization, e.g. by change of transportation or energy sources. On the other hand, Colicchia et al. (2011) argue that it generally is difficult to define specific initiatives that should be carried out in order to reduce emissions, since it depends strictly on the process or activities that are under consideration.

When looking at literature, Colicchia et al. (2011) mention that the key issues consist of GHG emissions and waste. Specifically, the authors state that the main focus is on carbon dioxide (CO_2) emissions, due to the commonly known fact about the increasing amount of CO_2 from human activities and thereby the global warming problem becoming more important. According to Colicchia et al. (2011), the total amount of emitted CO_2 is measured both directly and indirectly and many countries set out targets to limit the CO_2 emissions in different industries. Still, the authors mention that reduction of CO_2 emissions sometimes can be in conflict with other environmental performance indicators, such as e.g. recycling processes which actually might increase CO_2 emissions instead.

In order to map different emissions, GRI (2018a) mentions different types of emissions including GHG, ozone-depleting substances (ODS), nitrogen oxides (NOx) and sulfur oxides (SOx). Further, GRI (2018a) states that GHG emissions are a major contributor to climate change, and consist of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3), according to the United Nations (UN) *Kyoto Protocol.* In addition, GRI (2018a) mentions that GHG have a significant impact on ecosystems, air quality and human health. When it comes to ODS, GRI (2018a) states that such emissions contribute to depletion of ozone in the ozone layers. Furthermore, GRI (2018a) informs that NOx and SOx and other significant air emissions have a negative impact on ecosystems, air quality and human health as well. However, McKinnon (2015) states that all these different air emissions affect the environment on different levels of local, regional and global level.

According to the European Commission (2001), physical distribution is one of the major sources of environmental impact. In addition, both Colicchia et al. (2011) and Aronsson and Brodin (2006) state that the most critical element of these negative impacts is related to CO_2 emitted during transportation. IEA (2019) states that, based on their statistics on emissions, approximately 25 percent of all global CO_2 emissions was based on transportation emissions in 2017. Furthermore, when looking at all types of emissions, transportation emissions contribute by 14 percent on a global level. According to the United Nations Environment Programme (UNEP) (2019), the GHG emissions have risen with a rate of 1.5 percent per year in the last decade. However, in order to decrease the environmental impact, UNEP (2019) mentions that the new goal in the European Commission is to have reduced emissions by 45 percent by 2030.

Table 2.2 - Summarized list of EPIs for emissions.

Performance Measurements	**References**
GHG Emissions [ton/year]	(Altuntas & Tuna, 2013), (Colicchia et al., 2011), (GRI, 2018a), (Hervani et al., 2005), (Jamous & Muller, 2013), (Kuhre, 1998), (Scherpereel et al., 2001), (Supply Chain Council, 2012), (Tuni et al., 2018)
- Carbon Dioxide (CO_2) [ton/year]	(Altuntas & Tuna, 2013), (Braithwaite & Knivett, 2009), (Colicchia et al., 2011), (GRI, 2018a), (Kuhre, 1998), (Piotrowicz & Cuthbertson, 2015), (Scherpereel et al., 2001), (Supply Chain Council, 2012), (Tuni et al., 2018)
- Methane (CH_4) [ton/year]	(GRI, 2018a), (Kuhre, 1998), (McKinnon, 2015), (Supply Chain Council, 2012)
- Nitrous Oxide (N_2O) [ton/year]	(GRI, 2018a), (Kuhre, 1998), (McKinnon, 2015), (Supply Chain Council, 2012)
- Hydrofluorocarbons (HFC) [ton/year]	(GRI, 2018a), (Kuhre, 1998), (McKinnon, 2015), (Supply Chain Council, 2012)
- Perfluorocarbons (PFC) [ton/year]	(GRI, 2018a), (Kuhre, 1998), (McKinnon, 2015), (Supply Chain Council, 2012)
- Sulphur Hexafluoride (SF_6) [ton/year]	(GRI, 2018a), (Kuhre, 1998), (McKinnon, 2015), (Supply Chain Council, 2012)
Sulfur Oxides (SOx) [ton/year]	(GRI, 2018a)
Nitrogen Oxides (NOx) [ton/year]	(GRI, 2018a)
Ozone-depleting substances (ODS) [ton/year]	(Barber, 2008), (Jamous & Muller, 2013)
Other Air Emissions [ton/year]	(GRI, 2018a), (Hervani et al., 2005), (Kuhre, 1998), (McKinnon, 2015),
Fuel consumption [litres/year]	(Perera et al., 2013), (Scherpereel et al., 2001)
Vehicle Type	(Braithwaite & Knivett, 2009)
Emissions from CO_2 refrigerations systems [ton/year]	(Colicchia et al., 2011)
Use of alternative fuels (e.g. cleaner fuels)	(Colicchia et al., 2011)
Vehicle technological innovation (e.g. cleaner trucks)	(Colicchia et al., 2011)
Transportation mode and carrier selection	(Colicchia et al., 2011)
Balancing backhaul movements	(Colicchia et al., 2011)
Vehicle utilization degree and consolidation [average %/transport]	(Colicchia et al., 2011)
Travel distance optimization [km/transport]	(Braithwaite & Knivett, 2009), (Colicchia et al., 2011)
Number of days exceed the air emission limit [days/year]	(Kuhre, 1998)

2.4.2 Waste from Packaging and Preparation Activities

Waste generation is one among many things which influence the 'greenness' of a supply chain (Saadany et al., 2011). The term *waste* is however depending on a number of factors e.g. personal preference, time, state and location and is therefore not a fixed state (Christensen, 2010). More general, Christensen (2010) defines waste as:

> *"Waste is a left-over, a redundant product or material of no or marginal value for the owner and which the owner wants to discard" (Christensen, 2010:3)*

Waste can be classified as solid waste, which often means waste in a solid state but could also be e.g. sludge (Christensen, 2010). It can also be classified as wastewater, fluid waste or flue gases which instead is when the waste has some kind of transporting media e.g. water or air (Christensen, 2010). Moreover, waste can be divided into hazardous or nonhazardous waste, where hazardous waste is more harmful for the environment and is therefore more heavily regulated (Christensen, 2010). Examples of hazardous waste is toxic material/gases or highly flammable materials (Christensen, 2010).

Waste is more or less generated in the whole supply chain. Packaging and packaging waste, which can be made of e.g. cardboard, metal, plastic, glass or paper, are also a contributing factor to the amount of generated waste (Tallentire & Steubing, 2019). Furthermore, packaging can affect the environment both directly, through its volume, weight and material choice, but also indirectly through e.g. inefficient use of vehicle utilization due to poor package design (Colicchia et al., 2011).

Further, solid waste generation has a negative impact on the environment and is correlated with different kinds of pollution (Das et al., 2019; Saadany et al., 2011). CH4 and CO_2 are two examples of associated GHG which increases with increased generation of waste (Das et al., 2019). Furthermore, according to Das et al. (2019), leachate from solid waste are releasing different kinds of heavy metals, e.g. lead, chromium, cadmium and carbon, and are therefore contributing to the contamination of soil and water. Das et al. (2019) also mention that solid waste tends to affect human health, e.g. it can contribute to asthma, bronchitis etcetera.

Table 2.3 - Summarized list of EPIs for waste.

Performance Measurements	References
Quantity of waste [tons/year]	(Jamous & Muller, 2013), (Jasch, 2009), (Kuhre, 1998), (Perera et al., 2013), (Piotrowicz & Cuthbertson, 2015)
Solid waste generated [tons/year]	(Altuntas & Tuna, 2013), (Kuhre, 1998), (Saadany et al., 2011), (Scherpereel et al., 2001), (Supply Chain Council, 2012)
Liquid waste generated [tons/year]	(Supply Chain Council, 2012)
Hazardous waste [tons/year]	(Altuntas & Tuna, 2013), (Colicchia et al., 2011), (Jamous & Muller, 2013), (Jasch, 2009), (Kuhre, 1998), (Litman, 2019), (Saadany et al., 2011), (Scherpereel et al., 2001)
Landfill Waste [tons/year]	(Litman, 2019)
Amount of waste sent to disposal [tons/year]	(Jasch, 2009), (Kuhre, 1998)
Waste generated from products and materials [tons/year]	(Bonne et al., 2012)
Water waste [tons/year]	(Altuntas & Tuna, 2013), (Saadany et al., 2011), (Scherpereel et al., 2001)
Chemical waste [tons/year]	(Saadany et al., 2011)
Quantity of waste stored on site [tons]	(Jasch, 2009)
Fuel consumption for waste handling [litres/year]	(Perera et al., 2013)

2.4.3 Reduce, Reuse and Recycling of Packaging and Preparation Material

According to Piotrowicz and Cuthbertson (2015), there is an explicit correlation between reuse-, recycling- and waste metrics. The authors imply that the metrics can sometimes even be based on the same parameters and data. Moreover, according to Tallentire and Steubing (2019), packaging and packaging waste are accountable for approximately 2.8 percent of all GHG in Europe. In order to reduce the environmental impact, Das et al. (2019) discuss the 3R approach, i.e. reduce, reuse and recycle solid waste. Tallentire and Steubing (2019) describe the approach as a pyramid, where the first step has the least impact on the environment, the second step a bit more and so forth. Chi and Long (2011) describe the first step, *reduce*, as trying to minimize or avoid unnecessary waste. Further, the authors describe the second step, *reuse*, as trying to adopt the waste to other areas of application. Last step, *recycle*, Chi and Long (2011) defines as transforming waste into new materials or products (Chi & Long, 2011). Generally, according to Christensen (2010), the 3R approach aims to decrease the landfill and therefore also the environmental impact.

Packaging and packaging waste is one area where reuse and recycling have received more attention. In order to reduce the environmental impact of packaging and packaging waste, the European parliament introduced directive 94/62/EC in 1994. The directive partly aims to regulate companies within the EU to increase their reduction, reuse and recycle of packaging (Directive (EU) 2018/852, 2018). Further, the European Parliament has settled a few recycling targets for different kinds of packaging materials (Directive (EU) 2018/852, 2018). The recycling rates are: 25 percent for wood, 50 percent for plastic and aluminum, 70 percent for glass and ferrous and lastly, 75 percent for paper and cardboard (Directive (EU) 2018/852, 2018). Overall, by 2025 more than 65 percent of all packaging weight needs to be recycled (Directive (EU) 2018/852, 2018).

Table 2.4 - Summarized list of EPIs for reduction, reuse and recycling.

Performance Measurements	**References**
Waste reduction	(Colicchia et al., 2011), (Morali & Searcy, 2013)
Reduction in water usage	(Kuhre, 1998)
Reduction achieved in GHG emission	(Perera et al., 2013)
Quantity of waste converted to reusable material [tons/year]	(Colicchia et al., 2011), (Jasch, 2009)
Reused raw material [tons/year]	(Kuhre, 1998)
Reused paper in place of virgin paper [tons/year]	(Kuhre, 1998)
Reused products [%/year]	(Piotrowicz & Cuthbertson, 2015), (Wong et al., 2018)
Reused packaging material [tons/year]	(Kuhre, 1998)
Water reuse, %	(Perera et al., 2013)
Recyclable or reusable waste [tons/year]	(Colicchia et al., 2011), (Hervani et al., 2005), (Jasch, 2009), (Kuhre, 1998), (Scherpereel et al., 2001)
Recycled waste [%/year]	(Jamous & Muller, 2013), (Kuhre, 1998), (Supply Chain Council, 2012)
Recycled products [%/year]	(Piotrowicz & Cuthbertson, 2015)
Recyclable packaging [%/product]	(Perera et al., 2013)

2.4.4 Energy from Warehouse and Inventory Activities

According to Rudiger et al. (2016), when looking at the development towards decarbonization or when considering a complete assessment of logistics activities and their environmental impact, it is important to address warehousing activities equally as much as transportation activities. Specifically, Colicchia et al. (2011) mention that the main environmental impact from warehouses is connected to energy consumption, but also indirectly connected to CO_2 emissions from energy production. Rudiger et al. (2016) emphasize that the total energy demand of warehousing can equal around one quarter of the emissions from transportation. Moreover, Colicchia et al. (2011) suggest that the energy demand derives from activities and procedures such as air conditioning or heating, material handling operations, lightening and other processes that require electrical energy to operate.

Furthermore, Rudiger et al. (2016) also mention that energy efficiency in logistics processes and facilities has gained more importance, due to changes in regulations and market requirements such as the European Energy Efficiency Directive which put prioritization on energy demand of buildings. When it comes to logistics facilities and more specifically warehousing, Rudiger et al. (2016) state that several sources of energy and resource consumption need to be considered, compared to transportation processes. The authors state that there are several processes and sources that cause GHG emissions, and that it is important to determine system boundaries based on standardized criteria in order to reach measurable and comparable values for the environmental performance. Additionally, Rudiger et al. (2016) state that EPIs are a good way of comparing the annual amount of GHG emissions in reference to the logistics performance, even though logistics facilities undergo a lot of changes in order quantities, item handled or demanded service.

Aronsson and Brodin (2006) mention that the transport and logistics sector accounted for 32 percent of the total energy consumption in the EU in 2001 and focuses mainly on the combustion of fossil fuels. The authors state that 44 percent of the total CO_2 emissions generated derive from fossil fuels, why improvements and development of alternative fuels is crucial. Furthermore, Arvidsson (2013) discusses the term *energy efficiency,* and defines it as the ratio between output of performance, service, goods or energy and input of energy. The author also suggests that literature propose measures of energy and environmental impact deriving from total energy consumption and energy efficiency. Lastly, Arvidsson (2013) states that the total primary energy use continues to increase, despite efficiency improvements. However, the author also emphasizes the potential for improvements in energy efficiency to radically decrease total energy consumption.

Table 2.5 - Summarized list of EPIs for energy.

Performance Measurements	**References**
Energy Consumption [kWh/year]	(Altuntas & Tuna, 2013), (Arvidsson, 2013), (GRI, 2018b), (Hervani et al., 2005), (Kuhre, 1998), (Piotrowicz & Cuthbertson, 2015), (Rudiger et al., 2016), (Scherpereel et al., 2001), (Veleva et al., 2003)
Energy consumption efficiency [%/year]	(Arvidsson, 2013), (Colicchia et al., 2011), (GRI, 2018b), (Scherpereel et al., 2001)
Energy-linked emissions [tons/year]	(Altuntas & Tuna, 2013), (GRI, 2018a), (Jamous & Muller, 2013), (Scherpereel et al., 2001), (Veleva et al., 2003)
Using alternative and cleaner technology	(Altuntas & Tuna, 2013), (Colicchia et al., 2011), (GRI, 2018b), (Jamous & Muller, 2013), (Scherpereel et al., 2001), (Veleva et al., 2003)
Waste-to-energy processes	(Colicchia et al., 2011)
Use of energy-efficient lighting systems and day lighting	(Colicchia et al., 2011)
Efficient building thermal insulation	(Colicchia et al., 2011), (GRI, 2018b)
Introduction of solar and photovoltaic panels	(Colicchia et al., 2011)
Use of energy-efficient material handling equipment	(Colicchia et al., 2011), (GRI, 2018b)
Total energy during the life cycle [kwh/product life cycle]	(Hervani et al., 2005), (Kuhre, 1998)

3 Methodology

Following chapter will present the methodology of the study. Firstly, the choice of research strategy and research design will be discussed followed by a comprehensive description of the research process. The chapter will continue by describing the literature review and data collection as well as how the data analysis was performed. The last section will present the research quality of the study.

3.1 Research Strategy and Design

According to Bryman and Bell (2011) a research strategy can be qualitative or quantitative. The difference between the two strategies can shortly be described as qualitative studies being more focused on thoughts and experience while quantitative studies centers measurements and statistical analysis. Since the aim of this thesis is to increase the understanding of how companies can reduce their negative environmental impact, a qualitative strategy was considered most suitable. Furthermore, Bryman and Bell (2011) state that qualitative studies often are concerned with the generation of theory. During this thesis, in order to develop the EPEF, a lot of theory in different fields have been collected to support the EPEF as much as possible. For example, a lot of research was done to establish the most anticipated and highlighted fields of environmental impact from logistics activities. For each and one of the fields, further research was done to explore the areas and fields more in depth.

As argued earlier in the thesis there is a subjective matter of which fields to prioritize above others, since these are up to the organizations themselves. The same goes for EPIs to measure or improve within organizations, which also have been concluded to depend on the study or the organization itself. Meanwhile, Bryman and Bell (2011) argue that subjective fields or studies need to be interpreted from the perspective of the people being studied, which according to Sreejesh et al. (2016) is enabled with qualitative studies. Therefore, the qualitative approach of this study has helped understanding sustainable development from LifeSci's point of view, for their product B-Ointment and the consumer health industry. In this case, the interviews have been the main source of approaching LifeSci's point of view.

Generally, there has been limited research on the consumer health industry specifically, considering also that the boundaries for what is included or not in this industry has been unclear. Further, this emphasizes the explorative character of this thesis, since Wallén (1996) argues that explorative studies often aim to establish fundamental and common knowledge within a field. The study has therefore included research from both OTC products industries as well as the cosmetics industry to establish common knowledge in the field of the consumer health industry. According to Wallén (1996) and Bryman and Bell (2011) qualitative and explorative studies often have an inductive approach, meaning that the thesis has used empirical data to draw conclusions about connections to theory. Specifically, the thesis has had an iterative research process where theory and empirical findings have been connected in order to form the final findings of the thesis.

3.1.1 Case Study Design

The research design chosen for this master thesis is a case study design. Yin (2014) argues that a case study is relevant when the study requires an in-depth and extensive description of the studied phenomenon. This master thesis is limited to the environmental sustainability aspect and to the consumer health industry and requires comprehensive knowledge and understanding of the environmental sustainability areas and any specific circumstances. Even though many studies have investigated EPIs and the environmental sustainability of supply chains, there is limited research on how to evaluate a specific supply chain's environmental sustainability. Furthermore, there are also insufficient studies on the consumer health industry. To obtain the required in-depth knowledge and try to fill the areas where current theory is insufficient, Yin (2014) and Eisenhardt (1989) recommend researchers to use a case study design. Further, according to Bryman and Bell (2011), a case study is especially useful when the objective is to understand a specific environment. Hence since it was important for the EPEF to be developed and adapted to LifeSci's situation, a case study design seemed appropriate.

Further, the master thesis has only considered the product B-Ointment's circumstances and context, with the scope of first tier supplier until retailer. Thus, this case study would according to Yin (2014) be considered as a single case study. Even though Yin (2014) favors studies with two or more cases, there are five circumstances when single-case studies is defensible, specifically it is when the case is: critical, unique, revelatory, common and longitudinal. Since B-Ointment is a common product, low specific regulations and have a kind of typical supply chain for consumer health products the result or parts of the result could be used by other products. The case study is therefore, according to Yin (2014), defined as a common case.

3.2 Research Process

The research process for this master thesis can be presented by three main blocks; *pilot phase, execution phase and compilation phase,* see figure 3.1.

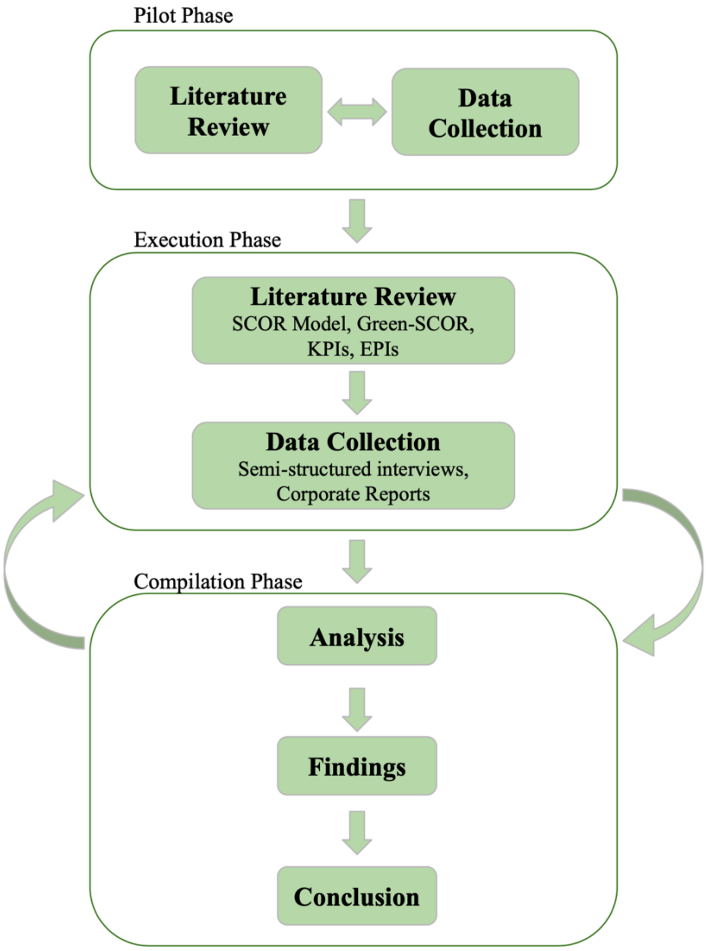

Figure 3.1 - Research process of the project.

Sreejesh et al. (2016) argue that the first step in a research process aims to identify and define the problem. The *pilot phase*, including the literature review and the data collection, therefore aimed to create a general understanding of the problem, which then was used to form the thesis' research objectives. The data collection during the pilot phase was mainly made through an unstructured Skype interview with five managers at LifeSci. Further, secondary data, such as LifeSci's annual report and sustainability report was also used to establish an understanding of the company context.

The second block, the *execution phase*, started with an in-depth literature review. The literature study began to examine the literature from the pilot study and was thereafter extended with new literature. When an in-depth literature review was established and summarized into a framework which aimed to facilitate the data collection and data analysis, the researchers continued with the data collection. The data was collected through semi-structured interviews, reports and other documents and will be further explained in section 3.3.

When the data collection and the literature study was established and basically all information was aggregated, the *compilation phase* proceeded. The data were coded and analyzed to form an analysis of the data itself. Thereafter, the findings from the analysis were iteratively compared to findings from the literature review in order to compare and find similarities and differences. After these iterative comparisons were made, the conclusions were summarized and the main findings from the study were highlighted.

3.2.1 Literature Review

The literature study was made mainly in two rounds. The first literature study was made during the pilot phase. The aim was to establish a comprehensive understanding of the current knowledge of the field, but also the problematic and necessity to investigate further within the topic. The literature was extracted from previous course literature, Google Scholar and Chalmers Library database. The keyword used for the pilot literature study was; *SCOR-model, consumer health industry, cosmetics industry supply chain, key performance indicators, environmental performance indicators, supply chain management, sustainability* etcetera.

The second literature study was made during the execution phase. The aim was, after establishing a general understanding and formulating the research objectives, to form a more extensive literature foundation based on the finding during the pilot phase and the established research objectives. The topics of interest were EPIs within supply chains, e.g. waste, emissions, energy, recycling and reuse. Further, already existing frameworks such as the Green SCOR-model and ISO 14031 were reviewed. The literature search was made through a so-called snowball sampling, which Bryman and Bell (2011) describe as an approach where new additional references could be found through a first reference and so forth. Once again, the initial literature references were collected through Google Scholar and the Chalmers Library database. Keywords used in the execution phase was; *Green SCOR, key performance indicators, environmental performance indicators, waste, emissions, recycling, energy, performance measurements etcetera*.

3.3 Data Collection

In addition to a research design, Bryman and Bell (2011) emphasize the importance of establishing a research method to know how the required data should be collected. This thesis has used both primary and secondary data to fulfill the research objectives. Easterby-Smith et al. (2015) distinguish the two concepts by defining primary data as information obtained directly from the source while secondary data is defined as information obtained indirectly from the source. Interviews were selected as a method for collecting primary data and were held with managers at the headquarter in Switzerland and the production site in Germany. The primary data was mainly used to obtain a perspective of LifeSci's environmental sustainability efforts. The secondary data was partially gathered through LifeSci's sustainability- and similar reports and aimed to enlarge the findings related to their environmental efforts. Further, the secondary data also was gathered through LifeSci's competitors annual- and sustainability reports which relates to the second research objectives sub objective.

3.3.1 Interviews

According to Gillham (2008), interviewing is a flexible research method no matter which level of structure there is. Further, the author also mentions that the interactive relationship between the interviewer and the interviewee makes it possible to adapt and further develop the interview depending on the answers. Initially, a kick-off meeting and a separate briefing meeting of unstructured character was held with the company to explore the scope of the thesis. During these meetings, the resources for further interviews and an interview schedule was established. According to Waller et al. (2015), the more explorative a research is, the less structure is likely in the research interview. As mentioned earlier, since there has been a need to create a context around the supply chain of the product B-Ointment and LifeSci and their consumer health segment, it was concluded that semi-structured interviews would be most suitable for the data collection of the thesis.

During the data collection, there were initially around 18 to 22 semi-structured interviews planned. However, due to complications connected to the global COVID-19 pandemic, the initial schedule of the interviews needed to be revised. Due to limited resources and time during this pandemic, there were in total five conducted interviews. The sampling was based on purposive sampling, which Waller et al. (2015) defines as choosing criteria for whom are to be interviewed. These criteria were communicated to a representative at LifeSci, who helped booking the interviews with employees at the company. Our criteria were mainly to involve managerial respondents both from the headquarter and from the production site of the product B-Ointment. Below, table 3.1 displays further information of the interviews, including the respondents job title, field of work and length of the interview.

Table 3.1 - Interviews Details.

Job Title	Field of Work	Interview Length
Head of Procurement Category Management Transportation & Warehousing	Managing purchasing of all transportation warehouses service related to the pharmaceutical and consumer health segments.	40 min
Procurement Business Partner	Working with supply risk management. Securing supply of raw material for the consumer health segment.	50 min
Head of Supply Chain Operations and Packaging Design	Managing the supply chain operations and packaging design at the production site of B-Ointment.	20 min
Senior Manager, Global Lead Environment	Involved in CO2 and EMEA, leading sustainable procurement for all segments of the company.	45 min
Global flexibility manager	Planning and bringing end-to-end visibility on the supply chains, in the consumer health segment.	60 min

The interviews were used both to get a brief overview of the respondents' involvement in sustainability but mainly to understand the environmental efforts at LifeSci. Further, the interviews were also a crucial part to understand the flow of the product and the environmental aspects connected to the supply chain of the product. According to Gillham (2008) and Bryman and Bell (2011), semi-structured interviews normally have a development process to establish the subject focus, and to make sure that the interviews cover all relevant fields. Therefore, the EPEF presented in the theoretical framework was used as a base for developing the interview guide for these interviews. The complete interview template can be found in appendix A. Bryman and Bell (2011) suggest that the interviewer should be familiar with the social context of the interviewee as well, in order to understand the interviewee on their own terms. To clarify, before the interviews, the background and field of work of every participant were clarified beforehand, in order to adjust the interview guide to the different interviewees. Still, the interview was adapted during the interview as well to suit the interviewee and their field of expertise. The interview templates were also sent out beforehand to give the participants the opportunity to prepare their answers.

Due limited access to visit the headquarter of any of the sites, all the interviews were conducted online. Each of the interviewees were asked for permission to record the interviews in order for us to capture all the data from the interviews without losing any important details. Gillham (2008) recommends interviewers to transcribe the interview directly afterwards, since it helps recalling certain expressions or emphasis that otherwise get lost in transcriptions of interviews. Therefore, each interview was transcribed from the recordings and combined with other notes that were taken during the interview.

3.3.2 Documents and Reports from LifeSci

The primary data from the interviews have been supplemented with data from documents and LifeSci's annual and sustainability report. LifeSci's annual report has been used to obtain general information about the company. Further, LifeSci's sustainability report has been used to understand the company's environmental targets, broaden knowledge about LifeSci's environmental efforts and what they chose to report. Apart from the company's annual and sustainability report, their report to Carbon Disclosure Project (CDP) has also been used to get an overview of all reported and accounted emissions from the company in separate categories, but also to get information about reported improvement initiatives.

3.3.3 Documents and Reports from Similar Actors

To get an overview of environmental efforts in the consumer health industry and to evaluate and find inspiration for improvement areas for LifeSci, other similar actors in the industry were investigated as well. From the interviews, it was clear that it would be difficult to define relevant competitors when looking at the general picture, since it depends on the product itself. It was therefore suggested that similar products with the ingredients panthenol or dexpanthenol (which is a derivative of panthenol) would be interesting to consider, since dexpanthenol is one of the main ingredients in the product B-Ointment. After some online research the following competitors were found to have similar products to the product B-Ointment: Beiersdorf, Johnson & Johnson (J&J),

Perrigo, L’Oréal and Unilever. Even though Procter & Gamble (P&G) do not have any products directly comparable to the product B-Ointment, it was brought up from the interviews that P&G can be seen as a benchmark in their supply chain, e.g. by looking at their speed of response. These choices of relevant competitors were also reviewed with one interviewee, and the respondent approved the chosen competitors since these also reflect LifeSci’s consumer health segment to some extent.

Since the product B-Ointment is registered as a cosmetics product, the chosen competitors make even more sense in a comparison, instead of comparing pharmaceutical products to a cosmetics product. The respondents themselves also highlight that it is good to benchmark and compare yourself with advanced competitors in order to understand what they are doing and to understand how the organization can advance in that direction. Furthermore, since this thesis is considering the product B-Ointment’s supply chain and flow into Sweden, the choice of competitors was also based on whether the products are sold in Sweden. Concluding, the choice of relevant competitors has both been based on ingredients, targeted use of the products, geographical areas but also input from our interviews at LifeSci.

General information about the identified competitors was obtained from their respectively sustainability report. Their sustainability reports have been used to understand the context of the consumer health industry, but also environmental sustainability efforts and initiatives present in the industry. Furthermore, these sustainability reports have also been used to determine which environmental fields competitors are focusing on and choosing to report publicly. Therefore, from each of the sustainability reports, the four fields of emissions, waste reduction, recycling and energy have been analyzed both on a general level for respective companies but also connected to their logistics activities. A summary of the data and information about the competitors is presented in table 3.2 below. The data in the table have been extracted from the companies’ respective reports or product

Table 3.2 - Summary of competitors.

Information Category	**Beiersdorf**	**J&J**	**Perrigo**	**L’Oréal**	**Unilever**	**P&G**
Total Revenue [million euros]	7,653	75,100	4,481	29,870	52,000	62,800
Number of Employees	20,000	132,000	10,600	88,000	150,000	97,000
Number of years active	135 years	133 years	133 years	111 years	90 years	183 years
Relevant Business Segments	Consumer Business	Beauty	Personal Care & Derma-therapeutics	Active Cosmetics	Beauty & Personal Care	Beauty & Baby Care
Brands Similar to B-Ointment	Nivea, Eucerin	Neutrogena	ACO	La Roche Posay, CeraVe	Clear, Rexona, Dove, Sunsilk	N/A

3.4 Data Analysis

As was mentioned in section 3.1, qualitative research is about focusing on the words and peoples experiences instead of numbers (Bryman & Bell, 2011). Hence, the data collection of this master thesis ended up in a lot of unstructured textual material. The respondents were from different departments and had different input for the same questions. Further, since the interviews were semi-structured, a lot of information that was both in and out of scope for the thesis was obtained. Thus, as Miles et al. (2014) state, in a qualitative study it is required to filter the relevant parts from the mass and a qualitative data analysis is therefore not that straightforward as for a quantitative study. As a quality measure in the data collection, the interviews were discussed and reflected upon immediately after, in order to use the novel information and knowledge to influence the following interviews. An example is the division of measurements and targets for the different transport modes that one respondent briefed about. This information was later used in another interview discussing LifeSci's future sustainability efforts.

Furthermore, coding of the material was carried out. According to Bryman and Bell (2011), coding is a filtration between useful and not useful data. After conducting the interviews, the recorded interviews were listened through again and transcribed. Thereafter, citations and information relevant for fulfilling the research objectives were color coded to distinguish different areas. The labels of the clusters used were similar to the different areas of the EPEF and the coding was made by the researcher together. Coding hence helped to cluster related material from different sources and made textual material more analyzable. The data were thereafter summarized and presented under these distinguished labels/areas in section 5. Before the empirical findings were compared to the literature findings, another round of coding was completed. This was made in a similar way but used other labels compared to the one before. Further, this sectioning was based on the most highlighted and most prominent aspect that appeared in the empirical findings and the literature. When the second coding was completed the findings were compared with literature.

3.5 Research Quality

According to Waller et al. (2015), qualitative research is often criticized for not being reliable, valid or objective. However, Miles et al. (2014) state that many researchers emphasize that it is not really possible to establish standards or criteria for good qualitative work, since it is not responsive to the contingent, contextual and personally interpretive nature of any qualitative study. Still, Bryman and Bell (2011) suggest an alternative way of assessing quality in qualitative studies and introduce the two primary criteria *trustworthiness* and *authenticity*. Below these criteria will be explained more in detail together with examples how these have been followed throughout the study.

3.5.1 Trustworthiness

Bryman and Bell (2011) state that *trustworthiness* consists of four criteria: *credibility, transferability, dependability* and *confirmability.* The authors elaborate that *credibility* is connected to internal validity, *transferability* connects to external validity, *dependability* connects to reliability and *confirmability* connects to objectivity of the research.

Bryman and Bell (2011) explain that credibility can determine the acceptability of the research among others when there are several aspects of social reality. When it comes to validity, Waller et al. (2015) argue that the way data is generated need to make sense given the specific aims of the research. For example, semi-structured interviews were combined with data from reports from companies in order to compare what the organization presents publicly and what is happening from an employee point of view. The interviewees were informed about the aims of the thesis and their role of the data collection, but also of their anonymity to avoid interviewees worrying about being exposed for their thoughts and opinions.

According to Bryman and Bell (2011), *transferability* is about how the thesis findings hold in other contexts or how the findings can be used in other studies. Even though this study is focused on a specific case in a company, the researchers have tried to explain the findings in such detail that other researchers can understand the reasoning behind the findings and therefore increase the transferability of the findings. Since the findings in this thesis have been based on the consumer health industry, the findings and learnings from this thesis should be applicable on any other organization or supply chain in this industry as well.

Bryman and Bell (2011) explain that *dependability* includes assessing how well proper procedures have been followed based on the records of the research process. Further, Waller et al. (2015) elaborate that dependability and reliability is connected to the replication of the study and reaching similar results even if the study were to be conducted by other researchers. Miles et al. (2014) argue that the sample used for the study should be specified with characteristics of the people or processes to increase the transparency of the study. Therefore, the data collection methods have been clearly described in order for other researchers to conduct a similar study without any complications.

According to Bryman and Bell (2011), complete objectivity is impossible in qualitative research. However, the authors argue that *confirmability* is about ensuring that personal values and beliefs have not affected the conducting of the study and the deriving of findings. An overall quality check of the data and the study were also made from supervisors and colleagues at Chalmers University of Technology in seminars throughout the project duration, which Miles et al. (2014) emphasize as an appropriate measure. The seminars have also been used to ensure an acceptable level of objectivity of the thesis. Secondly, Miles et al. (2014) suggest that the researchers should be self-aware of approaching the research with an open mind and be aware of how personal values, bias and beliefs might affect the study in its entirety. Therefore, a data quality check has been made by confirming the data among the researchers and the supervisor at LifeSci. During the collection of the data, it was also made sure that potential bias in the interviews were avoided, whereas awareness of bias has been present during the whole study.

3.5.2 Authenticity

Bryman and Bell (2011) also add criteria in *authenticity,* and suggest the criteria *fairness, ontological authenticity, educative authenticity, catalytic authenticity* and *tactical authenticity.* The authors define *fairness* to answer the question whether the research fairly represents different viewpoints among members of the social setting. Unfortunately, it has not been possible in this thesis to collect data from different stakeholders of the company or other parties involved in the supply chain due to limited resources and availability. Still, the study has aimed to cover several aspects and perspectives within the organization in order to get a diverse perspective on the subject. In addition, input from competitors documents and reports have been used for the sake of expanding the understanding of environmental performance and effort in the consumer health industry.

Furthermore, Bryman and Bell (2011) explain that *ontological authenticity* considers whether the research helps members to understand their context better. Since this is a master thesis based on a case at LifeSci, the main goal has been to also increase the understanding of the subject within the organization. For example, the EPEF was formed to fit the company and their context, and therefore also make sure that the company increases their understanding of our findings from their organization. Bryman and Bell (2011) define *educative authenticity* to cover whether the members better appreciate the perspective of other members in the same contextual setting. Since LifeSci is a large and well-established company with several departments and functions, the thesis has tried to increase awareness and establish an understanding of how different departments view the subject of environmental sustainability.

Bryman and Bell (2011) describe *catalytic authenticity* to consider whether the research has acted as an initiative to engage in action. Considering that the objectives of the thesis is to suggest a framework for evaluation of environmental performance and also suggest improvement and prioritization areas, the thesis will hopefully engage the organization in a change for improving their environmental efforts. The EPEF will hopefully provide the company with a starting point to carry out improvements in fields suggested from the findings. Further, Bryman and Bell (2011) state that *tactical authenticity* is about the research allowing the members to take necessary steps for action. However, this is a delimitation of the thesis since actual steps or initiatives cannot be planned or suggested, since this lies in the organization's decision areas. Instead, the study suggests fields that might need to be prioritized for improvement.

3.6 Ethics

Ethics in different types of research is highlighted in almost every journal or book that you can find about research methodology. This indicates the importance of research ethics, and that is also why the researchers in this thesis have taken caution to ethics throughout the whole project. Waller et al. (2015) defines ethics as honest and accurate research that is beneficial and not harmful to anyone. Further, the authors also elaborate that ethics includes respecting participants rights and dignity, meaning giving enough information about the study to let the participants decide whether to be involved or not. For this study, a comprehensive description of the research and its aims, the role of the participants and the interview guides have been sent out beforehand in order to let the participant decide whether to participate or not. Waller et al. (2015) point out that any type of private conversation in any form can be sensitive data. Therefore, the researchers have decided to be cautious of anonymity throughout the data presentation and have promised confidentiality to the respondents and the company. Waller et al. (2015) state that confidentiality also increases the willingness to participate in studies and gives respondents protection.

Waller et al. (2015) also highlights that the potential benefits of a research always should outweigh any potential harm that the study might lead to. To clarify, the authors state that there are different types of risk that needs to be considered: risk to the researcher, risk to the ones researched and risk to the institution. To avoid any risks for anyone involved in this thesis, the researchers have continuously consulted supervisors at LifeSci and Chalmers University of Technology for this matter, to make sure that the findings from the study will not harm any involved actor in any way, but rather just provide insights and understanding. Another measure to avoid any risk for the ones researched, this thesis does not include any sensitive or confidential data from the company that are not meant to be published.

4 Case Product Description

The following chapter will present information about the case product, B-Ointment. It will start by introducing usage and some overall knowledge about the product and thereafter describe the flow from the transportation from first tier suppliers to transportation to the product's retailers.

4.1 Marketplace and Usage

The product B-Ointment, 30 ml, is one of many products within the B-Ointment product category and is part of LifeSci's consumer health segment. The B-Ointment product category contains both prescriptive and non-prescriptive products, different sizes of tubes and different areas of use. The product B-Ointment that is covered in this thesis is however a non-prescriptive product, mainly used to nurture and protect sensitive and dry skin in areas such as feet, hands, nose and lips. According to one respondent, the product also has been proven to be noticeably useful for healing new tattoos.

Further, B-Ointment is a well-recognized product in the Swedish market and is considered as one of the LifeSci's products with highest Swedish demand and is thus classified as an *A* product. The product is registered as a cosmetic product and is hence not controlled by any specific regulations nor any specific transportation and storing conditions. Moreover, the product is also considered as one among approximately 70 products which is strategically important for LifeSci. Hence, the product has premium protection when it comes to material supply and it has among the highest prioritization by the company when it comes to robust supply chains. The following section will describe the product's supply chain.

4.2 The Supply Chain

The supply chain for B-Ointment is illustrated in figure 4.1 below. B-Ointment consists of approximately 10-15 components, one of which is the active ingredient dexpanthenol. The flow starts with components being transported from the supplier to the production site in Germany. Since the suppliers are based all over the world, different transport modes are used to supply the production site. One respondent stated that decisions regarding transport mode are made by the transport planning department at LifeSci. The production site receives the components and prepares them for the production process. The materials are hence formulated into a bulk i.e. into a two- or five-tonne mixture of B-Ointment. The mix is thereafter stored, waiting to be filled in the 30 g tubes.

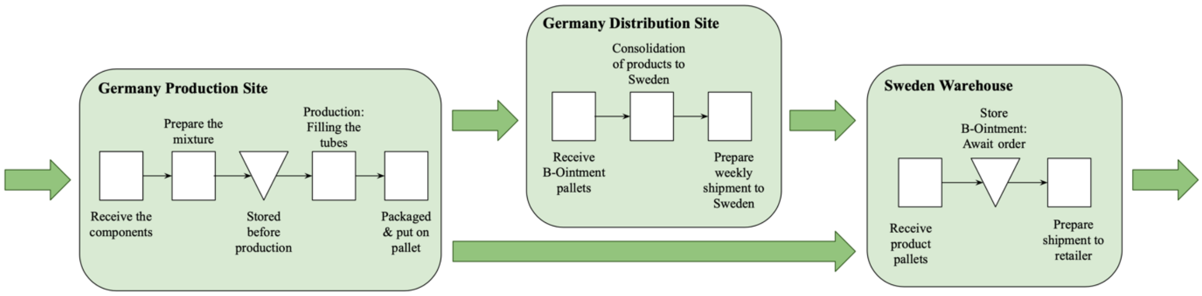

Figure 4.1 - The supply chain for B-Ointment from first tier supplier to retailers.

After the production, i.e. after the tubes have been filled, the tubes are put into a carton together with a leaflet. The product packages are then bundled with other product packages in a batch of approximately 20 B-Ointment packages. Further, each batch is thereafter put on what is called a shipper or a bigger cardboard box, which can consist of ten similar batches. Each bigger cardboard box hence consists of 200 B-Ointment tubes. When it is time for shipping, each bigger cardboard box is packed on a pallet together with other boxes and when the pallet is full it is labeled to Sweden and is thereafter waiting to be picked up by a transporter. One respondent explained that LifeSci uses external logistics service providers (LSPs) to organize the transportation from the production site to the different local warehouse. After the pallet is prepared, LifeSci informs the LSP about the shipment through their transport management system and the LSP is then arranging a pickup.

The flow from production site in Germany to the warehouse in Sweden might go one of two ways, as can be seen in the figure 4.1. It can either go through the regional warehouse/cross-docking hub in Germany, or it can go directly from the production site to the warehouse in Sweden. The flow of the pallets is decided by the supply manager for Sweden who is based at the head quarter in Switzerland. The supply manager needs to consider request, prioritization and the lead time for shipping. For example, if there somehow is an extreme demand for B-Ointment which results in empty stocks, the transportation would go directly from Germany to Sweden. The motivation behind the choice of flow will firstly be based on B-Ointment being classified as an *A* item and is hence extremely important to have in stock. Secondly, to minimize the effects of out of stock it would be best to deliver the new products as soon as possible and a direct flow would decrease the lead time by at least a week.

The first alternative, through the cross-docking hub, is however the most common flow, primarily since it maximizes the utilization of the truck but also because most of the deliveries are made before risking running out of stock. Thus, the transporter picks up B-Ointment pallets for the whole Europe demand at the production site and delivers it to the cross-docking hub. The B-Ointment pallets are then distributed and consolidated with pallets from other production sites with the same destination, in this case Sweden. The pallets are then waiting for the weekly or monthly shipment to Sweden and all products to Sweden are hence sent together. The transportation from cross-docking hub to the warehouse is also made by LSPs. When the products arrive at the warehouse in Sweden, the products are checked in and put in stock. When the warehouse receives an order from any Swedish retailer the product is picked from stock, prepared with other products with the same destination and are then sent to the retailer with an external LSP.

5 Empirical Findings and Analysis

The following chapter will present the study's empirical findings obtained from interviews, annual- and sustainability reports. The chapter will follow the similar structure as the processes in the EPEF, hence it will start with the context factors for the enable process. After presenting and analyzing the different context factors, the chapter will continue with the processes source and deliver, which will be introduced together. Section 5.2 Source and Deliver is divided into the four main areas for environmental sustainability i.e. emissions, waste reduction, reuse and recycling and energy.

5.1 Enable

According to one respondent, each segment of LifeSci (consumer health, pharmaceuticals and crop science) has a set goal within sustainability. Further, each segment also has sustainability teams that focus on reaching this goal and meeting the set goals for the segment. Nevertheless, the respondent stated that there is a corporate sustainability team as well that is managing everything among the segments and orchestrating everything on a more overall level. When it comes to the different corporate functions in each segment, there is also a team or department within each function that sets the rules and guidelines for how the function is operating and following the directions and goals from the overall sustainability team at LifeSci. For reporting purpose and usage of guidelines, the respondent also stated that LifeSci was early with using guidelines from CDP.

When it comes to challenges connected to environmental sustainability on a general level, one respondent emphasized the mindset connected to sustainability. The respondent stated that environmental actions still are linked to costs and profit at the company. Still, the respondent says that there has been a change to seeing the marketing advantages of environmental performance efforts, that can improve the reputation of the company. However, there is still a lacking understanding of the output of investments in environmental sustainability. The respondent emphasized that it partly is an investment in risk mitigation and means that eventual costs of heavy environmental impact can be avoided in the future. Furthermore, the respondent emphasized that it also is a business opportunity, where the environmental sustainability efforts can be used to differentiate the product or the company. The respondent implied that sustainability can act as a differentiator towards the customer and be an essential part of the brand. However, there are still too long payback periods for these investments to be considered profitable and favorable. Still, another respondent also stated that as a big multinational company, LifeSci are responsible for their impact on the environment and need to take responsibility and ensure minimized effect on the planet.

5.1.1 Organizational Environmental Targets

LifeSci states in their sustainability report from 2019, that sustainability is a crucial part of their strategy and the company has therefore included four sustainability targets. One of them, *climate protection,* is the one related to the environmental aspect of sustainability. LifeSci's target regarding the climate is to have production sites which are carbon neutral by 2030. The company's main effort to fulfill carbon neutrality by 2030 is, according to their sustainability report, to increase procurement of renewable energy and enforce energy efficiency measurements on production sites. Furthermore, one respondent stated that the environmental targets are based on international reporting standards, GHG Protocol, European standards or other national reporting standards.

The respondent further clarified that the target was only recently announced, more precisely in the beginning of 2019. Consequently, the environmental targets for LifeSci are still on a general level i.e. there are no specific targets for LifeSci's consumer health segment nor for the product B-Ointment itself. The fact that the different departments have low connection to the environmental targets also becomes visible in the question of what environmental targets the interviewees follow in their daily work. Where most of them answer that sustainability is not a part of their daily work. It is hence clear that there is still no explicit distribution or definition of the different department's contribution in the sustainability aspect. However, it seems that the respondents think it will be improved in the future.

One respondent continued explaining that the sustainability department at the moment is trying to define what each department has to do in order to reach the carbon neutrality goal together. The interviewee stated:

> *"When we started at the beginning of 2019 there was not even a CO_2 target for LifeSci. There were sustainability trends but not a target. Now we have the target and now I believe there will be a ton of other measures that will come along but just takes some time." - Managerial Respondent*

Hence, it seems that with a corporate environmental target in place, more efforts and measures will be implemented, and the environmental target will in the future be detailed down to a lower level and facilitate each department's sustainability work.

Further, to be in line with the *Paris Agreement* and to limit global warming, the company also aims to collaborate with customers and suppliers to decrease the greenhouse gas emission both up- and downstream the value chain by 2030. Comparing CO_2 emissions/transported weight before and after the target was set in the beginning of 2019, there has been a huge decrease. Even though there has been an increase in absolute CO_2 emissions there has been an even bigger increase of the weight transported, which makes the relative measure decrease.

Moreover, one respondent explained that they, in the objective of decreasing the GHG emissions up- and downstream the value chain, have identified targets on a transport mode specific level.

Hence, they have one target for air freight, one target for ocean freight and another for truck transportation. The respondent also, in the question regarding target level, stated:

> *"It is not easy or make any sense to have targets for a single product." - Managerial Respondent*

The respondent explained that it is not possible to keep it on a product level since the products almost never are transported separately. Furthermore, it can neither be on a segment specific level since products from different business segments also can be transported together. A higher target level would also become problematic, since different modes cause different amounts of emissions. Most sense would therefore be to have them based on the different transport modes.

5.1.2 Business Rules

There appeared to be only a few constraints or rules that applied for the product B-Ointment. One constraint that was presented during an interview was the supply chain segmentation. The company have in total four different segments i.e. *A-D* products and as was mentioned above, B-Ointment is classified as an *A* SKU and is hence an important product for the Swedish market. It is therefore crucial that B-Ointment never are out of stock. Thus, according to one respondent, an *A* classified product can never be transported by rail, since rail as a transport mode is too slow. Further, there are also rules or exhortation that these products should be supplied as often as possible from the production site in Germany to Sweden so that the lead time becomes shorter. It emerged that when it comes to an *A* product, it is a high prioritization of available products on the shelfs which seems to influence the environmental perspective negatively. The best would, of course, be to have a combination of both, however regarding the question of more frequently or higher vehicle utilization it feels like the first will be prioritized when it comes to an *A* classified product such as B-Ointment.

Furthermore, on a more general level, it emerged that the transport planning department, which is the ones responsible for the selection of transport mode, have a course of action to limit the air freight as much as possible. One respondent however emphasized that the limitation of air was not a matter of reducing the environmental impact but more a matter of reducing costs. Additionally, it appears that airfreight shipments that exceed a certain cost limit require some kind of approval and are afterwards reported to increase the awareness. The cost factor is hence in focus. However, the course of action promotes the environmental aspect and the share of CO_2 emissions originating from air freight has gone from being the largest share by 2018 to being the second largest in the end of 2019. Furthermore, the share of weight transported by air has also decreased from 2018 to 2019.

When discussing suppliers and business rules, one respondent explained how LifeSci uses the company EcoVadis to audit LifeSci's suppliers. All suppliers need to follow LifeSci's code of conduct in order to work with the company. The respondent continued explaining that this assessment is made repeatedly for all companies who potentially will or are currently working with LifeSci. Further, it is more than just the environmental aspect that is being audited. However, due to LifeSci's new sustainability program, the environmental part has been expanded. More focus has therefore been put on assessing what materials supplier uses and also what materials that suppliers have to avoid. The respondent stated:

> *"This is pretty new and was published in the beginning of the year. What this means for the product B-Ointment, still needs to be developed during the year or the next year." - Managerial Respondent*

More initiatives or rules are hence implemented but are still on a general level. Additionally, in cases when the audit reveals red flags, the supplier gets a reorder plan followed by a reassessment a year later. If the supplier has not made the crucial improvements, LifeSci will look for alternative suppliers.

5.1.3 Regulatory Compliance

One of the respondents stated that LifeSci probably has an overall highly regulated environment, e.g. for both pharmaceuticals, cosmetics and food products. The respondent also stated that the company should be aware of regulations and be complying in accordance. Further, the respondent stated that they cannot monitor each and one of certain regulations, but instead need to assume that the authorities are controlling the products and doing their job in making sure that the products are complying with the set regulations. Still, the respondent highlighted that there are several regulations that need to be followed for each industry and that with the use of EcoVadis, they hope to minimize any problems on the supplier side. The respondent explained that regulations might not be that strict from some countries, and that the EcoVadis assessment helps the company make sure that the regulations that they set out to meet are met by their suppliers as well.

When it comes to logistics activities, the respondent was not aware of any specific regulations for the shipments. LifeSci instead tries to make sure that the products are transported and stored probable, e.g. by the use of refrigerated trucks. Another respondent also added that they have safety data sheets of the products, where any concerning regulations are stated. For B-Ointment, as a cosmetics product, there are low regulatory hurdles compared to pharmaceutical products. These data sheets contain information on whether the product contains any hazardous ingredients and guidelines of how it should be handled during transportation. Specifically, for B-Ointment, the product does not contain any specific hazardous ingredients and therefore no further guidelines and directions of the shipments.

5.1.4 Environmental Guiding Initiatives and Standards

While analyzing and comparing all sustainability reports and environmental efforts and targets, there were a few guiding initiatives and standards which were frequently recurring. These were: *Carbon Disclosure Project*, *GHG Protocol Initiative*, *United Nations Sustainable Development Goals* and *ISO 50001 energy management system*. Since these initiatives and standards influence both LifeSci's and other actors' sustainability work and their reporting, the *environmental guiding initiatives and standards* can be seen as contextual factors and part of the *enable* process. The EPEF, established in section 2.1, has therefore been expanded and will be explained further below.

Carbon Disclosure Project

CDP is a global non-profit organization with the purpose of facilitating sustainable economic growth (CDP, 2020). Their system has been active the last 15 years and has improved the involvement in environmental issues with main focus on climate change, water security and lastly, deforestation (CDP, 2020). The organization manages a disclosure system where member companies, regions or cities obtain support on how to measure, understand and take actions regarding their environmental impact (CDP, 2020). During 2019 there were more than 8,400 companies and approximately 920 regions that took part of the disclosure system (CDP, 2020). Further, CDP's vision is that environmental impact first needs to be measured to later be able to be improved, the organization therefore provides members with standardized reporting systems to facilitate these processes (CDP, 2020). In addition, using the standardized reporting system enables benchmarking and identifying risks and opportunities (CDP, 2020). Furthermore, CDP has a score system where each disclosing member's environmental work and progress are evaluated (CDP, 2020). The score is hence used to indicate if the company or city needs to increase their effort but also benchmark how they do, compared to other companies or cities (CDP, 2020). Further, CDP also each year declares an *A List*, presenting the most outstanding and leading members (CDP, 2020). From the *A List 2019* can, among other, the following companies be identified; Johnson & Johnson, Unilever, L'Oréal and LifeSci (CDP, 2020).

Greenhouse Gas Protocol Initiative

The GHG Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organizations, governments, World Resource Institute and the World Business Council for Sustainable Development among others (GHG Protocol, 2015). The initial mission of the initiative was to develop GHG accounting and reporting standards for businesses. Their developed *GHG Protocol Corporate Accounting and Reporting Standard* provides a step-by-step guide for organizations to use in order to be able to quantify and report their GHG emissions (GHG Protocol, 2015). Further, the standard covers accounting and reporting of the six GHG covered by the Kyoto Protocol (CO_2, CH_4, N_2O, HFC, PFC, SF_6, NF_3). The GHG Protocol standard is supposed to help companies prepare a GHG inventory that represents a true and fair account of their emissions and increase consistency and transparency in GHG accounting and reporting among companies (GHG Protocol, 2015).

The GHG Protocol standard distinct direct GHG emissions from indirect GHG emissions. Direct GHG emissions are connected to emissions from sources that are controlled by the company, while indirect GHG emissions are defined as emissions that are a consequence of the company's activities but occur from sources that are connected to another company (GHG Protocol, 2015). Further, the standard defines three different "scopes" for GHG accounting and reporting: *Scope 1, Scope 2* and *Scope 3.* Since scope 1 and scope 2 are connected to direct GHG emissions from the company's activities, the standard states that reporting these is a minimum (GHG Protocol, 2015).

Specifically, scope 1 covers the direct GHG emissions from e.g. combustions in owned vehicles, production or other process equipment (GHG Protocol, 2015). Scope 2 covers the indirect GHG emissions from generation of purchased electricity that is consumed by the company. Physically, the scope 2 emissions occur at the facility where electricity is generated (GHG Protocol, 2015). Finally, scope 3 is an optional reporting category and considers indirect GHG emissions from consequences of activities but that occur from other sources not owned by the company (GHG Protocol, 2015). The standard states that it is difficult to provide a generic guidance on which emissions to include in scope 3. Still, the standard states that the accounting for scope 3 emissions does not need to involve a full GHG life cycle analysis, but it is more valuable to focus on one or two major GHG-generating activities. An important step in this standard is to identify GHG emissions sources before being able to calculate and report GHG emissions in each scope (GHG Protocol, 2015).

When it comes to transportation of material or products, scope 1 covers transportations and distribution made within the company by transportation processes and vehicles owned by the company (GHG Protocol, 2015). However, scope 3 includes transportation of purchased materials, sold products, waste and other transportation-related activities that are made with vehicles owned by external companies (GHG Protocol, 2015). Furthermore, scope 3 is divided into subcategories such as upstream transportation and distribution, downstream transportation and distribution and waste generated in operations (GHG Protocol, 2011). Specifically, subcategory 3.4 in the standard considers upstream transportation and distribution and includes emissions from transportation and distribution of products purchased or acquired by the company. Meaning, any inbound or outbound logistics and third-party transportation and distribution between first-tier suppliers to the company and between a company's own facilities (GHG Protocol, 2011). Additionally, the standard includes transportation and distribution of finished goods to warehouses and retailers in this category as well (GHG Protocol, 2011).

United Nations Sustainable Development Goals

In 2015, the 17 UN sustainable development goals (SDGs), see figure 5.1 below, were established and adopted by the UN member nations (United Nations, 2020). The goals, together with a large number of related sub-targets are part of the *2030 Agenda* and aims to stimulate and guide countries actions within highly critical areas for the planet and humanity until 2030 (United Nations, 2020). Hence, the SDGs consider all of the three sustainability pillars, people, planet and profit, and try to help countries to together develop in a more sustainable way (United Nations, 2020).

Figure 5.1 - United Nations Sustainable Development Goals. Source: United Nations (2020).

Furthermore, each SDG contains a number of sub-targets which further can be evaluated by a set of identified indicators (United Nations, 2020). Analyzing the environmental aspect of logistics and warehousing for companies, SDG 7, 9 and 12 can be considered.

SDG 7, *Affordable and clean energy,* includes, as it states, the energy aspect. Sub-targets within SDG 7 are firstly, increase the share of renewable energy in the energy mix substantially by 2030 and secondly, increase the rate of improvement of energy efficiency by double by 2030 (United Nations, 2020). Indicators for the sub-targets would respectively be; renewable energy share of total energy use and energy intensity (United Nations, 2020). Additionally, SDG 9, *Industry, innovation and infrastructure,* includes the aspect and indicator of CO_2 emissions. The sub-target is to increase the efficiency of resources used and update the infrastructure to be able to adopt new more sustainable technologies (United Nations, 2020). The SDG 9 sub-target is evaluated based on the CO_2 per unit of value added (United Nations, 2020). Finally, SDG 12, *Responsible consumption and production*, relates to disposal, reuse and recycling of waste (United Nations, 2020). The first related sub-target is, achieve better waste management by 2020, to limit and reduce the releases to water, air and soil and are evaluated based on the hazardous waste generated (United Nations, 2020). The second related sub-target is, reduce waste generation through reduction, recycling or prevention and is assessed by indicators such as recycling rate and tons of material recycled (United Nations, 2020).

ISO 50001 Energy Management System

The ISO 50001:2018 standard is a strategic tool that helps organizations to implement an energy management system in order to utilize their energy more efficiently and effectively (ISO, 2018). It involves developing and implementing an energy policy, setting targets and designing action plans to reach targets and measure progress. Further, the standard is used by a variety of small to large organizations worldwide, and can benefit both by reducing environmental impact, enhancing reputation and to improve competitiveness (ISO, 2018). According to Jabbour et al. (2017), the ISO 50001:2018 standard is divided into four groups of requirements: *energy planning, implementation and operation, checking* and *management review.* These four categories are based on the Plan-Do-Check-Act approach, and the authors conclude in their research that this standard may help to implement more environmentally sustainable energy plans for organizations and improve efficiency, resulting in less CO_2 emissions.

5.1.5 Approach to Sustainable Logistics in Similar Product Categories

Looking at the environmental targets and efforts among all the actors in the consumer health industry, there are some interesting observations of the reported efforts. Table 5.1 shows a summary of the environmental targets from both LifeSci and the chosen competitors

Table 5.1 - Summary of Environmental Targets.

Target	LifeSci	Beiersdorf	J&J	Perrigo	L'Oréal	Unilever	P&G
Emissions	Reduce emissions from our up- and downstream value chain between 2020 and 2030.	Reduce CO_2 emissions by 70 percent per product manufactured from 2014 to 2025.	Reduce CO_2 emissions by 80 percent by 2050.	Reduce GHG emissions by 15 percent by 2020.	Reduce the GHG emissions of plants and distribution centers by 77 percent from 2005 by 2020. (Achieved 2018)	Halve the GHG impact by 2030.	Reduce absolute GHG emissions by 30 percent from 2010 to 2020.
Waste Reduction				Reduce waste by 15 percent by 2020.	Reduce waste generated by plants and distribution centers by 60 percent, from 2005 to 2020.	Halve the waste of disposal by 2020.	
Recycling		Integrate at least 25 percent recycled materials in their plastic packaging in Europe by 2025.					Recycle or reuse 100 percent of their packaging by 2030.
Energy	Switch electricity from production to renewable energies worldwide by 2030.	100 percent of global electricity purchase of global production sites sourced production sites sourced.	Electricity from 100 percent renewable sources by 2050.	Reduce energy use by 15 percent by 2020.			Purchase 100 percent renewable electricity globally by 2030.

From the table, it can be concluded that emissions-related targets are present in all the actors in the industry. Further, all actors have initiatives towards increasing energy efficiency and reducing energy-linked emissions, but two actors do not report any targets in this area. Waste reduction and recycling targets are clearly not as well exposed among the actors. Another observation is also that the actors either have a target connected to waste reduction or recycling, but not in combination. Still, emissions and energy targets are the most occurring among the actors in the consumer health industry.

Many organizations are members of the CDP organization which feature climate change and the companies are evaluated and given a score based on their work and progress. The scoring of companies presumably motivates companies to make environmental efforts. As mentioned above LifeSci, J&J, L'Oréal and Unilever are all awarded an A score from 2019, which means they have made progress and worked with climate change in a good way. Additionally, number seven of the UN's SDGs has a clear connection to renewable energy, where they suggest using the *share of renewable energy* as an indicator. Further, the focus on emission reduction and energy efficiency might therefore be a result of these areas being considered to have greater environmental impact than waste reduction and recycling.

Further, as one respondent mentioned, LifeSci sustainability targets are newly implemented. In comparison, many of the competitors have years of experience of working with the environmental aspect such as L'Oréal with seven years of experience. So, it might not be that surprising that L'Oréal includes more areas than LifeSci. However, J&J (2020) who states that they have more than 30 years of environmental work, is only focusing on emission reduction and renewable energy which in contrary implies that it does not only require more experience to expand environmental efforts, but may also require other resources. This contradicts what some of the respondents from LifeSci hoped for, that with one target in place the rest will come. It is however difficult to tell what the reason is for some competitors having two focus areas while others have three or four based on only what is said in their sustainability report.

A further description of the highlighted environmental targets and efforts among the actors is presented below to give an overall view of what the competitors have chosen to report in their sustainability reports.

Beiersdorf

For assessment of the sustainability efforts and performance within their consumer business segment, Beiersdorf is oriented towards and utilizes the GRI framework to report their performance (Beiersdorf, 2020). Sustainability has been a part of the company culture for a long time and in 2012 the company initiated their sustainability strategy *We Care* to set up targets and to focus processes on sustainability (Beiersdorf, 2020). The environmental targets in this strategy have included purchasing electricity 100 percent from renewable sources by 2020 and reducing the energy-related CO_2 emissions per product by 70 percent from 2014 to 2025. The first target was met during 2019 and the latter have reached 65 percent so far (Beiersdorf, 2020). From 2020, Beiersdorf have revised their sustainability agenda based on the UN SDGs. This new agenda is focusing on the most problematic area which the organization considers to be the negative impact on the environment from their CO_2 emissions (Beiersdorf, 2020). Beiersdorf is still yet to define new objectives for the new agenda, but so far have added the goal of using 25 percent recycled material in the plastic packaging in Europe and make 100 percent of their global packaging recyclable, reusable or compostable by 2025 (Beiersdorf, 2020). In 2019, the company created a sustainability council within the organization which works with the sustainability activities and prioritization of initiatives (Beiersdorf, 2020).

Johnson & Johnson

J&J uses the GRI framework to present their sustainability performance (Johnson & Johnson, 2019). Furthermore, Johnson & Johnson has for the last 30 years been working with sustainability targets with the purpose of improving their environmental performance, mainly within GHG emissions and energy efficiency (Johnson & Johnson, 2019). The company decided in 2010 to reduce their CO_2 emissions and ended up with two environmental targets. Firstly, by 2020, the absolute CO_2 emissions should be reduced by 20 percent compared to 2010 numbers (Johnson & Johnson, 2019). Secondly, by 2050, the absolute CO_2 emissions should be reduced by 80 percent compared to numbers from 2010 (Johnson & Johnson, 2019) Further, in 2010, J&J also determined two targets for the electricity used. Firstly, 35 percent of the electricity used, should by 2020 come from renewable sources (Johnson & Johnson, 2019). Secondly, all electricity used should by 2050 come from renewable sources (Johnson & Johnson, 2019). Their main effort to fulfill the targets is to reduce the unnecessary energy demand, increase the energy efficiency and shift to low-carbon or renewable energy options for the remaining demand (Johnson & Johnson, 2019).

Perrigo

Perrigo started their sustainability work 2015 and implemented an *Environmental Stewardship Program* the following year (Perrigo, 2020). The program extends from the manufacturing site until the distribution of products to the end customer and aims to mitigate the company's environmental impact (Perrigo, 2020). The focus areas of the program are; efficient operation, sustainable packaging and lastly, responsible supply chain. Furthermore, the program contains a number of environmental targets (Perrigo, 2020). Considering the efficient operations, Perrigo aims to reduce their GHG emissions, waste, water and energy by 15 percent by 2020 (Perrigo, 2020). Further, looking at sustainable packaging, the company aims to improve recyclability of packaging and labeling, but also improve the packaging efficiency (Perrigo, 2020). Their goal is to have product packaging that is fully recyclable but there is no published information regarding when this should be fulfilled (Perrigo, 2020).

L'Oréal

In 2013, L'Oréal initiated their sustainability program *Sharing Beauty With All* and set several environmental targets towards 2020. This sustainability program is based on the UN SDGs and includes quantitative measurements every year to make the results available publicly for everyone (L'Oréal, 2019). According to L'Oréal's numbers, 88 percent of their brands have conducted assessments of their environmental impact. Further, L'Oréal managed to reduce their CO_2 emissions from their plants and distribution centers by 77 percent in 2018 compared to 2005 (L'Oréal, 2019). L'Oréal was also awarded an A score by CDP in 2018 for their sustainability effort for the third year in row. In 2018, the company started initiation of their commitments towards 2030, which includes reducing its entire GHG emissions by 25 percent compared to 2016. Furthermore, the company wants to have an improved environmental profile for all of their brands and products by 2020, which include sourcing of raw materials, reducing the environmental footprint of the product formulas and optimizing packaging (L'Oréal, 2019).

Unilever

Unilever was early in considering the environmental aspect of their business and in 1995, they began to measure and report energy and water consumptions but also CO_2 emissions (Unilever, 2019). The company has afterwards come to consider the sustainability aspect as a strategic part of their business and has hence created the framework *Unilever sustainable living plan (USLP)* to help the company improve their performance (Unilever, 2019). Further, Unilever bases their sustainability work on the UN SDGs and has focused on areas where they think they can affect the most (Unilever, 2020). Since the company considers the whole life cycle of the product, when discussing sustainability, they have decided to divide the targets into the product and the manufacturing (Unilever, 2019). The targets stated 2010, in the USLP for the product category are the following; halve the GHG impact by 2030, halve the water used by 2020 and halve the waste of disposal by 2020 (Unilever, 2019). Further, the targets related to the manufacturing are; CO_2 emissions from energy used in 2020 should be lower than in 2008, by 2020 should the water abstraction be lower than the water abstraction in 2008 and lastly, total waste sent for disposal should be lower in 2020 compared to 2008 (Unilever, 2019).

Procter & Gamble

P&G considers issue prioritization an important tool to make sure they understand their stakeholders' views and address the most relevant issues (P&G, 2020). For this matter, the company makes use of a software solution platform that utilizes artificial intelligence to analyze thousands of publicly available sources, such as corporate reports, regulations etcetera, in order to tailor their prioritization areas to the company and the industry (P&G, 2020). One of these prioritized areas continues to be environmental sustainability. In 2018, the company announced their *Ambition 2030* sustainability goals, which includes enabling a positive impact on the environment (P&G, 2020). One of their goals for 2030 is to have 100 percent recyclable or reusable packaging. Further, P&G currently have reached 100 percent renewable electricity in all their sites in the U.S., Canada and Western Europe, but aim to reach 100 percent globally by 2030. Furthermore, the company has also managed to reduce their absolute GHG emissions by 25 percent from 2010 to 2020 (P&G, 2020). Further, P&G aim to reduce their footprint at every stage of their supply chain, mainly by advancing partnerships to drive circular solutions within the supply chain (P&G, 2020).

5.2 Source and Deliver

When it comes to the operational parts of the supply chain, there does not seem to be any distinction in the measurements of environmental performance between steps of the supply chain at LifeSci. One respondent stated in the interviews that there currently is no data connected to specific activities or processes, but rather that there is a general view of every aspect of environmental sustainability and the performance in each aspect. According to our respondents, most of the metrics are calculated instead of measured directly from its source. Still, one respondent described an initiative towards detecting the true number of emissions from its source, which will be further described in section 5.2.1.

Regarding the suppliers of LifeSci's consumer health segment, one respondent said that each segment of the company has a sustainability team that focuses on the goal and strategy that they are committed to. However, LifeSci has a central procurement sustainability and compliance team within procurement that serves all segments of the company. Within the procurement function of the company, with initiative from the sustainability team, they are working with supplier assessment audits from EcoVadis. After an assessment from EcoVadis of the suppliers, they get a sustainability score, which is compared to targets from LifeSci before they decide whether to work with the supplier or not. If the assessed supplier does not comply with the score from LifeSci, they can go through a reassessment after one or more years later. The respondent states that the assessment from EcoVadis is central and not looking into certain categories. However, CO_2 emissions seems to be one of the factors that is measured from the suppliers.

When it comes to the delivery of the final product to the customer, there has not been any clarification among the respondent on whether environmental sustainability is assessed during this part of the supply chain. Two respondents emphasized that every logistics-connected activity within the company is almost completely centralized. Specifically, one of the respondents stated that the selection of carriers and evaluation of transportation activities are conducted and planned on a global level across the organization. The initial observation is therefore that the sustainability efforts are kept centralized at LifeSci. When discussing sustainability efforts with one respondent from the production site for the product B-Ointment, the respondent was not really certain of the subject and referred to other team members and the central functions of LifeSci in order to sort the questions out. Therefore, it seems that the local sustainability teams at different sites might work towards the targets set by the central sustainability team, but other than that, other respondents did not seem to be sure on the subject of environmental sustainability.

When it comes to warehouse activities, the respondent stated that these activities are managed more on a regional level. However, there is no clarification on what aspects of warehouse activities that are reviewed, but this will be further explained in section 5.2.4. Still, another respondent stated that the use of warehouses between shipments from plants to retailers or customers helps maximizing the utilization degree in the vehicles used for the shipments. This indicates that vehicle utilization degree seems to be considered, but yet not measured in any way. For the centralized planning of shipments, one respondent explained that for the selection of carriers, refrigerated trucks are used for most of the pharmaceutical and OTC products, and some of the cosmetics products. The products often need to be kept chilled during transportation in order to avoid any chemical reactions or degradation of the ingredients in the products.

5.2.1 Calculations of Overall Emissions

According to one respondent, LifeSci wants to become carbon neutral by 2030. Specifically, LifeSci states that they want to achieve carbon neutral production by 2030. Further, as stated before, the organization wants to reduce emissions from their up- and downstream value chain between 2020 and 2030, by optimizing areas such as logistics, packaging and through cooperation with suppliers. Another respondent explained that CO_2 emissions currently is the dominating factor when it comes to the environmental aspect of sustainability at the company. The respondent claimed that CO_2 emissions is a big affecting factor when it comes to the questions of the climate crisis and therefore the most relevant field at the moment. Further, the respondent stated that other environmental aspects of sustainability can be derived from the issue of the climate crisis, but since the CO_2 emissions seem to be in focus, these are mostly highlighted and prioritized at the company. A third respondent also claimed that carbon footprint is the most highlighted environmental aspect in the respondent's surroundings.

While focusing on environmental targets for emissions and for different aspects of emissions connected to transportation, one respondent stated:

> *"The targets are transport mode specific. Meaning, one target for air freight, one target for ocean freight and one for road freight, because you know that there would be a lot more emissions from air freight then from other transport modes, so you have to have different targets for different modes." - Managerial Respondent*

However, the respondent did not indicate that these targets are measured absolutely or that there is any connection to any specific product. The targets are kept on an overall level for the organization, but the respondent suggested that calculations could be made based on the product. The respondent further explained that according to a chosen product, the likeliness of different transport modes could be considered and concluded before differentiating targets for products connected to respective transport mode. Still, looking at the obtained data from LifeSci, the data seem to be calculated based on country and company segment only and divided into the four different transport modes. Further, this data is calculated by different calculation rules and approaches, including e.g. satellite distance measurements, and therefore not measured directly from its source.

The respondent also described an initiative that was started in early 2019, where the goal was to measure the CO_2 footprint directly from air and ocean freight. Further, the respondent described why the project was initiated and stated the following:

> *"The first thing that you need to do in order to reduce your CO_2 footprint is to increase transparency on how big your CO_2 footprints are." - Managerial Respondent*

The initiative was started with a focus on the air and ocean freight since, as the respondent stated, these are the transport modes with the highest amount of emissions and a rather consolidated number of external logistics service providers (LSPs). Ten of the LSPs were chosen and asked for details and reports on CO_2 emissions for the shipments that have been executed for LifeSci. These reports are normally collected on a monthly basis and compiled in data sheets for both reporting and visual purposes. Additionally, LifeSci has EPIs defined for the CO_2 performance and are continuously measuring and comparing the reports from the LSPs to the set EPIs on a monthly basis to track progress towards the set targets.

Still, the respondent emphasized that the initiation of this project was a big challenge. It took a long time for the project leaders to get the LSPs onboard and start reporting the requested metrics. According to the respondent, it was an even greater challenge to establish a comparable structure of the data, since it otherwise would be difficult and almost impossible to compare CO_2 emissions from different LSPs. When it comes to other transport modes or a larger scale, the respondent said that there are a lot of different shipments and entities that need to be considered, which is not available for the moment. More specifically, the LSPs are not able to provide such primary data today to that extent and with that level of detail. Therefore, the respondent stated that this way of measuring the actual CO_2 emissions from transportation activities would become complex rather quickly. Another option that is emphasized is to use the mathematical approach and calculate the emissions connected to shipments. Still, the respondent stated that these calculations are not that often close to the real measurements.

Another respondent commented on the project of measuring emissions from transportation activities and stated that this only considers a fraction of the total and that the model is not mature enough to apply on the bigger picture. The calculations from this project are included in LifeSci's final report, but the respondent stated that it cannot be connected directly to the other numbers since it differs from the usual way of calculating and reporting CO_2 emissions. Further, the respondent described that the reporting of emissions from transportation activities is calculated from the extraction of data across all divisions in LifeSci. The data is then combined with industry standards for emission factors as well as distance travelled throughout the year and then reported on a general level for all activities and divisions. Furthermore, the respondent said that all the numbers in LifeSci's report to CDP are calculated from an organizational perspective through average data. The company is not capable of product carbon footprinting, and even if they tried this approach, the respondent stated that there would be assumptions similar to a life-cycle analysis and in the end not connected to the rest of the organization's measurements, and therefore not applicable on a larger scale.

Furthermore, the respondent described the three aspects of the commitment to CO_2 emissions at LifeSci, which include carbon neutrality, carbon reduction and further downstream value chain commitment to CO_2 emissions. Particularly, the respondent is focusing on the carbon reduction in their daily work and therefore connects it to scope 3 of the GHG Protocol. According to LifeSci, they identify eight key categories in scope 3, including category 3.4 which is connected to upstream transportation and distribution. In their report to CDP, LifeSci only reports one summed up number in scope 3.4 of the GHG Protocol that is connected to the CO_2 emissions from all upstream transportation and distribution activities. Meaning there is no distinction between different transport modes, parts of the supply chain or other direct connection to any specific activity. Another observation is that this number is only reported in LifeSci's report to CDP and not available in their annual sustainability report.

Further, the respondent described that the scope 3.4 category includes any in- or outbound logistics that LifeSci has paid for in the supply chain until the products are being shipped from their warehouses to the local warehouses or retailers. Meaning, LifeSci does not consider downstream transportation and distribution activities for CO_2 emissions, since it would not be feasible to take end-consumers CO_2 emissions into account. However, the respondent emphasized that they currently are recalculating each category in scope 3 of the GHG Protocol. Additionally, they are reviewing improvement areas for each category thanks to the new strategy and commitment of carbon footprint reduction.

Overall, one of the respondents did not seem to see any bigger concern around CO_2 emissions from transportation activities, by stating:

> *"My perspective is that it is a very small part of the total emissions that LifeSci as a company are producing. The majority of CO_2 emissions are for example coming from production. All transportation and warehousing activities make less than one percent of the total emissions that LifeSci is producing."*
> *- Managerial Respondent*

However, looking at the figures from LifeSci's sustainability report and LifeSci's report to CDP the impact from transportation activities might be a bit hidden. In their sustainability report, they report a total of 2,88 million tons of CO_2 equivalents emitted directly and indirectly, namely scope 1 and scope 2 from the GHG Protocol. Further, LifeSci report 10,85 million tons of CO_2 equivalents emitted in scope 3 of the GHG Protocol, whereas the major part consists of category 3.1 which according to the GHG Protocol (2015) includes production, extraction and transportation of goods and services acquired or purchased by the company which are not included in the other categories. Specifically, LifeSci reports 507,000 tons CO_2 equivalents emitted in category 3.4 which is connected to upstream transportation and distribution. Judging by these numbers, the emissions reported in category 3.4 makes up 3.7 percent of their total accounted emissions. However, as stated before, the measurements are calculated and estimated for the whole organization and therefore not specific to any product or supply chain. Therefore, the true emissions might be hidden in the greater numbers. Still, the data obtained from LifeSci shows that there is an initiative from 2016 of increasing end-to-end visibility on transports, which means connecting LSPs to a cloud solution in order to track shipments better. However, how this data is managed or analyzed is not yet clear.

When it comes to the competitors, there are different approaches to emissions connected both to production and logistics activities. Utilization of the GHG Protocol seems to be present at all of the chosen competitors in this thesis, as well as reporting guidelines from CDP. Further looking at scope 3 of the GHG Protocol which considers transportation and distribution activities both upstream and downstream. From the interviews, it was clear that the downstream category was not relevant or feasible for LifeSci at all to measure, since the scope of this would be too big. Considering that there are no measurements connected to specific processes or supply chains, it is understandable that this might not be the primary focus for LifeSci in their environmental sustainability efforts for the moment. Still, looking at competitors, both J&J and P&G are reporting downstream linked emissions in scope 3 of the GHG Protocol. Meaning, they may have systems and solutions in place to track transportation-linked emissions throughout the whole supply chain. Although, no conclusions can be drawn on how specific this is measured or calculated by other actors, since that data has not been acquired in this thesis.

All competitors have a target of reducing their total carbon footprint in the upcoming years, connected to an overall level mostly highlighted from a producing point of view. Considering emissions linked to transports, P&G (2020) have reached their goal to reduce truck transportation kilometers by 20 percent per unit produced by 2020. In 2019, the company reached this goal by reducing kilometers by more than 25 percent, and in other words, were successful in their goal of road optimization. Compared to LifeSci, P&G (2020) also measures downstream transportation and distribution activities in addition to upstream activities, and therefore consider a greater scope of their transportation-related emissions. Further, looking at L'Oréal (2019), they report that they have initiatives among their business transport teams to reduce transportation emissions by studying the network, in order to reduce the distance travelled but also to optimize the refilling rate. This approach has helped the company reduce their transportation-linked CO_2 emissions by 8 percent from 2011 to 2018. L'Oréal (2019) also states the financial savings from these investments will be invested once again in sustainable transportation solutions.

Looking at the data obtained from LifeSci, the company seems to have an initiative from 2018 of optimizing road transportation in the U.S. and in Canada. However, there is no clarification in the data or in LifeSci's sustainability report on how to proceed with this initiative or any linked targets to this initiative. In fact, this initiative is not mentioned at all in their sustainability report.

According to J&J (2019), they work with their transportation providers to optimize their distribution network, by e.g. optimizing transportation routes and consolidating shipments. The company also participates in the U.S. EPA's Smartway program, which is described to help companies voluntarily increase transportation energy efficiency and decrease GHG emissions and air pollution. Further, J&J (2019) states that they provide incentives for customers to order in quantities in order for the company to optimize the vehicle utilization degree. The company also measures and reports both upstream and downstream transportation-linked emissions, similar to P&G.

Beiersdorf (2020) reports that they use a tool called EcoTransIT in order to calculate their accounted global transportation-related CO_2 emissions, and also present their metrics of emissions in scope 3 of the GHG Protocol. However, looking at Perrigo (2020) and Unilever (2020), there are no metrics reported connected to transportation activities. Both of the companies bring up scope 3 emissions, but neither specify the upstream- or downstream transportation-linked CO_2 emissions. There is also a lack of information about transportation-linked emissions in general in both reports.

5.2.2 Development Process of Waste and Waste Reduction Metrics

When discussing the environmental sustainability aspect of waste from packaging and preparation activities for the product B-Ointment, it appears that LifeSci has not yet evaluated this aspect to a wider extent. One respondent stated that avoidance of waste and packaging, in general, is considered but that they are in the beginning of developing any concrete plan. Another respondent briefed that the company lacks information and course of action within this area and informed that the company especially lacks information on the product level. Hence, it appears that the company has low insight in how much packaging waste and preparation waste is generated by the single product B-Ointment, but also on an overall level. The perception is therefore that packaging waste and similarly its environmental impact has a low priority.

One respondent also explained that the main focus of the company's sustainability efforts has been revolving the company's CO_2 emissions and that now, with an implemented emission goal, it will bring more speed into the development of other aspects. So, reduction of CO_2 emissions seems to be a first step for the company within their environmental sustainability work but during the discussion about future efforts it turned out that some of the interviewees can imagine waste avoidance as a next step. However, to do so, another respondent stated that it requires more information regarding packaging specifications than what is available today. The respondent emphasized the package's purposes, e.g. protecting and marketing the products, as aspects which need to be considered before improving reusability and packaging waste reduction.

When considering LifeSci's waste efforts in general, they want to minimize their generated waste. It is however up to each production site to decide what waste-mitigating actions to implement and also how to dispatch the waste safely. Comparing LifeSci to the identified competitors, some competitors seem to stress the importance of measuring waste reduction more than LifeSci. As stated in section 5.1.4, Perrigo, L'Oréal and Unilever include waste reduction as one of their environmental targets and Unilever has a history of measuring and reporting waste since 1995. Moreover, L'Oréal achieved to have zero landfill from production and warehousing sites by 2018, which was earlier than their original aim.

Furthermore, competitors' sustainability reports seem to focus on waste generated from manufacturing or production facilities. The category plastic packaging or plastic waste also seem to be a highlighted topic, at least for Unilever and P&G who aim to halve the virgin plastic used in their product packaging. LifeSci on the other hand, does not seem to highlight plastic waste. They, however, differentiate waste into four categories. First, they separate between hazardous and nonhazardous waste, second, they detach waste from production and not from production. Packaging and waste from preparation activities presumably are a part of the *nonhazardous* and *not from production* category, it is however not stated anywhere, and it seems that their documentation is only on a general level, as was also mentioned by one respondent. Even if it might be included into one of these general categories it becomes difficult for the logistics department to understand how large their share of waste generated is and hence what to do about it. Although, this general level can be identified in the competitors' reports as well. The differentiation between hazardous and nonhazardous waste is recurrent among the sustainability reports and appears to relate to the standards of the GHG Protocol Initiative.

Additionally, it is hard to tell whether companies consider waste from packaging or preparing activities or if they only examine waste in connection to the product or its manufacturing process. It can hence be worth mentioning that L'Oréal is the only one explicitly discussing waste related to packaging in transportation and in distribution centers (L'Oréal, 2019). They state that they aim to reduce their waste by 60 percent from 2005 to 2020 (L'Oréal, 2019). They also discuss redesign, optimize and make packaging for transportation and warehousing more lightweight as one way of accomplishing the target (L'Oréal, 2019). Another interesting initiative in order to reduce waste generated by transportation packaging and warehousing is what L'Oréal calls the *wall-to-wall strategy*, where L'Oréal uses the same packaging unit as their supplier and hence can use the same packaging through major parts of the supply chain (L'Oréal, 2019).

5.2.3 Unfamiliarity of Reuse and Recycling

Based on the respondents' answers, reusing and recycling of packaging and preparation material are not a topic of LifeSci's sustainability efforts, or at least not yet. One respondent confirmed that there currently are no long-term attempts within reusing or recycling of packaging material. Another respondent stated the following when asked about documenting any data connected to recycling:

"I don't think we have a lot of information." - Managerial Respondent

Overall the respondents seemed, in general, a bit unfamiliar with the topic and many of them proceeded to inform that their main focus is regarding the reduction of their CO_2 emissions. Another respondent also added that measurements are made on a more general level. Even though some measurements are made, it is not documented on a product specific or an activity specific level. One respondent was however hopeful that the efforts and targets linked to CO_2 emissions also can facilitate future work of other areas. The same respondent stated:

> *"In the future, I think, we will look into more what could be done in case of used raw materials in packaging? For example, do we use recyclable paperboards for all folding cards already? Or are we still using virgin material for paper boards for the folding cards?"- Managerial Respondent*

The respondent also mentioned the opportunity to look into the reduction of the number of colors used for printing logos on packaging. Analyzing the response, it seemed that reuse and recycling is an area which can require more time and effort by the company. Some potential improvement areas or initiatives are identified but their focus seems to be concentrated on CO_2 emissions and the implemented CO_2 target for 2030.

When considering LifeSci's recycling and reuse efforts and reporting in general, it appears that they only report waste recycled. Hence it is reasonable to assume that they do not have any efforts within the area of reuse. One reason for why they do not measure it, might be that it is harder to measure reuse compared to recycling and also make the limits for when it is reused or not. Another reason might be that reusing is not specified in the UN sustainability goals or other standards e.g.

Green SCOR or ISO 14001 such as recycling is and hence forgotten when companies use standards as inspiration for their efforts.

Further, they classify the recycled waste as hazardous or non-hazardous, which is similar to the way they report the amount of waste. How and what are reported regarding reuse and recycling differs among the competitors. Some competitors report both reuse and recycling, other competitors only report recycling. P&G (2020) reports recycled and reused waste from manufacturing and J&J (2020) differs, as LifeSci, between hazardous waste recycled and non-hazardous. Furthermore, it does not emerge anywhere in LifeSci's sustainability report if packaging for transportation or storage is included. However, looking at all actors' reports, it seems like no one highlights that kind of packaging waste. Main focus in the competitors' sustainability reports is on recycled and reused product packages, which is out of the scope in this master thesis.

5.2.4 Considering Energy from a Global Aspect

One respondent, who previously described the project for identifying absolute CO_2 emissions connected to air and ocean freight, stated that warehousing activities is not part of their scope yet. The respondent highlighted the focus on CO_2 emissions only and that there is no possibility to look into the matter of energy consumption from warehousing activities at the company today. However, the respondent was open for the opportunity of looking into these activities in the future. Another respondent also claimed that there might be calculations connected to warehousing, but at the same time state the following:

> *"Environmental aspects of warehouse operations is a rather new area, and we currently have nothing on this or any connection to any program strategy." - Managerial Respondent*

The respondent continued by emphasizing the topic of circular economy and that this can be an area where the CO_2 linked energy consumption can become an interesting factor to look into. Further, a third respondent highlighted that reduction of energy is mostly connected to reduction of cost and emphasized a general goal of decreasing the energy consumption within the company.

Looking at LifeSci's published reports, there is no reporting of any energy-related metrics connected to warehouse activities within the company. In the report to CDP, LifeSci reports that they have conducted improvement projects in 2018 connected to energy efficiency in buildings. Specifically, they report that they have improved the heating, ventilation and air conditioning control in a warehouse. However, there are no further details if these changes or improvements have been implemented at several warehouses since then. In LifeSci sustainability report, the subject of energy consumption connected to warehouses is a missing aspect as well.

Generally, neither LifeSci nor any of the competitors report emissions or other energy-related data that is tracked specifically to warehouses or storage of any kind. The energy consumption is either integrated in the reduction of GHG emissions or reported on a general level for the whole organization. LifeSci does not report any achievements of increasing the amount of renewable energy, but states that they want to switch their electricity from production to renewable energy by 2030. Beiersdorf (2020) reached their goal of purchasing all their electricity from renewable energy sources in 2019. Further, P&G (2020) also reports that they are purchasing all their electricity in the U.S., Canada and most of Europe from renewable sources, and Unilever (2020) reports that all of their grid electricity across the globe was from renewable sources in 2019. When it comes to improving energy efficiency, the utilization of the ISO 50001 energy management standard is reported by LifeSci, Beiersdorf (2020), L'Oréal (2019) and J&J (2020).

When it comes to the efforts of improving energy efficiency, additionally to using the ISO 50001 standard, Beiersdorf (2020) reports that improvements of lightning and heating has been in focus during 2019. Meanwhile, L'Oréal (2019) states that they have been focusing on improving the building design and insulation of their manufacturing sites in order to reduce energy consumption. Further, P&G (2020) emphasizes that they want to keep reducing their carbon footprint in the sense of energy consumption at both their manufacturing and distribution sites. J&J (2020) also reports that they aim to build all new sites or renovations in accordance with a green building protocol. Lastly, looking at Perrigo (2020) does not report any goals or efforts connected to energy consumption reduction, but still emphasize that they are looking into lightning, heating and ventilation of all their buildings and sites.

6 Discussion

Following chapter contains a discussion of the empirical findings together with the literature presented in section 2. The chapter is divided into eight fields which were highlighted or observed during the data collection. The first field discussed is the centralization and decentralization of sustainability efforts of LifeSci. The chapter continues with a discussion of what level of measurements LifeSci has in general and what EPIs the company chooses to include in their environmental sustainability efforts. Thereafter, the four environmental areas, highlighted in the theoretical framework, are discussed and chapter 6 will end with a discussion about the EPEF for B-Ointment.

6.1 Centralized and Decentralized Planning and Decision Areas

Even though there is a lot of communication between the production sites and the headquarter at LifeSci, the activities connected to sustainability and logistics activities still seem to be centralized and decoupled from the actual physical supply chain. As mentioned in the theoretical framework, the World Resource Institute (2009) concludes that up to 80 percent of all emissions in a supply chain are composed of all other organizations within the supply chain, rather than the focal firm itself. Meaning that having centralized efforts at LifeSci might lead to a better understanding of the supply chain from an overall view. Further, it could mean that LifeSci can identify improvement areas much easier. As Tuni et al. (2018) argue, environmental performance needs to be addressed with a holistic approach, taking the whole supply chain into consideration rather than just the single company. Having a centralized sustainability function can therefore also make sure that the environmental performance is monitored and measured with regards to the whole supply chain. For the procurement function, LifeSci uses EcoVadis as an assessment of suppliers' environmental sustainability efforts. In that way, the organization considers more of the supply chain than the focal firm itself. However, this assessment also seems to be on an overall general level, and not specific to any product or any supply chain.

Still, having a centralized sustainability management might also lead to inefficiency of the efforts for environmental sustainability. As observed from the interviews, the majority of the respondents were unfamiliar with the environmental sustainability efforts within the company, other than the fact that emissions is important to consider. Also considering the challenges of changing the mindsets of sustainability being connected to costs, it might therefore mean a decrease of the priority for environmental sustainability at LifeSci. As stated by Graham et al. (2018), logistics activities might account for up to 75 percent of the total emitted CO_2 of the supply chain. Still, this area of concern does not seem to get as much attention as it should, since some respondents clearly did not see it as a prioritized problem.

Another challenge that may be a result of the centralized environmental sustainability efforts is the mindset of trade-off between costs and investments in environmental efforts. The cost aspect seems to be prioritized above the environmental aspect, which also becomes visible e.g. when looking at limitations of air freight which are based on cost rather than the high amounts of emissions. Further, even if LifeSci is aware of business-related benefits from environmental efforts, such as differentiation in marketing, the investments are still considered to have long payback time. However, payback time and profit should not be assessed the same between investments in environmental efforts and other investments. In that case, environmental efforts may tend to not be prioritized at all, which will disrupt the progress in environmental performance.

The fact that B-Ointment has two different flows which may allow for some planning of the shipments in order e.g. increase vehicle utilization degree, and therefore be in favor of reducing LifeSci's environmental impact. However, this metric is not measured specifically, but rather just considered as an advantage of using distribution centers. Due to the complexity of all shipments and different supply chains, it might be difficult to measure the vehicle utilization degree of specific shipments. Still, the efforts to improve this aspect might be relatively small compared to the resulting reduction in yearly accounted emissions from transports. Considering that Colicchia et al. (2011) brings up vehicle utilization degrees as an important aspect of reduction in transportation-related emissions, it should definitely be considered as a possible improvement initiative.

Looking at warehouse activities, these are managed on a regional level. Further, the activities connected to waste handling is also handled by the production sites on a regional level. From a centralized level, it was unclear what environmental metrics or efforts these activities included. Having such a mix of centralized and decentralized efforts in such a large organization might be one way of managing sustainability. However, it seems to lead to a misalignment in sustainability efforts and goals, and also lead to decreased visibility of environmental impact along the supply chains. Additionally, this misalignment might lead to efficient efforts or less accurate areas of focus. One example is the inability to connect EPIs specifically to products or supply chains, and not measuring the EPIs from its source, but rather calculating them. Meaning, there is no visibility of the actual environmental impact.

6.2 Detail Level of Measurements for EPIs

From the empirical findings it becomes clear that LifeSci's environmental measurements are on a general level. The Supply Chain Council (2012) however highlights that more specific metrics are needed to increase companies' ability to improve performance. These thoughts were the basis of the development and establishment of the EPEF. Hence, there were also expectations that LifeSci's level of measurements was on a more specified level. More specifically there were hopes that the measurements would be product specific and connected to the different parts of the products supply chain where it originates from. However, LifeSci seemed to only have a clear subdivision for the emissions area where measurements and targets were based on the transport mode i.e. air, ocean and road. Even though there was no distinction of where the emissions were emitted from in the supply chain, it still is some kind of more detailed level that could increase LifeSci's ability to improve performance. Nevertheless, transparency of the environmental impact along the supply chain could help prioritize among improvement initiatives.

Further, Chae (2009) argues that many companies tend to have too many indicators, which could result in EPIs not being properly managed or measured. Chae (2009) therefore indicates that it in that case is better with fewer EPIs which might promote LifeSci number of environmental targets and low detail of measurements. The fact that LifeSci has not yet implemented EPIs within all four environmental areas or at a more detailed level might be because they want to manage the ones they have before they expand their environmental efforts.

6.3 Choice and Prioritization of EPIs at LifeSci

As concluded from the theory, choosing EPIs to monitor and improve can be difficult for organizations. Mcintyre et al. (1998) argue that EPIs are influenced by contextual factors such as company size, corporate culture etcetera. Hooper and Greenall (2005) emphasize that this context dependency means that there is no general agreement of relevant EPIs. Still, there are a lot of frameworks and standards that give guidelines on what to measure when it comes to environmental performance. From the theory, GRI and ISO 14031 were identified as highlighted and emphasized standards. Further, several organizations, including LifeSci, use GRI in their sustainability reporting as an index of locating the different fields of environmental performance. It is also worth mentioning that only the indexes and chapters of the GRI are used by LifeSci, but not the subsections of the GRI where calculations and specific allocations of environmental performance are made. Meaning that the GRI is only used as a table of contents for their report, but not mentioned more detailed in how the suggested measurements from GRI is used. Sureeyatanapas and Tawwan (2018) argue that the standard ISO 14031 is one of the most well-known standards for environmental performance evaluation that can be adapted to any organization. Still, there is no sign of LifeSci using this tool for evaluation of their environmental performance. Though, the organization reports working towards a certification in ISO 14001, which is the standard family for environmental management. Still, there has been no clarification of using this framework for measurement or improvements of environmental performance.

Veleva et al. (2003) mention that organizations can choose freely which EPIs to include in the evaluation of the environmental performance. Meaning, LifeSci can choose freely among all indicators in both GRI and ISO 14031 in order not to monitor too many EPIs. Sureeyatanapas and Tawwan (2018) and Scherpereel et al. (2001) both argue that organizations typically can end up monitoring too many EPIs and get distracted from their main focus. Still, the overall observation is that LifeSci has chosen the field of emissions as their main focus for the environmental efforts, since this is mostly trending right now. Further, there is no clarification on specific EPIs that are measured at LifeSci, such as emissions from transportation between two plants. Instead, the company accounts for emissions in categories according to the GHG Protocol. Considering that the GHG Protocol standard is developed to increase the representability of the true emissions and increase the consistency and transparency in GHG accounting, it can be a suitable tool for LifeSci to utilize in their GHG accounting.

Even the GHG Protocol (2015) mentions that they suggest scope 3 to be optional and does not need to include a complete GHG life cycle assessment. Instead the standard suggests that it is more valuable to focus on one or two major GHG-generating activities. This becomes clear in the delimitation that LifeSci has included in their GHG accounting, where they consider downstream GHG-generating activities not being feasible for the company to measure or monitor. Still, an observation is that the organization still might be monitoring too many EPIs and not being able to focus deeply on a specific field. As mentioned earlier, the level of measurement is on a rather general level but looking at the width of all the included fields of environmental performance there is a lot more. In their reporting, LifeSci mentions the ISO 14001 standard-family, GRI, GHG Protocol, CDP, ISO 50001 energy management system and the UN SDGs. Nevertheless, this variety of reporting guidelines and tools point towards wanting to cover a lot of content in their environmental sustainability efforts, without going in depth of each area. Additionally, all of these guidelines and tools are mostly used to cover the fields of emissions and energy consumption connected to emissions. Meaning that the attention and priority towards the fields of waste handling and recycling is lower.

For the optimization and improvement of environmental sustainability efforts connected to logistics activities, it was identified from the literature that even though emissions take up more of the attention than the other fields, each and one of the fields are equally as important. Considering that wants to improve their environmental sustainability efforts linked to logistics activities, it might therefore be important to start considering more of the fields connected to waste from preparation activities, recycling of packaging material and energy form warehouse activities. Still, an initial effort could be to identify the sources of the environmental impact in previous mentioned areas in order to understand what improvement efforts need to be considered. As CDP (2020) mentions, environmental impact first needs to be measured, in order to later be improved. Therefore, some of the other fields that are suggested by the theoretical framework and included in our EPEF could use some more attention in order to improve the overall level of environmental impact from logistics activities.

6.4 Development of Emissions Accounting from Logistics Activities

Schneider et al. (2010) state that pharmaceutical companies in particular tend to focus on reductions in GHG emissions since this is considered a *low hanging fruit,* and therefore making it a starting point for reducing environmental impact. Even though LifeSci is a company with three large segments, where the consumer health segment is in focus for this thesis, this trend is still applicable here as well. Emissions seems to be the most dominating area within environmental sustainability at the company. Still, emissions connected to transportation activities does not seem to be a bigger concern within the company, and maybe even underestimated in terms of relative numbers. Additionally, connecting it to the theory, the European Commission (2001) states that physical distribution is one of the major sources of environmental problems. IEA (2019) also states that approximately 25 percent of all global CO_2 emissions was from the transport sector in 2017. Even though this is a general statistic of all emissions from all actors in the world, it still highlights the importance of considering emissions from transportation activities. It also highlights that transportation activities might account for more of the environmental impact that one may think.

Clearly, there have been challenges with initiatives connected to environmental sustainability, e.g. with increasing transparency of the environmental impact and getting LSPs onboard for digital solutions. These challenges show how difficult it can be for large organizations to measure their environmental impact directly from its source. Having a lot of actors and service providers etcetera in the supply chain adds to the complexity of measuring the environmental impact. This may also be a reason for Colicchia et al. (2011) statement about the difficulty to define initiatives to reduce emissions due to its dependence on the process or activity under consideration. Since there are a lot of actors involved in LifeSci's logistics activities, it may be difficult and almost impossible to measure the emissions directly from its source in an effective but yet efficient way. Furthermore, it is also a reason for LifeSci calculating their environmental impact, rather than measuring it, and therefore also on such a general level that has been discussed before. Nevertheless, it means that there is no connection at all of the emissions from logistics activities towards any specific product or supply chain. Considering the target to reduce their emissions by optimizing their logistics activities, it may be problematic to motivate efforts towards this target if there is no transparency of the actual problem.

Considering that some other actors already have put effort into travel distance optimization, but also that there is nothing reported publicly on this from LifeSci, might suggest that this also can be a potential improvement initiative at the company. Still, the fact that there has been an initiative to optimize travel distance is an indicator of LifeSci moving towards that aspect of logistics optimization. Even though there has been no report on the progress of that initiative, this should be considered to be developed and further developed by the company. Considering that travel distance optimization has been an EPI highlighted in the theory as well (Braithwaite & Knivett, 2009; Colicchia et al., 2011), this indeed could be a potential area of improvement or priority for LifeSci in the future. Further, LifeSci seems to consider vehicle utilization degree and consolidation as well, since the product B-Ointment seems to have two different flows of distribution, in order to have the option of consolidating the product with other products before shipping the products to its destination. The organization is also aware of the need for refrigerated trucks, and how that impacts the amount of emissions as well. Still, there is no sign or clarification that these two EPIs are measured or considered from an environmental perspective, but rather just considered as an advantage of their overall supply chain planning.

6.5 Tracing and Categorization of Packaging Waste

One environmental area which was highlighted in literature and presented in section 2.4.2 is waste. As Saadany et al. (2011) state, waste generation affects the 'greenness' of a supply chain and should therefore be mitigated as much as possible in order to decrease the environmental impact. Since it appears that LifeSci did not have any reduction efforts within the environmental area waste, there seems to be large potential to develop this aspect in order to decrease their overall impact. Further, the lack of any concrete plan of waste reduction might be connected with or a result of LifeSci's low detail of measurements. As Sureeyatanapas and Tawwan (2018) emphasize, measurements are important for improved performance and the Supply Chain Council (2012) recommend metrics to be closely tied to origin cause. Further, in the empirical findings, CDP (2020) also emphasized that environmental impact needs to be measured in order to be improved. With lack of transparency of how much waste that originates from transportation and warehousing packaging, it presumably is difficult for LifeSci to initiate efficient mitigating actions. To increase the understanding and tie the waste to the actual cause LifeSci could do more like L'Oréal and use packaging in transportation and distribution centers as a category. L'Oréal presents good initiatives and efforts to decrease their transportations and warehousing packaging such as redesign, optimize and weight reduction which are factors related to what Colicchia et al. (2011) present as indirect and direct environmental impact. These initiatives and efforts are something that LifeSci could consider and imitate as a first step to any concrete plan.

Further, Christensen (2010) discusses what categories waste could be classified into. The author mentioned distinctions between hazardous and non-hazardous waste which is what could be seen in LifeSci sustainability report as well. Having the distinction between hazardous and non-hazardous waste is according to Christensen (2010) important, since hazardous waste has a larger environmental impact along with higher levels of regulations and could therefore require different actions. Hence, it is appropriate that Bayer keep this division. Still, LifeSci reports a low number of different waste-categories which, once again, could affect implementation of efficient waste-reducing efforts. An uncertainty of what categories to use might be a reason why. Comparing categories used by the competitors there does not appear to be any single solution of what to use, which Christensen (2010) also emphasizes. Still, if LifeSci in the future wants to have an environmental target related to waste, perhaps packaging waste, they also need to develop their reported and measured waste categories.

6.6 Distinguishing Recycled and Reused Transport Packaging Material

Concluded from the empirical findings, LifeSci does not measure recycling or reusing related to the product B-Ointment. The result is not surprising, as stated by Piotrowicz and Cuthbertson (2015), metrics such as recycling and reuse have a correlation with waste. Consequently, if waste is measured and reported on a general level it would be reasonable that recycling and reusing also are measured and reported on a general level. Further, looking at the overall efforts among the actors in the consumer health industry, almost all actors report targets in either one of the areas. Whereas, LifeSci does not include any target in any of the two fields. Thus, including either waste reduction or waste recycling as a sustainability target might be a potential improvement for LifeSci.

Further, there is nothing reported in the area of reuse at all from LifeSci. It would however be good for LifeSci to keep track of their reusing as well as increase it, since Tallentire and Steubing (2019) state that from an environmental perspective, reuse is better than recycling. Still, other actors in the consumer health industry do not report waste reused either, meaning that these kinds of measures may be difficult or not feasible to include yet. The definition of reuse was according to Chi and Long (2011) that the material or component will be adopted to another area of use. A difficulty, which might be the reason for low number of users, is the distinction when it is adopted by another area or not. The assessment could become particularly subjective and the discussion would supposedly end up similar to what Beamon (1999) meant when he discussed evaluation using *good* or *bad*, that it is difficult to use the information.

Recycling is however a more occurring field among the actors in the consumer health industry, even though recycling of transportation and storage packaging is left out. Further, the European Parliament has established some directives and recycling targets for packaging material to be met by 2025. It is reasonable to assume that the category *packaging material* refers to both the product packaging but also packaging related to transportation and storage. It therefore seems odd that no actor explicitly reports recycling of packaging from transportation or storage and that only some competitors report recycling of the product packaging. To fulfill the recycling target of paper and cardboard which is to have 75 percent recycled by 2025, LifeSci needs to put greater focus into measuring and reporting recycling rates of packaging from transportation and warehousing.

6.7 Global or Warehouse Specific Energy EPIs

From theory, it was concluded that both warehouse activities and transportation activities are equally as important for reduction of environmental impact and carbon reduction (Rudiger et al., 2016). Specifically, looking at warehouse activities, the main EPIs are connected to energy consumption and CO_2 emissions from energy production (Colicchia et al., 2011). The general theme from the empirical findings have been that LifeSci and all the chosen competitors are reporting EPIs and initiatives connected to energy-related environmental impact. Still, there is no data reported that is traced specifically to warehouses or distribution centers. Although, from the theory there were several EPIs connected to warehouse activities, such as energy consumption, energy consumption efficiency and usage of alternative and renewable technology. In this case, an observation would be that the theory sees a higher importance of measuring the environmental impact from warehousing activities, compared to organizations in the real world.

Rudiger et al. (2016) emphasize that several sources of consumption need to be considered when looking at warehouse activities, compared to transportation activities, which is why the authors suggest setting system boundaries for the evaluation and measurements. At LifeSci, warehouse activities seem to be managed on a regional level and not on the same global level as some of the previous EPIs. This was discussed earlier for the misalignment of centralized and decentralized environmental sustainability efforts. Still, LifeSci accounts for energy-linked emissions on a global level mostly connected to their production. Further, initiatives and usage of tools such as the ISO 50001 standard are mainly for cost benefits rather than environmental benefits. However, the company seems to have reported improvement projects from 2018 that were connected to improving energy efficiency in buildings by improving heating, ventilation and air conditioning control. According to Colicchia et al. (2011), these aspects of energy are the main areas when looking at energy demand, which means a right start for LifeSci to focus on. However, there has been no clarification on any further progress with these projects and whether it was connected to warehouses.

Meanwhile, P&G (2020) emphasize that they want to keep reducing their environmental impact from both manufacturing and distribution sites, which may be an indicator of upcoming environmental efforts connected to warehouses. But once again, there is not any other clarification of specific initiatives or data connected to warehouses in particular. Other actors have also reported achievements on purchasing 100 percent renewable energy, while LifeSci still does not have any progress on this aspect. As concluded in the theory, the primary energy use continues to grow, despite efficiency improvements. Therefore, this might be an important area to consider for improvement in the future as well, considering that warehouse- and transportation activities are equally as important for reducing environmental impact.

6.8 EPEF Application on B-Ointment's Supply Chain

When it comes to applying the suggested EPEF for the product B-Ointment, the initial general observation is that the level of measurements and specific areas do not match in the current situation. From one aspect, the EPEF was developed to be adapted to a specific product or a specific supply chain. Meaning, the EPEF is used to develop a single product or supply chain and set the evaluation boundaries and context according to the selected supply chain. Looking at the organizational structure at LifeSci, as discussed before, there is a misalignment between centralized and decentralized environmental sustainability efforts. Nevertheless, the centralized parts of the efforts lead to general efforts for the whole company rather than any specific initiatives or efforts linked to a specific supply chain. Further, this misalignment also impacts the type of information that can be utilized in the framework to set the evaluation boundaries for the framework. For example, regulations and overall business rules have been proved to be somewhat difficult from an external point of view.

Another aspect of the mismatch between the EPEF and the product B-Ointment is the detailed level of measurement. The EPEF has been based on the anticipated SCOR model and its different levels, practices and metrics. The Supply Chain Council (2012) mentions that the SCOR model is not sector-specific and does not provide any 'right' answers, but rather introduce standardized metrics etcetera. During this thesis, the metrics and activities have been adapted to the consumer health industry and towards logistics activities only. However, comparing the EPEF with the reality of LifeSci, there is a large gap between how detailed the proposed EPEF sets out the metrics, and what is measured and linked to processes and activities at the company.

Considering that LifeSci wants to optimize their logistics activities, and also considering that B-Ointment is a strategically important product for the company, adopting a framework such as the EPEF could benefit LifeSci a lot in their improvement process. The Supply Chain Council (2012) mentions that using metrics on all levels ties chosen metrics to specific processes and therefore helps to improve the organization's total environmental performance. Since the EPEF is based on the most highlighted areas (emissions, waste reduction, recycling and energy) and EPIs from theory, the framework provides a list of EPIs that LifeSci can start to consider and look into. Below, the application of the EPEF on the product B-Ointment will be discussed further both from the overall view in the *enable* process but also on an operational level in the *source* and *deliver* processes.

6.8.1 Expansion of the General Context in Enable

In the EPEF, the process *enable* includes four areas to form the product context for the evaluation of environmental performance. These areas are *competitors*, *regulatory compliance*, *business rules* and *organizational environmental targets*. The *enable* process was thereafter broadened to also include guiding initiatives and standards that frequently occurring in the sustainability reports. It was clear from the review of all competitors' reports that the framework needed expansion with UN SDGs, CDP, GHG Protocol and the ISO 50001 standard, since there appeared to be connections between these initiatives and standards, and other actors' environmental work. A membership in the CDP did for example show more efforts within the emission area which affected the context for the product B-Ointment. Including the guidelines and standards also created an understanding of why some companies did what they did and why their targets were as they were.

Connecting the context areas to the product B-Ointment, it can first be concluded that emissions reduction and renewable energy are the most highlighted environmental areas among the competitors and are also covered, at least to some extent, by LifeSci. Additionally, waste reduction or recycling rate might be an area to consider in the future since the competitors tend to have at least one of them. When it comes to regulations, LifeSci operates in a highly regulated market in general, but the product B-Ointment itself has low regulations being registered as a cosmetic product. Hence, no regulations seem to affect the environmental work of B-Ointment. Further, business rules related to B-Ointment are mainly the product segmentation. The product will never be supplied with slow transportation modes such as rail, which probably will end up with the product having a high amount of emissions. Further, the higher frequency of supply will probably decrease the utilization degree of the vehicle. The first thought would hence be to prioritize these areas, since they probably have a major environmental impact. However, since the product is highly important, high amounts of emissions and low utilization degree will probably be more acceptable for this product. It would perhaps therefore instead be important to prioritize other EPIs. Yet, the utilization degree and emissions should however also be measured but environmental improvements might be easier within other areas. Lastly, since LifeSci aims to decrease their GHG emissions up- and downstream the value chain it would be valuable to have the EPIs for B-Ointment aligned with this target.

The *enable* process and its contextual areas from the EPEF are more applicable to the product B-Ointment than the processes *source* and *deliver.* The purpose of the enable process was as mentioned, to create the evaluation context, specifically what was done by the company and other similar actors on a more general business level. The reason is that the context probably influences the EPIs and environmental efforts in the supply chain for B-Ointment. Additionally, benchmarking could help prioritize improvement areas. Consequently, the information demanded was on a more general level than for the other two processes. This might be a result of what was previously discussed about LifeSci's centralization of the environmental efforts.

6.8.2 Limited Application of Source and Deliver

Due to the general view of environmental sustainability efforts that LifeSci currently have, the business processes of *source* and *deliver* cannot kept separate in this discussion, as first suggested in the EPEF. From LifeSci's point of view, there are no specific measures or efforts linked to any specific process of the supply chain of B-Ointment. Therefore, there is not much distinction between the stages of the supply chain, and accordingly, not any distinction between the *source* and *deliver* process from the EPEF. However, one observation during this thesis has been that further data collection and investigation of the company's environmental sustainability efforts, the EPEF could at least be applied to some extent. For example, the EPIs connected to emissions from transportation activities have been examined, but there were also some indications that further information of EPIs connected to energy from warehouses and waste handling could be acquired from a local level. Still, from a global level, there are some challenges with performance measurements and transparency of environmental impact that need to be addressed before a framework as the EPEF could be applied for the supply chain of a product such as B-Ointment.

Considering the fact that the product has two flows and that the respondents were aware of both flows, it means that the company eventually could apply some parts of the EPEF quite effortlessly. When it comes to the *planning and decision areas* section in the EPEF, LifeSci already considers aspects such as transport mode and source of energy on a centralized level. Still, there has been no clarification whether the company considers other local aspects such as packaging material or inventory level. Still, it is believable that LifeSci can also revise the *activity* column according to their view of the supply chain of B-Ointment. Whereas, the detail level of activities should not be compromised by grouping several activities into one general part of the supply chain. As mentioned by the Supply Chain Council (2012), one of the main benefits with their SCOR model is that metrics are linked directly to specific processes and therefore enhances the improvement potential for that specific process.

When it comes to the *evaluation EPIs* section in the EPEF, this is where the main problem arises when evaluating the environmental performance in the supply chain of B-Ointment. The evaluation EPIs in the EPEF have been based on the most anticipated and highlighted indicators and fields from the theory, connected to the activities accordingly. Still, looking at emissions, LifeSci reports GHG emissions linked to upstream transportation activities, but not specifically to any segment or supply chain. Other air emissions and fuel consumption has not been reported at all. There has been an initiative explained earlier about measuring the emissions from its source, but it has not been possible to apply on a larger scale yet. Looking at the vehicle utilization degree, it seems to be considered as an advantage of their transport planning, but still not measured or considered as a part of LifeSci's environmental efforts. Waste generated and recycled waste was reported on a rather general level and gives no indication where the waste came from or which waste was recycled, connected to B-Ointment. The same have been observed for hazardous and non-hazardous waste, since these EPIs have been reported on a general level and not supply chain specific. Reusing waste was not even mentioned on a general level but was however not included by any competitors either, which might question how well exposed this EPI is in the consumer health industry. Inventory and warehouse activities do not have any linked measurement either.

Even though LifeSci calculates their energy consumption, energy efficiency and energy-linked emissions in scope 2 of the GHG Protocol, none of these are connected specifically to any part of the supply chain. Nevertheless, there is no trace of any energy-linked EPIs specifically for the supply chain of B-Ointment.

Beamon (1999) argues that organizations need to think of what to measure, what level to measure, how often to measure and how often to follow up and reevaluate metrics in a correct performance measurement system. The evaluation of the EPIs has been based on this argument to assess the EPIs with correct evaluation. However, this developed evaluation has clearly not been applicable for the activities in the supply chain for B-Ointment. Still, the EPEF can be used as a tool for LifeSci to evaluate their progress instead, in order to identify which areas to prioritize in order to optimize their logistics activities. Instead of evaluating the EPIs at the company, LifeSci can instead use it to visualize how much of the EPEF that can be applied for any supply chain within their organization. From there on, the EPEF can help identify which areas that still are missing any efforts or data to evaluate the process, and thereafter prioritize areas of improvement for further environmental performance evaluation.

7 Conclusions

The aim of this thesis has been to increase the understanding of how companies can reduce their negative environmental impact of their consumer health related logistics activities. Following chapter will conclude the thesis and summarize the findings from this study. Lastly, practical implications and suggestions for further research will be discussed.

7.1 Assessment of Environmental Performance

The first objective of this master thesis has been to investigate how organizations in the consumer health industry can assess environmental performance of their supply chains. In this case, the EPEF has been developed from theory to be applied on the supply chain of B-Ointment at LifeSci's consumer health segment. Meaning, the EPEF suggests a way of assessing environmental performance. Still, even though the EPEF was based on the SCOR model's standardized business processes and metrics for evaluating supply chains performance, there seems to be a gap between information required and information available for assessing the environmental performance of B-Ointment's supply chain. Both Supply Chain Council (2012) and Sureeyatanapas and Tawwan (2018) emphasize the importance of tying metrics to specific processes or activities. However, LifeSci seems to have a centralized level of their environmental sustainability efforts, which affects the implementation of their efforts throughout the organization. Their EPIs are also measured on a general level for the whole organization, meaning that there is no connection to the sources of environmental impact. Nevertheless, not measuring the environmental impact from its source decreases the transparency of their environmental impact and therefore also impacts the ability to assess or improve their environmental sustainability efforts, as was described by the Supply Chain Council (2012).

In order not to limit the assessment of the environmental performance of B-Ointment's supply chain, LifeSci could therefore benefit from considering the level of measurements from the EPIs in the EPEF. Nevertheless, looking at other actors in the industry, benchmarking or comparison might give an idea of how to proceed with the assessment of environmental performance. For example, considering that other actors, such as Beiersdorf, L'Oréal, P&G and J&J, seem to have more initiatives implemented in several aspects of logistics and can hence be seen as leading actors.

7.2 Improvement and Prioritization Areas

The second objective of the thesis has been to identify improvement areas and prioritize based on the current environmental efforts at LifeSci, but also with regards to environmental sustainability efforts carried out by similar actors in the consumer health industry. As mentioned above, the EPEF can be used to assess environmental performance but also to guide prioritization of future efforts. At LifeSci, there is no visibility of the actual environmental impact from B-Ointment's supply chain. As CDP (2020) mentions, environmental impact needs to be measured in order to be improved. Brown (2014) also argues that visibility within the supply chain is typically in increasing concern in the cosmetics industry. Therefore, it has been concluded that LifeSci could benefit from initially increasing the visibility of their environmental impact, e.g. by linking metrics to processes, before taking on further initiatives, in order to prioritized correctly.

Also, when it comes to the importance of environmental sustainability efforts, it has been concluded that there still seems to be a challenge to acknowledge the value in environmental sustainability. A first step could be to lower the hurdles to invest in environmental sustainability improvement projects, by changing the mindsets towards acknowledging the value in environmental sustainability efforts rather than just considering the costs. Environmental sustainability in logistics seems to be considered difficult to approach or not feasible on some levels within the company. Meanwhile, literature concludes that cost often is a limiting factor (Brown, 2014), while physical distribution still remains one of the major sources of environmental impact (European Commission, 2001). Visualization, from e.g. the EPEF, may help increase the understanding of the value in improving environmental performance for the company and could, once again, benefit LifeSci.

LifeSci wants to optimize their logistics activities, which include transportation, load preparation, storing and warehousing activities. Still, there only seems to be focus on decreasing their CO_2 emissions in general on a central level. While Bom et al. (2020) argue that environmental impact occurs along the whole supply chain, and Rudiger et al. (2016) emphasize the importance to include both transportation and warehousing activities, LifeSci still does not consider any other aspects of logistics activities other than emissions from transportation activities. Also considering that the majority of the included competitors have included some general targets in the other fields of waste-, recycling- and energy-linked environmental impact, LifeSci could potentially benefit from initiating improvement efforts in at least one of the fields, in order to reduce their overall negative environmental impact from logistics activities.

7.3 Practical Implications

Generally, it is obvious that there are a lot of guiding initiatives, standards, reporting metrics and frameworks for either assessing performance in general or reporting efforts in environmental sustainability. As mentioned by Sureeyatanapas and Tawwan (2018) and Scherpereel et al. (2001), organizations can end up monitoring too many metrics and get distracted from their main focus. Hopefully, the EPEF presented in this thesis can guide organizations through the choice of metrics or the overall assessment of environmental performance connected to logistics activities. Being based on the anticipated SCOR model, the EPEF can assist with a structural way of assessing the environmental performance, and also be adapted to any supply chain, by revising which activities or planning and decision areas that are considered in the framework. Meaning that the EPEF can be adapted to any organization in the consumer health industry, but also be adapted to organizations in other industries. However, the limitation of the framework is that it is based on the logistics aspect of environmental sustainability.

When it comes to the findings of the study, lack of visibility in environmental impact is one aspect that has been highlighted. For managers in organizations and for organizations in general, it could mean that there might be a need for investments or efforts for further development of the transparency of environmental impact in their respective supply chains. Also, considering the mindset of emphasizing costs of environmental initiatives rather than the value, it might be a challenge as well to develop a new mindset, within organizations, that promotes environmental efforts. Even though the findings from this thesis is context specific for a company that operates in the consumer health industry, the findings can be an eye opener for any other actor when it comes to the complex of problems of promoting and investing in improving environmental sustainability within organizations.

7.4 Further Research

The focus in this master thesis has been on one case product and its supply chain in the consumer health industry. A number of actors in similar markets have been included for a wider analysis of efforts connected to environmental sustainability. However, the efforts analyzed from the other actors have been based on their reporting in their sustainability efforts, and therefore a further research could involve deeper analysis at each and one of the companies included in this thesis to map their environmental sustainability efforts. Further, one interesting finding has been LifeSci's challenge of mindset, where the cost aspect might prevent investments within environmental initiatives. Thus, for further research it would be interesting to study how companies should manage the trade-off between return of investment and environmental impact.

Another clear aspect of the environmental impact in supply chains is the problem with visibility of environmental impact throughout the supply chains. Due to the complex network within supply chains involving a large number of actors, it may seem impossible for several organizations to evaluate the environmental impact. Therefore, further research of the transparency of environmental impact is suggested from this thesis, in order to assess that aspect of the problem with evaluating environmental performance. These implications also impact organizations' ability to link certain metrics to certain products or activities, and therefore makes it difficult to understand where the actual problem is. Not understanding the root cause of the environmental impact can also make it difficult for organizations to prioritize among environmental improvement initiatives and efforts. Further research could help discover tools, frameworks or approaches that potentially could help organizations increase the visibility of the environmental impact within their supply chains in order to understand where the main problems are.

References

Abbasi, M. & Nilsson, F. 2012. *Themes and challenges in making supply chains environmentally sustainable*. Supply Chain Management. 17(5), 517–530.

Altuntas, C. & Tuna, O. 2013. *Greening Logistics Centers: The Evolution of Industrial Buying Criteria Towards Green.* The Asian Journal of Shipping and Logistics, 29, 59–80.

Ammara, R., Fradette, L. & Paris, J. 2016. *Equipment performance analysis of a Canadian Kraft mill. Part I: Development of new key performance indicators (KPI).* Chemical Engineering Research and Design, 115, 160–172.

Aronsson, H. & Brodin, M. H. 2006. *The environmental impact of changing logistics structures*. International Journal of Logistics Management, 17(3), 394-415.

Arvidsson, N. 2013. *Essays on operational freight transport efficiency and sustainability*. Diss. (sammanfattning) Göteborg: Göteborgs Universitet, 2013. Göteborg.

Barber, E. 2008. *How to measure the "value" in value chains*, International Journal of Physical Distribution & Logistics Management, 38(9), 685-698.

Beamon, B. M. 1999. *Measuring supply chain performance*. International Journal of Operations & Production Management, 19(3/4), 275-292.

Beiersdorf. 2020. *Sustainability Review 2019 - Beiersdorf Consumer // tesa.* Available at: https://www.beiersdorf.com/~/media/Beiersdorf/sustainability/reporting/sustainability-review/2019/Beiersdorf-Sustainability-Review-2019.pdf. (Accessed 23 March 2020).

Bom, S., Ribeiro, H.M. & Marto, J. 2020. *Sustainability Calculator: A Tool to Assess Sustainability in Cosmetic Products. Sustainability*, 12(4), 1437.

Boone, T., Jayaraman, V. & Ganeshan, R. 2012. *Sustainable Supply Chains*. Models, Methods, and Public Policy Implications. Springer New York, 223-241.

Borglund, T., De Geer, H., Sweet, S., Frostenson, M., Lerpold, L., Nordbrand, S., Sjöström, E. & Windell, K. 2017. *CSR och hållbart företagande*. 2nd ed. Stockholm: Sanoma utbildning.

Braithwaite, A. & Knivett, D. 2009. *Evaluating a supply chain's carbon footprint*. Logistics & Transport Focus, 11(1), 18–22.

Brundtland Commission. 1987. *Our common future*. New York: United Nations General Assembly.

Brown, J. 2014. *Cosmetics Logistics: The Beauty of an Optimized Supply Chain.* Inbound Logistics, Thomas Publishing Company. Available at: https://www.inboundlogistics.com/cms/article/cosmetics-logistics-the-beauty-of-an-optimized-supply-chain/ (Accessed 4 May 2020).

Bryman, A. & Bell, E. 2011. *Business Research Methods*. 3rd ed. New York: Oxford University Press. Commission of the European Communities. 1999. *European Spatial Development Perspective: Towards Balanced and Sustainable Development of the Territory of the EU*. Luxembourg.

Cai, J., Liu, X., Xiao, Z. & Liu, J. 2009. *Improving supply chain performance management: A systematic approach to analyzing iterative KPI accomplishment*. Decision Support Systems, 46(2), 512–521.

Chae, B. K. 2009. *Developing key performance indicators for supply chain: an industry perspective.* Supply Chain Management, 14(6), 422–428.

Chan, M. 2018. *Understanding the Cosmetic Industry's Supply Chain.* Business Tips, Unleashed Software Inventory. Available at: https://www.unleashedsoftware.com/blog/understanding-cosmetic-industry-supply-chain (Accessed 4 May 2020).

Chi, N. K. & Long, P. Q. 2011. *Solid waste management associated with the development of 3R initiatives: case study in major urban areas of Vietnam*. Journal of Material Cycles and Waste Management, 13(1), 25–33.

Christensen, T. H. 2010. *Solid Waste Technology & Management.* United Kingdom: Blackwell Publishing Ltd. E-book.

Colicchia, C., Melacini, M. & Perotti, S. 2011. *Benchmarking supply chain sustainability: insights from a field study*. Benchmarking: An International Journal, 18(5), 705-732.

CDP Worldwide. 2020. *CDP Disclosure insight actions: The A List 2019.* Available at: https://www.cdp.net/en/companies/companies-scores. (Accessed 26 March 2020).

CeraVe. 2020. *Baby Skincare.* Available at: https://www.cerave.com/skincare/baby. (Accessed 23 March 2020).

Das, S., Lee, S.-H., Kumar, P., Kim, K.-H., Lee, S. S. & Bhattacharya, S. S. 2019. *Solid waste management: Scope and the challenge of sustainability.* Journal of Cleaner Production, (228), 658–678.

Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste. OJ L. 150. 14.06.2018, 141-154.

Easterby-Smith, M., Thorpe, R. & Jackson, P. R. 2015. *Management and business research*. Sage.

Eriksson, L. T. & Wiedersheim-Paul, F. 2008. *Rapportboken - hur man skriver uppsatser, artiklar och examensarbeten*. Malmö: Liber.

Eucerin. 2020. *Products.* Available at: https://www.eucerinus.com/products. (Accessed 23 March 2020).

European Commission. 2001. *European Transport Policy for 2010: Time to Decide*. Office for Official Publications of the European Communities, Luxembourg.

European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste. OJ L. 365. 31.12.1994, 10-23.

Galizia, F.G., Bortolini, M., Mora, C. & Ferrari, E. 2016. *A reference framework integrating lean and green principles within supply chain management*. International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering.

Gillham, B. 2008. *Forskningsintervjun: tekniker och genomförande*. 1st ed. Lund: Studentlitteratur.

Girjatovičs, A., Rizoto-Vidala-Pesoa, L. M. & Kuzņecova, O. 2018. *Implementation of SCOR Based Business Process Implementation of SCOR Based Business Process Framework for Logistics and Supply Chain in Retail Company*. Information Technology & Management Science (RTU Publishing House), 21, 69-74.

Global Reporting Initiative (GRI). 2018a. *GRI 305: Emissions 2016*. Netherlands: Amsterdam.

Global Reporting Initiative (GRI). 2018b. *GRI 302: Energy 2016*. Netherlands: Amsterdam.

Graham, S., Graham, B., & Holt, D. 2018. *The relationship between downstream environmental logistics practices and performance*. International Journal of Production Economics. 196, 356–365.

Green Jr, K. W., Zelbst, P. J., Meacham, J. & Bhadauria, V. S. 2012. *Green supply chain management practices: impact on performance*. Supply Chain Management. 17(3), 290–305.

Greenhouse Gas (GHG) Protocol. 2011. *Corporate Value Chain (Scope 3) Accounting and Reporting Standard - Supplement to the GHG Protocol Corporate Accounting and Reporting Standard.* Available at: https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf. (Accessed 26 March 2020).

Greenhouse Gas (GHG) Protocol. 2015. *The Greenhouse Gas Protocol - A corporate Accounting and Reporting Standard, Revised Edition.* Available at: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf. (Accessed 26 March 2020).

Gunasekaran, A., Patel, C. & McGaughey, R. E. 2004. *A framework for supply chain performance measurement*. International Journal of Production Economics. 87(3), 333.

Hervani, A.A., Helms, M.M. & Sarkis. J. 2005. *Performance measurement for green supply chain management . Benchmarking: An International Journal*. 12(4), 330–353.

Hooper, P.D. & Greenall, A. 2005. *Exploring the potential for environmental performance benchmarking in the airline sector*. Benchmarking: An International Journal. 12(2), 151–165.

International Energy Agency (IEA). 2019. *CO2 Emissions from Fuel Combustion 2019*. IEA, Paris.

Jamous, N. & Muller, K. 2013. *Environmental Performance Indicators*. Organizations' Environmental Performance Indicators, 3-18.

Jasch, C. M. 2009. *Environmental and Material Flow Cost Accounting*. Principles and Procedures. Springer Netherlands, 49-63.

Johnson & Johnson. 2019. *2018 Health for Humanity Report.* Available at: https://healthforhu manityreport.jnj.com/_document/johnson-johnson-2018-health-for-humanity-report?id=0000016a-c2a5-d717-ad7a-c6fff45a0000. (Accessed 25 March 2020).

Johnson & Johnson. 2020. *Annual report 2019.* Available at: http://www.investor.jnj.com/ann ual-meeting-materials/2019-annual-report. (Accessed 25 March 2020).

Jonsson, P. & Mattsson, S-A. 2016. *Logistik – läran om effektiva materialflöden*. 3rd ed. Lund: Studentlitteratur.

Kleindorfer, P. R., Singhal, K. & Van Wassenhove, L. N. 2005. *Sustainable Operations Management.* Production & Operations Management. 14(4), 482–492.

Kuhre, W. L. 1998. *ISO 14031 : environmental performance evaluation (EPE) : practical tools and techniques for conducting an environmental performance evaluation*. Prentice Hall PTR.

Li, L., Su, Q. & Chen, X. 2011. *Ensuring supply chain quality performance through applying the SCOR model.* International Journal of Production Research, 49(1), 33–57.

Litman, T. A. 2019. *Well Measured: Developing Indicators for Sustainable And Livable Transport Planning.* Victoria, British Columbia, Canada: Victoria Transport Policy Institute, 1-93.

L'Oréal. 2019. *2018 Progress Report.* Available at: https://www.loreal-finance.com/system/files/2019-10/LOreal_2018_Progress_Report_SBWA.pdf. (Accessed 23 March 2020).

L'Oréal. 2020. *2019 Annual Report.* Available at: https://www.loreal-finance.com/system/files/2020-03/LOREAL_2019_Annual_Report_3.pdf. (Accessed 23 March 2020).

Mcintyre, K., Smith, H. A., Henham, A. & Pretlove, J. 1998. *Logistics Performance Measurement and Greening Supply Chains: Diverging Mindsets*. International Journal of Logistics Management. 9(1), 57–68.

McKinnon, A. C. 2015. *Green logistics : improving the environmental sustainability of logistics.* (3. ed.). Kogan Page.

Miles, M. B., Huberman, A. M. & Saldaña, J. 2014. *Qualitative Data Analysis:a method sourcebook.* 3rd ed. California: SAGE Publication Ltd.

Morali, O. & Searcy, C. 2013. *A Review of Sustainable Supply Chain Management Practices in Canada*. In Journal of Business Ethics, 117(3), 635-658.

Niazi, S. K. 2009. *Handbook of Pharmaceutical Manufacturing Formulations : Over-the-Counter Products*. CRC Press LLC.

Nivea. 2020. *Provitamin B5 (Panthenol).* Available at: https://www.nivea.com.au/advice/ingredients/provitamin-b5. (Accessed 23 March 2020).

Parmenter, D. 2015. *Key Performance Indicators : Developing, Implementing, and Using Winning KPIs*. (3rd ed.). John Wiley & Sons, Incorporated.

Perera, P. S. T., Perera, H. S. C. & Wijesinghe, T. M. 2013. *Environmental Performance Evaluation in Supply Chain*. Vision (09722629), 17(1), 53–61.

Perrigo. 2019. *Annual report 2018.* Available at: http://investor.perrigo.com/download/2018+Annual+Report+for+Web.pdf. (Accessed 23 March 2020).

Perrigo. 2020. *Making Lives Better: 2019 Corporate Social Responsibility Report.* Available at: https://s3.eu-west-3.amazonaws.com/perrigo.com/perrigo_com_assets/documents/inline-documents/2019%20CSR%20Report%20-%20Horizontal.pdf. (Accessed 23 March 2020).

Piotrowicz, W. & Cuthbertson, R. 2015. *Performance measurement and metrics in supply chains: an exploratory study.* International Journal of Productivity & Performance Management, 64(8), 1068-1091.

Procter & Gamble (P&G). 2020. *2019 Citizenship Report.* Available at: https://us.pg.com/citizenship2019/. (Accessed 25 March 2020).

Rudiger, D., Schön, A. & Dobers, K. 2016. *Managing Greenhouse Gas Emissions from Warehousing and Transshipment with Environmental Performance Indicators*. Transportation Research Procedia, 14, 886–895.

Saadany, A. M. A. E., Jaber, M. Y. & Bonney, M. 2011. *Environmental performance measures for supply chains.* Management Research Review, 34(11), 1202-1221.

Scherpereel, C., van Koppen, C. S. A. & Heering, G. B. F. 2001. *Selecting Environmental Performance Indicators*. Greener Management International, 33, 97-114.

Schneider, J.L., Wilson, A. & Rosenbeck, J.M. 2010. *Pharmaceutical companies and sustainability: an analysis of corporate reporting*. Benchmarking: An International Journal. 17(3), 421–434.

Sellitto, M. A., Pereira, G. M., Borchardt, M., da Silva, R. I. & Viegas, C. V. 2015. *A SCOR-based model for supply chain performance measurement: application in the footwear industry*. International Journal of Production Research, 53(16), 4917–4926.

Shahin, A. & Mahbod, A.M. 2007. *Prioritization of key performance indicators: An integration of analytical hierarchy process and goal setting*. International Journal of Productivity & Performance Management, 56(3), 226–240.

Slack, N., Brandon-Jones, A. & Johnston, R. 2016. *Operations management*. 8th ed. Harlow: Pearson.

Sousa Jabbour, A. B. L., Verderio Junior, S. A., Jabbour, C. J. C., Leal Filho, W., Campos, L. S. & Castro, R. 2017. Toward greener supply chains: is there a role for the new ISO 50001 approach to energy and carbon management? Energy Efficiency, 3, 777.

Sreejesh, S., Mohapatra, S. & Anusree, M. R. 2014. *Business Research Methods. [electronic resource]: An Applied Orientation*. Springer International Publishing.

Sureeyatanapas, P. & Tawwan, K. 2018. *Environmental performance assessment using the evidential reasoning approach: The case of logistics service providers*. MATEC Web of Conferences, 1-9.

Supply Chain Council. 2012. *Supply Chain Operations Reference Model.* United States of America: Supply Chain Council, inc.

Tallentire, C. W. & Steubing, B. 2019. *The environmental benefits of improving packaging waste collection in Europe*. Waste Management, 103, 426–436.

Themistocleous, M. & Rupino da Cunha, P. 2019. *Information Systems.* 15th European, Mediterranean, and Middle Eastern Conference, EMCIS 2018, Limassol, Cyprus, October 4-5, 2018, Proceedings. Springer International Publishing.

Tuni, A., Rentizelas, A. & Duffy, A. 2018. *Environmental performance measurement for green supply chains*. International Journal of Physical Distribution & Logistics Management, 48(8), 765-793.

Unilever. 2019. *Unilever Sustainable Living Plan: Progress in 2018.* Available at: *https://www .unilever.com/Images/uslp-performance-summary-2018_tcm244-536032_en.pdf*. (Accessed 24 March 2020).

Unilever. 2020. *Annual report 2019.* Available at: https://www.unilever.com/Images/unilever-annual-report-and-accounts-2019_tcm244-547893_en.pdf. (Accessed 24 March 2020).

United Nations Environment Programme (UNEP). 2019. *Emissions Gap Report 2019*. Executive summary. United Nations Environment Programme, Nairobi.

United Nations. 2020. *Sustainable development goals.* Available at: https://sustainabledevelop ment.un.org/sdgs. (Accessed 25 March 2020).

Veleva, V., Hart, M., Greiner, T. & Crumbley, C. 2003. *Indicators for measuring environmental sustainability: A case study of the pharmaceutical industry*. Benchmarking: An International Journal, 10(2), 107-119.

Wallén, G. 1996. *Vetenskapsteori och forskningsmetodik*. 2nd ed. Lund: Studentlitteratur.

Waller, V., Farquharson, K. & Dempsy, D. 2015. *Qualitative social research: contemporary methods for the digital age*. Los Angeles: SAGE.

Wong, K. L., Chong, K. E., Chew, B. C., Tay, C. C. & Mohamed, S. B. 2018. *Key Performance Indicators for Measuring Sustainability in Health Care Industry in Malaysia*. Journal of Fundamental & Applied Sciences, 10, 646-657.

World Resource Institute (WRI). 2009. *The Greenhouse Gas Protocol Initiative: Scope 3 Accounting and Reporting Standard*. WBSCD and WRI, Geneva.

Appendix A - Interview Template

General personal background

- What is your current position in LifeSci?
    - What are your main responsibilities?
- For how long have you been working at LifeSci?
    - Any previous positions at the company?

Overall organizational environmental background

- What is the main reason for LifeSci to improve the environmental sustainability of their supply chains?
- What would you say is the core values of LifeSci's sustainability efforts, from an environmental perspective in the Consumer Health Segment?
- What kind of environmental targets do you acknowledge and follow in your daily work?
    - How specific are these environmental targets at different organizational levels at LifeSci?
    - What are these environmental targets based on?
    - Are there any product specific environmental targets for B-Ointment?

- Which competitors do you think are relevant to consider for the product B-Ointment?
    - How do you think these competitors perform in environmental performance compared to LifeSci?
- Do you feel that there are any conflicts in the identification of the market segment and the competitors for B-Ointment?
    - How are the decision areas or functions segmented in the Consumer Health section, depending on the product?

- What external environmental regulations are considered for the product B-Ointment?
- Which environmental regulations affect your daily work?
- Do you see any specific environmental challenges with B-Ointment?

Function-specific background

- What parts of the supply chain for B-Ointment does your department's responsibilities cover?
- How much are you working on developing suppliers from an environmental perspective? And creating relationships with suppliers?
- What are the challenges with environmental sustainability in the logistics area of the supply chain for B-Ointment?

- How centralized or decentralized is the planning and selection of carriers for transportation?

- Can you tell us more about the footprint and how far you have come with that development?
- When it comes to the Warehouses, do you measure any energy consumption, or energy efficiency?
- Are you looking into any hazardous waste in packaging or waste in general?
- Do you decide, or who decides what kind of transport mode to use?
- How well can LifeSci influence decision areas such as vehicle type, transportation mode or source of fuel?

- For the transportations to Germany production site, do you measure and evaluate GHG emissions, Air emission and fuel consumption?
  - If so, which level, how often, any follow-ups?
- How does LifeSci plan in areas such as frequency of shipments to Germany production site and packaging material?
- Do you measure vehicle utilization degrees for the transports?
  - If so, which level, how often, any follow-ups?
- When receiving materials, do you measure solid waste generated, recycled waste and reused waste?
  - If so, which level, how often, any follow-ups?
- How does LifeSci plan source of energy, level of technology and inventory level in inventory?

- Do you measure energy consumption, energy efficiency and energy-linked emissions?
  - If so, which level, how often, any follow-ups?
- Do you measure hazardous waste and recycled waste from disposal of material from inventory?
  - If so, which level, how often, any follow-ups?
- How does LifeSci plan the source of energy, level of technology and inventory level in Sweden warehouse?
- Do you measure energy consumption, energy efficiency and energy-linked emissions?
  - If so, which level, how often, any follow-ups?
- Do you measure hazardous waste and recycled waste from disposal of material from inventory?
  - If so, which level, how often, any follow-ups?

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