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**SUSTAINABLE PACKAGING SOLUTIONS WITHIN MACHINERY SPARE
PARTS SUPPLY CHAIN**

Replacing single-use plastic packaging

Master's Thesis in
Industrial Management

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LIST OF ABBREVIATIONS AND TERMS

ABS	Acrylonitrile butadiene styrene
B2B	Business-to-Business
B2C	Business-to-Customer
CSR	Corporate Social Responsibility
EC	European Commission
ERP	Enterprise Resource Planning
EU	European Union
HDPE	High-density polyethylene
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LDPE	Low-density polyethylene
PET	Polyethylene terephthalate
PHB	Poly-beta-hydroxyalkanoates
PLA	Polylactide Acid
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl chloride
SCM	Supply Chain Management

UNIVERSITY OF VAASA**School of Technology and Innovations**

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Pages: 90**ABSTRACT**

The harmful effects of plastic is a topic under discussion worldwide and its usage is a concern despite the industry in environmental, political and society contexts. It is important to maintain this planet to the further generations and it requires everyone to take their responsibility by acting with sustainable manners. This thesis is a study over how packaging of machinery spare parts could be developed more sustainable with a focus on single-use plastic packaging. It is also a market research, whether this topic has already been acknowledged in this industry and if sustainable developments within packaging would increase the value brought to customers. The aim is to find optional ways to replace the use of single-use plastic in packaging. However, the most important role of packaging is to protect the goods and enable their safe and efficient delivery to customer; this fact cannot be overlooked, when considering new ways in packaging of globally operating supply chains.

This study analyzes quantitative and qualitative data and it consists of review over the topics of plastic, sustainable development and social and environmental responsibility of companies by using literature sources as well as industrial sources from collected data. Used methods for data collection were observation, structured interviews and quantitative data was provided by the third party service provider responsible of packaging. There were interviewed B2B customers and the party responsible of packaging of these machinery spare parts.

The findings of this study proved that B2B customers see usage of plastic in packaging as an issue to be developed more sustainable. There is not a clear answer to solve this issue, but different options as utilizing the theories of circular economy and new innovations may provide drastic improvements in this area. This study proposes three different concepts, which support supply chain managers in developing more sustainable packaging solutions.

KEYWORDS: Sustainable Supply Chain Management, machinery, spare parts packaging, single-use plastic

VAASAN YLIOPISTO**Tekniikan ja innovaatiojohtamisen yksikkö**

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TIIVISTELMÄ

Muovin haitalliset vaikutukset ovat olleet jo vuosia aiheena keskusteluissa niin politiikassa kuin yhteisöä ja ympäristöä vaikuttavalla tasolla. Muovin käytön aiheuttamat haitat ovat nähtävillä ympäri maailman merissä ja vesistöissä, joissa se kierrättämättömänä aiheuttaa lukuisia haittoja eläimille ja ekosysteemeille. Sen vuoksi on tärkeää, että yritykset keskittyvät kehittämään toimintaansa vastuullisemmaksi, jotta tämä planeetta säilyy tuleville sukupolville. Tämä tutkielma keskittyy, kuinka koneiden varaosien pakkaamista voitaisiin kehittää kestävämmäksi ja kuinka muovin kertakäyttö pakkausmateriaalina voitaisiin korvata. Tutkielma pyrkii myös selvittämään, onko tällä teollisuusalalla jo huomioitu aihe ja lisäksi kestävä kehitys toimitusketjussa arvon luontia asiakkaalle. Tutkimuksen tarkoitus on löytää vaihtoehtoisia ratkaisuja kertakäyttömuoville pakkauksessa. Siitä huolimatta pakkauksen rooli suojella tuotteita kuljetuksen aikana ja mahdollistaa tehokas toimitus asiakkaalle tulee olla keskiössä vaihtoehtoisia ratkaisuja arvioitaessa.

Tämä tutkimus pohjautuu määrälliseen ja laadulliseen aineistoon kerättyinä toimialan yrityksiltä ja kirjallisuuskatsaukseen aiheista muovi pakkausmateriaalina, kestävä kehitys ja yritysten sosiaalinen ja ympäristöön liittyvä vastuu. Käytetyt menetelmät olivat havainnointi sekä strukturoidut haastattelut ja määrällinen data oli saatu kolmannelta osapuolelta, joka on vastuussa pakkaamisesta. Haastateltavat olivat teollisuusyritysasiakkaita ja varaosien pakkaamisesta vastuussa oleva osapuoli.

Tämän tutkimuksen tulokset indikoivat, että yritysasiakkaat kokevat muovin käytön pakkausmateriaalina ongelmalliseksi ja toivovat tämän osa-alueen kehittämistä kestävämmäksi. Ongelmalle ei ole selkeää yksiselitteistä vastausta vaan enemmänkin useita mahdollisuuksia, kuten kiertotalouden teorian hyödyntäminen pakkaamiseen ja uudet innovaatiot, jotka voisivat mahdollistaa kestävä kehityksen. Tämä tutkielma esittää kolme konseptia, jotka tukevat toimitusketjuja pakkausratkaisujen kestävässä kehityksessä.

AVAINSANAT: kestävä toimitusketjun hallinta, yritysten vastuullisuus, varaosien pakkaus, muovin käyttö yksittäispakkauksissa

1 INTRODUCTION

This chapter introduces the topic of this thesis and justifies the importance to study this topic. It also provides the details, how the topic was constructed and what is the motivation to study it. Moreover, it provides the details, how the study is limited and reasons for setting the limitations. Further, it also refers the structure of the thesis.

1.1 Motivation and justification

Variety of industries producing consumer goods have begun to make actions to develop more sustainable packaging in their products (Unilever; Nestlé; PepsiCo). Usage of plastic and especially single-use plastic are seen as the main issue in packaging. Plastics are effectively used as packaging material due to their several advantages in packaging. More than a third of plastic material demand is used for plastic packaging and its applications (PlasticsEurope 2016). The ways these consumer good organizations are attacking against this plastic issue are, such as circular economy and replacing single-use plastic by optional and recycled materials. There was also launched a new European Strategy on last year in 2018 for Plastics in a Circular Economy (EC 2018), which also underlines the single-use plastic and aims to ban certain types of them from use. There can be seen a transition towards this type of strategies and business models of the future.

Consumers are more aware of the impact of their choices nowadays and they have interest in making more green choices. The research shows that consumers' choices between different products are influenced by ethical and environmental concerns. As an example based on the results of study performed in already 2008 by Rokka and Uusitalo, the consumers' preferred strongly environmentally friendly packaging in choosing between functional drink products. The sustainable packaging has been already for longer time under discussion in consumer markets, but now it is also becoming increasingly important topic in variety of industries, where the customers are also other industry customers on B2B markets and not regular consumers on B2C markets (Lindh, Olsson & Williams 2016).

For the past two decades other types of negative features than cost in packaging have risen into discussions by governments and media in general. Such as EU and governments make legislations and goals regarding packaging and managing the waste caused by it (Lindh, Williams, Olsson & Wikström 2016). Currently the European legislation within packaging focuses on mainly the material choices in packaging and the management hierarchy: prevention, preparing the material for reuse, recycling, recovery of the material and disposal of it, which guides that creating waste should be prevented, but in case it is not possible the material should be disposed appropriately (Horodytska, Valdés & Fullana, 2018).

It is identified that plastic packaging is an ecological burden and its negative impacts have been identified, such as they end up in oceans, seas, rivers and other areas around marine nature and by this way causing harm not just by polluting environment, but also by harming the marine species, such as fishes and turtles (Castro-Jiménez, González-Fernández, Fornier, Schmidt & Sempéré 2019). Different species are being harmed by plastic by either them getting entangled in plastic waste or by them getting it into their digestion.

However, in order to create sustainable development in packaging, it has to be understood that one of the main goals of packaging is still to deliver the product itself in good condition throughout the whole supply chain and by this way also minimizing waste and costs and increasing sustainability, when the good is delivered correctly at once. It is identified that there is a growing amount of research done over the topic of sustainable supply chain management (Melkonyan, Krumme, Gruchmann, Spinler, Schumacher and Bleischwitz 2019). Packaging has an important communicative role in delivering the goods to customers, which cannot be disregarded (Lindh, Williams, Olsson & Wikström 2016).

There has been identified a research gap in replacing single-use plastic in industrial packaging context, but development of more sustainable packaging has been studied in such industries as food and consumer goods (Stenis, van der Lans, van Herpen & van Trijp 2018; Herbes, Beuthner & Ramme 2018; Lindh, Olsson & Williams 2016). There exists also a research gap between theoretical concepts of the topic and the current practices in the topic of reducing the negative impact of packaging on environment and in the topic of supply chain

sustainability extensions in organizations' practice (Molina-Besch & Pålsson 2016; Campos, Straube, Wutke and Cardoso 2017). Sustainability can be seen as one key element in bringing competitive advantage to companies these days (Zhang, Tse, Doherty, Li & Akhtar 2018) therefore it is important for organizations to consider sustainable development throughout their businesses. It is raised that currently circular bioeconomy and circular economy business models are planned in future agenda in various industries, but empirical research from industry contexts is not yet existing (D'Amato, Veijonaho & Toppinen). The change movement can be seen in larger organizations and they are implementing these models in contexts of sustainability and operations, which can also be seen in previously mentioned consumer good organizations. In order to fill these research gaps, it is important to study opportunities for sustainable supply chain development and find more sustainable ways to package than currently often used single-use plastic packaging in industries.

1.2 Research problem and objectives

The purpose of this study is to find optional sustainable packaging solutions within machinery spare parts supply chain for replacing single-use plastic as a packaging option. The topic for this master thesis began in a company X by customer's request by setting a goal to get rid of single-use plastic in spare parts deliveries during 2020. Based on this request the topic was constructed and it was identified that the current stage of processes and materials would have to be evaluated in order to see, how they could be modified to improve towards these goals of replacing single-use plastic in packaging spare parts and also to improve the overall supply chain operations more sustainable.

There are set two research questions for this study:

Research question 1) How could plastic be used more sustainably and efficiently as packaging material?

Research question 2) What packaging options are there to develop more sustainable supply chain?

1.3 Scope of the thesis

The scope of the thesis will be limited to sustainable packaging solutions and it does not consider other sustainable development areas within supply chain management. The main focus under consideration with materials is to replace single-use plastic packaging and therefore only materials including plastic are considered under development. There is not set limitation, how this could be done and therefore reusing the current plastic packaging, replacing it with other material and creating a completely new system of packaging are all taken as options into the scope of this study. Due to the nature of the topic and the machinery spare parts business there was set a geographical limitation for the study to only focus deliveries and customers within Europe.

1.4 Structure of the thesis

This thesis' literature review consists of reviewing such research topics as using plastic as a packaging material and discussion over its features from pro and con perspectives. It considers different types of plastic used in packaging: traditional, renewable and degradable plastic. It also reviews sustainability as a research topic and how sustainability is becoming a part of strategies and decision making in choosing packaging solutions in terms of packaging materials and processes. It reviews the current state of science, how supply chain can be seen as sustainable and how this can be evaluated. The third sub-chapter of the literature review focuses on value creation and how delivering value can be increased by adding sustainability to an organization's strategy. The third main chapter of the thesis is methodology and it defines the data collection process and the methods chosen for this study. It also includes justification, why these methods have been chosen and the process of data analysis is being described as well as the validity and reliability of used data is being evaluated and argued.

The fourth main chapter focuses on the results of the data collection and analysis of it. It describes the current state of the packaging including the different features and functions of it and focuses on the packaging from the process perspective as well as from the material perspective. After these sub-chapters the focus is on, how plastic is currently being used as packaging material and it follows the data analysis results of the amount of plastic being used as a packaging material during year 2018. After these results follow the results from conducted interviews with customers and their point of view over sustainability in customer company site and how they see the current packaging and how the future of packaging in spare parts could be developed towards more sustainable direction.

The fifth main chapter is conclusions and evaluation over future research within these topics. This chapter concludes the study and its results and how they can be seen, when comparing to the start phase of the study. It also evaluates the research results and sums up the main findings of it. In the end there is suggested a direction and need for future research based on, what kind of gaps this study revealed and what topics are important still to be focused on and have a lack of research still.

2 LITERATURE REVIEW

This chapter consists of three different themes. Firstly, it explains the background for plastic and why it became such commonly used packaging material. It also considers the advantages and disadvantages of it in packaging context and explains the terminology behind different types of plastic packaging. Secondly, it considers sustainability and what is sustainability in supply chain management context as well as then further, how sustainability is part of packaging as in process design and material decisions. Thirdly, this chapter focuses on value creation and how social and environmental responsibility play part in creating value throughout the supply chain, but especially to end customer.

2.1 Plastic packaging

Plastics, such as polyethylene and propylene, were discovered in 1950s and ever since their usage has been growing in daily lives of people. Both of these plastics can be also in flexible form as a plastic film and these applications can be often seen in packaging. The production of plastic materials globally in 2015 was 322 million tons (Plastic Europe, 2016). This amount proved that the production and usage had grown more than 40 percent in a decade. The main end-user market for plastics is packaging, which constitutes 40 percent of the overall market share worldwide. In 2014, of total plastic packaging was covered 34 percent by plastic films, which are flexible packages, such as shrink and stretch films and plastic bags (Horodytska et al. 2018).

Usage of plastics can be divided into packaging and non-packaging, when categorizing their usage. From this category, packaging can again be divided into commercial and industrial packaging, which are often also called secondary and tertiary packaging (Horodytska et al. 2018). Plastics are built by multiple chains, which are composed of monomers and these are connected by chemical bonds (Hahladakis & Iacovidou 2018). These chains composing plastics can also be called polymers. Plastics have different structures, which creates multiple types of different plastic materials. This depends on, how the chains are linked between

different monomers and how these monomers are placed in the chain. The most used polymers in packaging are, such as high-density polyethylene (HDPE), low-density polyethylene (LDPE), polyvinyl chloride (PVC), polystyrene (PS), polypropylene (PP) and polyethylene terephthalate (PET). All these polymers compound around 90 percent of total plastic production around the world. They also have a high resistance towards corrosion, which categorizes them as materials, which are hard to degrade and they remain a century in the environment (Andrady & Neal 2009).

2.1.1 Strengths in plastic usage

Plastic is commonly used as a packaging material, since it has several positive features to protect the item itself inside the packaging. As a material, it has various thermal and mechanical properties; such as it does not conduct electricity and plastics function well as thermal insulators (Andrady 2015: 21-22). It has also low cost and density (Li, Tse and Fok 2016). Moreover, its features being strong, durable and resistant against corrosion, plastics are good in maintaining the quality of goods especially, when delivering them via ocean shipment. From packaging point of view, plastic also has other positive features as low weight, resistance and the possibility to print on it (Horodytska et al. 2018). Printing on plastic enables to provide informatively the product details as well as support branding of the product to the customer.

Since plastic packaging is more light weight than many other materials, it requires less energy in handling and transporting the package itself. Also the durability of the plastic material can be designed based on the needs and requirements of each use context (Andrady, 2015: 21- & 127-128).

2.1.2 Weaknesses in plastic usage

The usage of plastics has several negative impacts, since none of the polymers are completely recyclable nor biodegradable (Mahalik & Nambiar 2010). 99 percent of plastics are having a fossil fuel origin and fossil fuels have been proved to have a negative impact on environment. Approximately eight percent of global oil production is used for plastic production (Beitzel-Heineke et al. 2017). Due to these facts plastics cause harm to ecosystem and human health and have adverse effects on environments.

Another issue with plastics is that they tend to break down into smaller pieces: macroplastics and microplastics. Macroplastics are tractions of plastic, which are size of 25 millimeters or larger and microplastics are size of 5 millimeters or smaller. Microplastics can be composed by larger pieces of plastic breaking into smaller particles of plastic. Plastic particles can easily break down into smaller fragments by mechanical forces hitting them, which can also be such as waves, when plastics end up into the oceans and other land areas in the environment. Plastics are polluting waters and landfill around the world and by this way disturbing the natural ecosystems in the marine areas (Li et al. 2016). Several rivers have been under study within this topic and the study of river Rhone revealed that the litter found from the river was mostly plastic in total amount of all the litter it consisted 77 percent of it. Out of this 77 percent most of the items were single-use plastic or smaller than 50cm fragments of plastic (Castro-Jiménez et al. 2019).

Plastic packaging has a very short time of living in its usage process, which causes it to have extensive demand for collecting and recycling it. This also includes need for the material to be recovered and redistributed and simultaneously this recovery or recycling process needs to pay attention to protecting environment from plastics harmful effects, such as incorrect ways of disposal and leakages (Jambeck, Geyer, Wilcox, Siegler, Perryman, Andrady, Narayan & Law 2015). The recycling of plastics packaging is still unfortunately on quite low level globally, since only approximately fourteen percent of produced plastic packaging is

being recycled (Hahladakis & Iacovidou 2018). The common problem with plastic usage is that it is creating non-biodegradable waste into environment (Horodytska et al. 2018).

Plastics are in theory highly potential to be recycled, but the actual recycling rate is still low and some researchers (Hahladakis & Iacovidou 2018) assume it can be due to low quality of plastics being one reason. Quality of plastics can be considered from such points of view as the material designed characteristics, properties of it and the changes made on the material in use and reprocessing. During the design process of plastic, there may be used several additives in order to improve the material functionality and performance and this depends on the future material usage. These additives may be, for instance light and heat stabilizers, pigments and acid scavengers. These have an impact on the quality of plastics and how they can be handled during their lifecycle. When plastics come darker colors or black, it lowers their overall market value and limits the ability to recycle or reuse them, since the color cannot be changed into lighter shades and also the material itself has more additives (Hahladakis & Iacovidou 2018).

Plastics waste can be treated by different types of processes and by this way they be modified as a resource to be used again. These types of treatment processes can be, such as mechanical and chemical recycling and energy recovery (Horodytska et al. 2018). In mechanical recycling the polymer structure of the plastic remains the same and its recycling is treated by different mechanical processes. It is widely used recycling technique for plastic due to its feasibility from technical and economic perspectives. In chemical recycling the polymer structures are being broken down in order to save the original monomers and other chemicals that are valuable. Then they can be used again in producing new polymers. In energy recovery the plastic waste is used to create electricity or heating energy by incineration of the waste material. This third option is though often not considered as recycling in waste management, rather it is a non-recycling process of the material (Horodytska et al. 2018).

2.1.3 Traditional, renewable vs. degradable plastics

Terms bio-based and biodegradable plastics can be misunderstood easily and used as meaning the same, but they are different. Plastics can be bio-based, but this does not necessarily mean they are biodegradable. Even if some material is completely bio-based, but it is not biodegradable, it will still become a waste in the environment just like a regular plastic and it would degrade into micro-plastics in the nature. When instead biodegradable materials, and especially fast-biodegradable materials, won't leave any micro-plastic behind (Women in Tech Forum 2019: Sulapac).

Biodegradation can be defined as the process of decompose of chemical compound, which are containing carbon, and this decompose process occurs in the presence of enzymes, which are secreted by living organisms. The aim of using bioplastics is to repeat the biomass life cycle the way that the fossil fuels, water production and carbon dioxide are conserved. The usage of biodegradable polymers is increasing. Biodegradable means that the materials in packaging can be decomposed again by bacteria after its usage (Herbes et al. 2018). It is possible to be decomposed through physical, chemical, thermal or biological decomposition and then it produces as water, dioxide and biomass. Degradable instead is defined as materials, which break down into smaller pieces and particles after some period of time, when they are exposed to oxygen, heat or ultraviolet light. Compostable materials are biodegrading in a natural process by micro-organisms (Emblem, 2012: 77-78).

There is variety of raw materials, out of which packaging can be made of, also different crops of, such as soy, rice and corn. Bio-based materials are having a renewable raw material base and they do not produce as much toxic in the environment as oil-based produced materials, but they still are always not biodegradable. There are various different kinds of bio-based plastics and it has got lot of attention due to that fact from researchers and organizations aiming to develop their packaging more sustainable. So far the biggest segment in bio-based plastic manufacturing is packaging. Another option that has been raised in more ecological packaging, is using bio-methane as a material, in which bio-gas is used from organic sources, such as from plants or biowaste. But still it is a bit of under question, how each different

material option can be evaluated, how overall environmentally friendly it is, since for example this type of plastic packaging made of bio-methane is not biodegradable, even the raw materials used to manufacture the packaging have been from renewable sources. Also there are other things considered in using renewable raw material sources in packaging, such as if using for instance PLA made from corn, does cause issues, when the land use is changed into growing crops for new purposes (Herbes et al. 2018).

In bioplastics the entire or partial material usage is from renewable sources, for example from plant-based material (Hahladakis & Iacovidou 2018). The following bioplastics are acceptable in usage, as Cellulose, Starch, Poly-beta-hydroxyalkanoates (PHB) and Polylactide Acid (PLA) plastics (Mahalik & Nambiar 2010). PHB has remarkable features, such as it is 100 percent water resistant and 100 percent biodegradable material. PLA is one of the most versatile bioplastics and is a biocompatible material, which has a good rate in biodegradability and ability in process. It is a compostable material together with other organic waste. It is possible to also recycle it or decompose it into small-size pellets (Hahladakis & Iacovidou 2018).

The production of plastic is dependent on fossil fuels. Since the oil prices are changing and also it has been acknowledged that oil is a raw material that is diminishing, it has been predicted that the plastic prices would also increase (Andrady, 2015: 20). In case plastic is still aimed to be used as a packaging material, plant-based plastics could be an answer to support the usage of traditional plastics.

Oil-based plastics are more difficult to recycle than bio-based plastics, due to oil-based having the feature that they have high amount of different kinds of polymers and additives in them. The development in using bio-based packaging, should be focused on, how to make environmentally friendly packaging, which is recyclable or biodegradable and not just made of renewable materials (Herbes et al. 2018).

Some consider that biodegradable plastics would be a solution for replacing the traditional plastics, since they degrade faster and therefore decrease the environmental burden, but in case the disposal and recycling of them is not performed correctly, they are just as environmentally unfriendly as traditional plastics are. (Li et al. 2016).

2.2 Sustainability

When discussed about sustainability there are often several describing terms used with same intentions, such as eco-efficient, green, eco-friendly and sustainable. Sustainability can be measured based on the end result of materials, processes or systems usage within the environment, economy and society (Greene, 2014: 1).

Sustainable development can be defined as:

“development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Our Common Future, Oxford University Press, 1987.)

It is said to consist of three areas: environmental, economic and social, which together enable sustainable development. Environmental part of this model consists of how efficiently materials and energy are used, how resources are replenished and how waste is treated and whether there is considered reuse in design and if it is also considering sustaining biodiversity on the planet. Economic part of this model is considering, such factors as long-term profitability, competitive advantage, creativity and innovation and efficient processes among others. Social part of this model consists of such factors as human rights, employment security and ethical practices. (Andrady 2015: 35-36.)

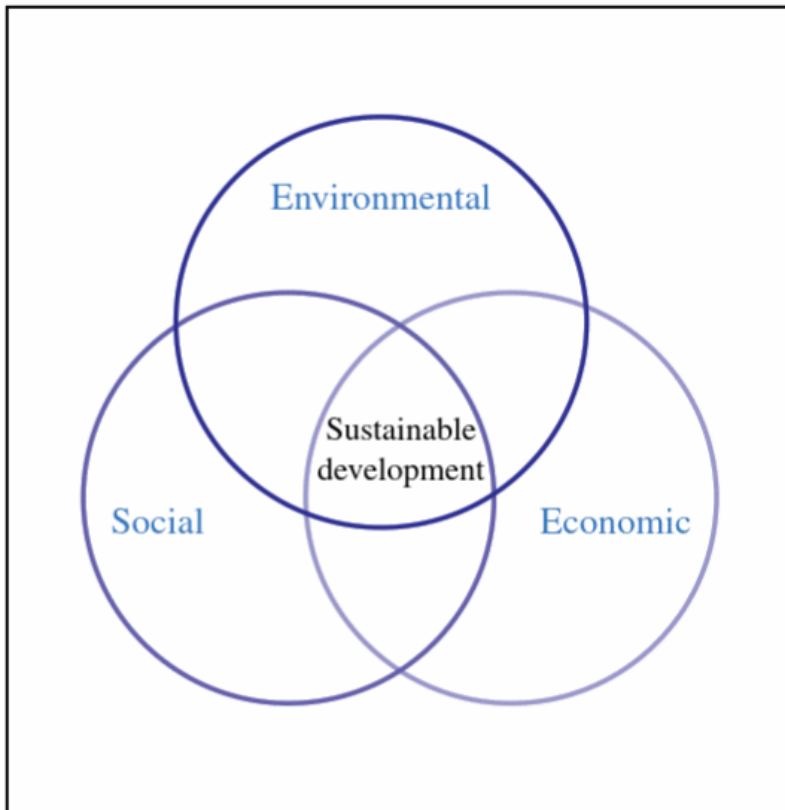


Figure 1. Sustainable development. (Andrady 2015: 36.)

It has been identified that several organizations focus on sustainability aspects, economic, environmental and social aspect, separately and don't consider them all as together, when focusing on problems to develop. Some research underlines that all these aspects should be focused on rather together and it is significant to have them in balance (de Castro Hilsdorf, de Mattos & de Campos Maciel 2017; Amini & Bienstock 2014).

Organizations are becoming more interested in their business operations' impact on the environment. The drivers for this are demand from the customer side and to maintain their position against competitors on markets and environmental regulations on different sales regions. Ethical factors and competitiveness are driving organizations to consider their business sustainability. By having more environmentally friendly business, organizations can

gain competitive advantage (Carvalho, Govindan, Azevedo & Cruz-Machado. 2017: 76). Many organizations tend to avoid too direct commitments with environmental factors, since if some sustainability statement is published, there is a pressure that it needs to be met or take the image costs, if the organization does not meet these published goals. Instead they use wider interpretations, when marketing their sustainable goals within business operations (Ullwer et al. 2016: 106).

Eco-efficiency is a good way to measure an organization's economic and environmental challenges (Carvalho et al. 2017: 75–76). Its aim is to create more with fewer resources and support organizations in reaching the desirable level of sustainability. The goal is to improve value creation and economic value to end customer.

2.2.1 Sustainable supply chain

Improving Supply Chain Management (SCM) enables the processes of sustainable transformation in organizations and it may also strengthen the different members of supply chain to closer teamwork (Melkonyan et al. 2019).

Seuring and Müller (2008: 1700) have defined sustainable supply chain management with following way:

“The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social, into account which are derived from customer and stakeholder requirements”

Melkonyan et al. (2019) state that on the operational level sustainable supply chain management focuses on practice to such areas as environmental purchasing, environmental marketing and management, lifecycle analysis, waste management and energy usage, and often the practices with sustainability are strongly related to Corporate Social Responsibility (CSR).

The aim of sustainable supply chain management is transparent integration of an organization's social, economic and environmental factors, which are all in responsibility in ensuring improved long-term performance within organization's business processes (Ullwer, Campos & Straube 2016: 102). The decisions are made based on strategy and the aim is to reach continuous improvement and efficiency within all of these factors affecting an organization. If the supply chain is sustainable, it may produce long-term profitability without causing harm for social or natural systems (Seuring & Müller 2008). The request for more sustainable supply chain is coming from stakeholders, governments and customers among others. Nevertheless, no direct approach exists, which would guide managers in practice to implement sustainable supply chain (Zhang et al. 2018). It has been acknowledged that packaging could play an important role in sustainable development. It reaches wide variety of different groups of people, such as customers, suppliers, but also legal authorities. In order to develop packaging towards more sustainable direction, there should be used a common terminology to define packaging and its different functions and features. This enables better communication and understanding between different groups of people (Lindh, Williams, Olsson & Wikström 2016).

Green supply chain management may reduce an organization's environmental risks and impacts, and therefore it increases competitiveness and ecological efficiency. Applying green practices into supply chain management may support organizations in maintaining or reaching the desirable levels of costs, reliability, energy efficiency and quality (Carvalho et al. 2017; Srivastava 2007). Increase in value creation can be gained by eliminating waste, reducing cost and improving efficiency, which leads sustainable supply chain to have several alike aims as lean supply chain management does. Applying eco-efficiency on supply chain focuses on environmental and economic objectives in addition to improving value chain. Eco-efficiency can be utilized in improvement of products, services and processes within supply chain, when increasing the product's overall value chain (Carvalho et al. 2017: 77). An eco-efficiency set has been introduced and it consists of sixteen practices and tools. These include considerations of environmental aspects in processes, recycling or re-usage of

materials, environmentally friendly packing of materials and taking environmental efficiency in delivery of materials into consideration among others. These previously listed factors should be taken into consideration within value chain, and the aim should be enhancing recyclability, increasing the environmental efficiency and decreasing material intensity. A grouping of affecting factors is used with three different groups: increasing the product or service value, minimizing consumption of resources and minimizing the negative impacts on environment (Carvalho et al. 2017).

Sustainable packaging solutions cannot be built just by one company on its own. It requires different parties throughout the supply chain to be part of it, such as suppliers for packaging raw material, the party responsible of packaging process and recyclers among others. In research it has been identified that developing more sustainable packaging often begins from the focus on packaging material. There is not though identified some packaging material that could be said to be the most environmentally friendly material. This is also, because choosing packaging material depends a lot on, what the packaged item is and what its features are like (Lindh et al. 2016).

2.2.2 Sustainable packaging processes

Packaging has multiple functions in item cycle. It protects the item and enables efficient and safe transportation to customer (Beitzen-Heineke et al. 2017). Packaging has also an important role in branding and therefore it should be convenient and attractive to customers, when they receive the packaged item (Magnier & Schoormans 2015). Businesses have become more interested in industrial ecology and eco-efficiency by leading them to develop these businesses more sustainable and green in the markets and in their stakeholders' eyes (Hahladakis & Iacovidou 2018).

When aiming to implement social and environmental goals into operations of an organization, the first step in implementing these is sustainable packaging and process design (Pullman & Sauter 2012: 76).

Supply chains can be operated as linear, closed loop systems, circular economy as well as in circular bioeconomy. Reusability and recyclability should be considered in design, since this may support organizations to drive their supply chain management towards closed loop system instead of linear system and therefore to eliminate the waste (Pullman & Sauter 2012: 76).

Circular economy aims to improve the efficiency and use of resource inputs as well as recycling of them by increasing the level of reuse and recycling of them. Circular economy has been acknowledged by industries also in form of circular bioeconomy. It differs from circular economy by also aiming to replace the usage of fossil fuel input resources with biomass based. Such practices would enable several benefits for businesses, such as cost reductions and increase in innovations and competitiveness (D'Amato et al.). Linear economy concept instead is simpler than circular economy concept and it can be also described as three steps: take, make and dispose. In packaging it focuses on reduction of waste by such ways as reducing amount of used materials or making it more lightweight. A closed loop supply chain offers organizations various opportunities to increase their competitive advantage by creating new innovations and value. When considering the change to closed loop system, the organization should firstly decide valid metrics to collect and analyze economic and environmental performance data. Secondly, there has to be decided economic and environmental factors to be improved. Thirdly, there should be limitations and strategy defined for taking back and recycling the materials. Reducing the amount of packaging material is another way also to gain improvements in packaging sustainability and in minimizing waste (Pullman & Sauter 2012: 110 & 116 & 131). Biological circular redesign is seen as the most sustainable, when instead the linear redesign is seen as the least sustainable out of these packaging designs. (Steenis, van der Lans, van Herpen & van Trijp 2018).

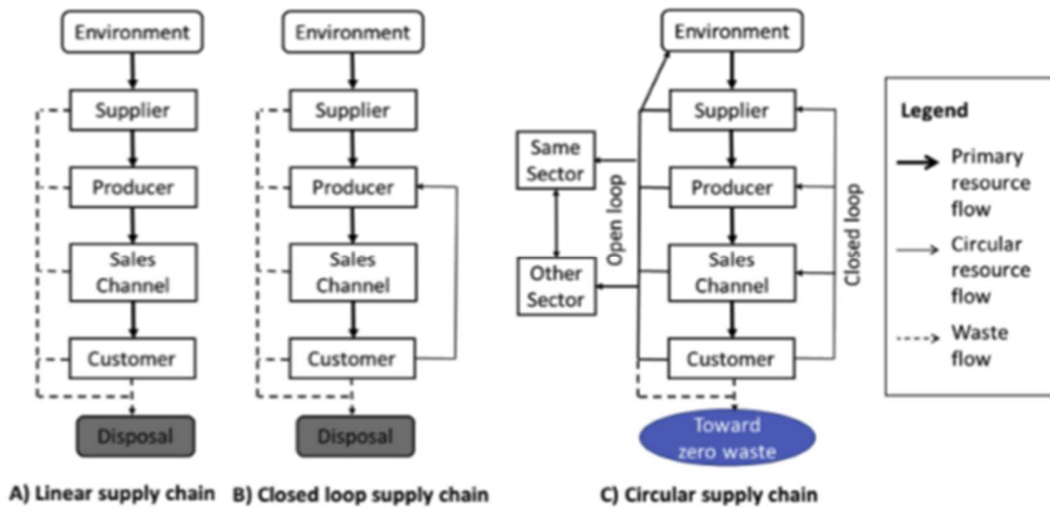


Figure 2. Linear, closed loop vs. circular supply chain. (Farooque, Zhang, Thürer, Qu & Huisingsh 2019: 885.)

The principles of circular economy can be applied to supply chain management by modifying the traditional linear supply chain as circular supply chain as visualized in the figure 2 (Farooque, Zhang, Thürer, Qu & Huisingsh 2019). It has been mentioned in research, how transition from linear economy model to circular economy model is needed in developing supply chains towards more sustainable way of handling business operations (Meherishi, Narayana & Ranjani 2019). By this way the supply chain could become more efficient and the use of resources from economic, environmental and social perspective could be minimized. This requires systemic practices and companies to change their economies from linear to circular as a transition into more a cyclical way of handling operations. The circular supply chain management could gain organizations resource efficiency and profitability as well as simultaneously minimize the negative impacts from economic, environmental and social perspective (Farooque et al. 2019). Packaging system solutions can be considered through circular or linear economy concept (Stenis et al. 2018). Circular economy concept is a sustainability paradigm and it focuses on utilizing the materials and products among others with the highest possible level and value throughout their whole cycle. In packaging it can be utilized in both technical and biological cycles. In technical cycle perspective this

means that the technical elements can be designed, so that they are possible to be recovered in such ways as by reusing or recycling the packaging material. In biological cycle perspective this means that the biological elements or ingredients are possible to be returned to the biosphere safely (Farooque et al. 2019; EMF 2012). In biological cycle are considered, such as if the materials are renewable and biodegradable (Steenis et al. 2018). Circular management means the ability to recover and redistribute materials and components by recycling, reusing or recovering them (Hahladakis & Iacovidou 2018).

Farooque et al. (2019) have identified that Supply Chain Management research is not on a mature stage with, how to fully apply the vision and all the potential of circular economy in supply chain management and to gain the benefits out of it, and the concept of it is still under development to fully apply these theories together. There are a few research done were circular economy is applied on Supply Chain Management, but also these are from the recent years (Farooque et al. 2019; Hahladakis & Iacovidou 2018). Concept of circular supply chain can be seen as quite new concept in development of supply chain and therefore it has various opportunities for supporting to develop more sustainable supply chain solutions considering processes and usage of materials.

Farooque et al. (2019: 884) created a definition for circular supply chain management by combining features from sustainable supply chain management and green supply chain management and circular economy. They have defined circular supply chain management by following way:

“Circular supply chain management is the integration of circular thinking into management of the supply chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and supply chain functions from product/service design to end-of-life and waste management, involving all stakeholders in a product/service lifecycle including parts/product manufacturers, service providers, consumers and users.”

In a research conducted by Pålsson, Finnsgård and Wänström (2013), using a case study of supply chains in Volvo Car Corporation and Volvo Logistics Corporation, the aim was to compare two packaging systems, one-way packaging and returnable packaging, and their economic and environmental impacts. This study resulted after evaluation that choice between packaging materials has a greater impact in one-way packaging system than in returnable packaging, where the packaging is still reused multiple times. For pallets the CO₂ emission rate is zero, since when using wooden pallets, the tree consumes the CO₂ emissions, while it is growing. The results also show that, when considering the material supply the one-way packaging causes the lowest CO₂ emission levels. When comparing the supplying costs of one-way packaging and returnable packaging systems, the one-way packaging costs are lower, but then again when comparing the packaging material costs, it is the other way around and the costs are greater in the one-way packaging system. In this specific case study the cost and carbon analysis concluded with the result that the one-way packaging system is preferable from both economic and environmental perspective. Other main conclusions of the study were that fill rates in packaging and distances geographically influence the most for economic and environmental factors. The model used in this analysis can be used in evaluating and comparing between different packaging systems and to support the decision making in this. This model may also support in seeing potential improvement focus areas, what comes to CO₂ emissions and costs in packaging (Pålsson et al. 2013).

When choosing a packaging system, supply chain's economic and environmental performance should both be considered. In literature within this topic it has been identified that often this is not the case; either one of them is considered in the process of selecting packaging system, but not both, which creates a holistic view over sustainable supply chain research (Pålsson et al. 2013).

There are multiple ways, how selecting between different packaging features and systems may have an impact on costs within the supply chain. Decision between different materials has an impact on handling waste and recycling of materials, but also if used materials in packaging are not protective, the amount of waste within the supply chain may increase. The

dimensions and shape of a package should be considered, since they have an impact on efficiency (Pålsson et al. 2013).

Such approaches have been raised for packaging, when the aim is to reduce the environmental impacts: optimization of material use, environmentally responsible sourcing of packaging materials, developing packaging for efficient reuse, recycling or recovery and maximizing fill rate under transport and storage (Pålsson et al. 2013; Nilsson, Olsson and Wikström 2011).

2.2.3 Sustainable packaging materials

Packaging has various functional benefits as previously mentioned in protecting the item as well as in enabling the branding (Magnier & Schoormans 2015). The issue with packaging is that it is often only used once and it is discarded after the product has been delivered to the customer or the latest after the product has been used or taken into use by the customer. This increases the environmental footprint and creates the concern, how could packaging be improved and developed more sustainable. Some argue the environmental footprint caused by packaging waste could be lowered by using more ecologically designed packaging.

Packaging has several functions along the supply chain and it faces several different stakeholders during the process chain. Packaging can be divided into primary, secondary and tertiary packaging, and when developing packaging, it encompasses them all. The packaging is called the primary packaging, if it is contacting the good directly. The secondary packaging consists of several primary packages. The tertiary packaging can be defined as several primary and secondary packages assembled in for example on a pallet. In choosing packaging system, these all three levels should be considered to find the most appropriate solution for packaging. (Pålsson et al. 2013).

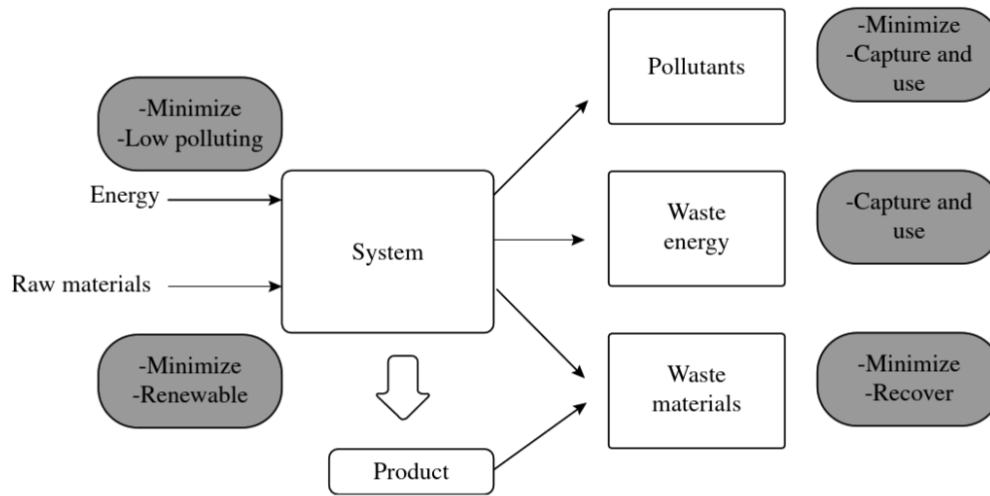


Figure 3. Flow of materials. (Andrady, 2015: 34.)

In figure 3 is seen, how materials should be considered in the beginning stage before they are used, if they could be minimized and considered as little environmental burden as possible. Also after they have been used, they should be considered, if they can be, for instance recovered and reused. The theories of “industrial ecology” are based on this model, which can also be called as a circular model, which was introduced in previous chapter (Andrady, 2015: 34). Materials, which can be processed with circular management are, for instance glass, paper, metals and plastics (EC 2016). This is due to their high level of possibility to recycle them. It has been identified by the European Commission that plastics are one of the five areas, which should be prioritized, when developing circular management in practice within businesses. It was mentioned in the recent relative strategy (EC 2018).

This issue of plastics causing harm to environment has been identified and more sustainable applications in packaging should be implemented. More sustainable ways of packaging should first utilize used energy and materials as efficiently as possible. This requires cooperation with handling and storage of products as well as with transportation, since it applies the whole supply chain of the product. If the intention is to minimize the material degradation, the packaging materials should be recycled continuously by using either

technical or natural systems (Mahalik & Nambiar 2010). Andrady (2015: 140) has also identified that despite the material, when there is aim to improve packaging more sustainable, then the goal should be to improve and recover the materials for reuse as well as innovate new solutions for current packaging.

It has been identified that there could be environmentally more acceptable materials, which could replace the usage of plastic in packaging. This could be either figured by identifying biodegradable materials or by solving the issue with plastic being impossible to recycle completely and find new ways of making plastic degradable (Mahalik & Nambiar 2010). There can be seen change in the packaging markets and how new innovations in materials and processes are arising in the packaging industry to replace single-use plastic. One good example of this is Sulapac, a Finnish Start-up company, which created its own biodegradable and micro-plastic free material to be used in packaging. The material has the benefits of plastic, but it is made of renewable material sources and such as wood, and it is completely biodegradable without leaving traces to environment. The recycling method for the material is industrial composting and anaerobic digestion, which are an organic way of recycling. (Sulapac -website). There is a demand for new innovations, which can replace plastic and still have its certain elements and features to be able to deliver and maintain the goods in good quality during storing and delivery. The mission of Sulapac is related to plastic waste problem and it aims to bring solutions to compete with this problem. They have especially raised the topic of micro-plastics into center and see it as a big issue with plastics, since they can spread even into drinking water, but also due to fact that materials that leave micro-plastics cannot be further digested by microbes and they remain longer in the environment. Materials, which are micro-plastics free can go further in the cycle and be digested by microbes and then further biodegrade resulting as carbon dioxide, water and biomass (Women in Tech Forum 2019: Sulapac). Sulapac utilizes circular design in their products and it considers sustainability in each step of their business and products. Their products can be manufactured in the existing plastic factories and as mass-production. Due to this fact

local manufacturers may be used and it may also eliminate unnecessary transportation costs (Women in Tech Forum 2019: Sulapac).

Sulapac also considers that there is a need for different ways to tackle this issue with plastics. Firstly, plastic should be avoided, but in case it cannot completely be avoided, at least should be used recycled materials rather than traditional virgin plastic. Secondly, there is a growing need to invest in new materials and innovations in order to create new options for replacing plastic as a packaging material. Thirdly, recycling waste should be considered under development and, such ways as chemical and mechanical recycling could provide the chance for less unecological handling of materials (Women in Tech Forum 2019: Sulapac).

Features of packaging that have been argued to have an impact on the environment in packaging are the fill rate and shape of the package (Pålsson et al. 2013). They are said to have an impact on transport efficiency (Lindh, Olsson & Williams 2016). Ikea is one good example of considering the fill rate and the shape of the package. In order to build sustainable logistics as part of sustainable supply chain management Ikea is ensuring that their packaging is protecting the product, but simultaneously the packaging efficiency is optimized by using minimal amount of materials and minimal amount of air between the product and packaging material. By this way also the loading of packages during transportation is optimized, when there is not left unnecessary extra space between the product and its packaging. Ikea is continuously focusing on optimizing its items' packaging and delivery by measuring such as emissions caused per item or units per container. The drivers for Ikea are to gain cost savings and to set environmental goals by maximizing the efficiency in delivering their products. (Pullman & Sauter 2012: 103).

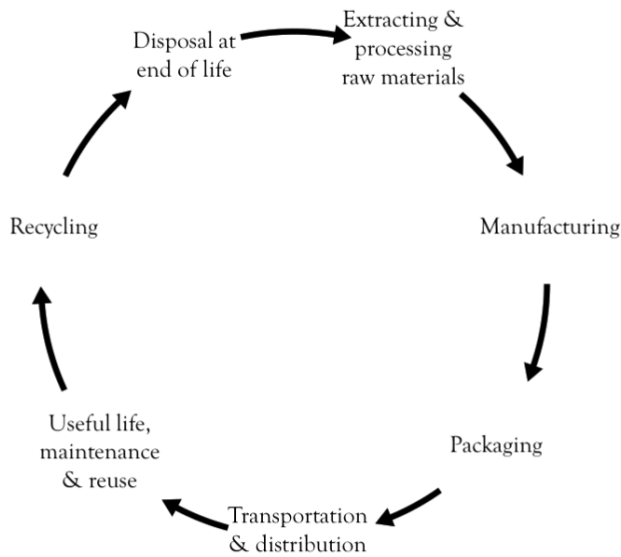


Figure 4. LCA scope for packaging materials. (Pullman & Sauter 2012: 69.)

Life Cycle Assessment (LCA) relate strongly to managing waste it is a valid method to use, when wanting to compare between different possible scenarios and to still reach the same environmental goal in the study with the solution. It can be used for studying the environmental impacts of processes and products. These impacts studied can be categorized based on, for instance such ways as eutrophication, climate change, and depletion of natural resources (Horodytska et al. 2018). LCA is not used in this study, but it is seen as a good way to proceed further with the topic of this study.

Packaging creates various different types of waste during its whole life cycle and it can be only evaluated properly by taking the whole product life cycle into consideration (Lindh, Williams, Olsson & Wikström 2016). By reducing any of these waste consumptions during the life cycle can the packaging be brought towards more sustainable direction (Herbes et al. 2018). Several governments are also considering these ways of reducing waste and to deal with this issue they set legislations around Europe since 1990s. During the past few years also organizations have started considering this minimization of packaging waste by developing towards sustainable packaging or also called green as well as eco-friendly

packaging. Herbes et al. (2018) state the issue to be still that it is often not properly defined or that there is not understanding over, what this means. When materials are considered there should be considered the whole life cycle of them to see, which materials could be the most sustainable option. There is no one packaging material that could be said that this is the material or the amount of it that should be used, when you consider different materials from environmental perspective. Both the material choice and the amount of it depend always on the content and the context of each package. The choices should be made based on, so that the packaging protects the goods and still so that the environmental negative impact of it is minimized (Lindh, Olsson & Williams 2016).

In 2014 European Commission has asked opinion from European citizens regarding plastic usage in packaging and 96 percent have agreed that organizations should have more initiative to minimize plastic waste and improve recycling (Magnier & Schoormans 2015). In a study by Young (2008) the results proved that the consumers see a packaging system sustainable based on recyclability of the packaging materials and the amount of used material for packaging was not seen as an important factor (Lindh, Olsson & Williams 2016).

The indirect effects of packaging are often overlooked, even they often have more negative impact environmentally than the packaging itself. Such indirect effects can be, such as the handling of the package is convenient throughout the whole chain and that the packaging provides required information easily about the product inside the packaging as well as the packaging itself. These indirect effects create value and can be seen as value-adding services (Lindh, Williams, Olsson & Wikström 2016).

As previously mentioned, the main purpose of packaging is to protect the goods inside of it, so that the customer can receive them in correct quality. One of the main purposes of packaging is also to enable proper and efficient handling of the package. It is enabling convenience, but also creating utility or service. The features making the packaging convenient to handle may add value and it enables convenient handling for the end customer as well as others related to supply chain. This way it may also improve efficiency and increase competitive advantage, but also have a positive influence in mentioned three sustainable

packaging aspects: economic, social and environmental (Pålsson et al. 2013). Packaging has also an important role in communication to forward information by such ways as marketing and to validate the brand identity of the good and the company providing it to customer. In addition to its communicative role in the interaction between the selling company and customer, packaging also communicates to its handlers during its delivery and handling. When considering sustainable packaging development, also packaging cost and its cost effectiveness as well as its value creation to customer should be acknowledged. The literature has also identified other strategy options to develop packaging and still with negative environmental effects being low. These kinds of strategies are, for example minimizing waste and used resources as well as cautious usage of substances that are hazard for the environment (Lindh, Williams, Olsson & Wikström 2016).

Table 1. LCA analysis of plastic and paper bags. (Greene 2014: 162.)

Life Cycle Assessment of Plastic and Paper Bags

Environmental impact	HDPE plastic bag two units	Paper bag (40% recycled content) one unit	Ratio, paper/HDPE bag
Energy consumed (MJ)	1.47	1.68	1.14
Carbon footprint (factor)	0.45	1	2.22
Solid waste generated (kg)	14	50	3.57
Air pollution (kg)	1.1	2.6	2.36
Eutrophication/acidification (factor)	0.85	1	1.18
Greene Sustainability Index	1	2.445	

Based on results of previous study using LCA analysis to compare the plastic and paper bags environmental impacts, was shown that paper bag in this context was not environmentally more friendly than a plastic bag, but instead it had required more energy to produce it and it created more waste among other factors (Greene, 2014: 162-163). Plastic bags generated

more waste, when compared to same amount carrying capacity of paper bags. But then plastic bags take five to ten years to decompose, when paper bags instead take about a month and may disintegrate in water with minimal negative effects on biodiversity in marine areas. Plastic bags create significant negative impact as well, since only one percent of them is being recycled (Pullman & Sauter 2012: 69-70). This example shows the fact that packaging decision has to be considered as the whole system and there cannot be said one material that would be over another, the decision is rather about, what is seen as the most important goal and how all the three levels of sustainability are going to be considered in optimizing the development.

Table 2. Scottish report results single-use plastic vs. reusable plastic vs. single-use paper bag from retail field of industry. (Greene 2014: 167.)

Environmental Indicators for Plastic and Paper Bags in Scottish Report

Indicator of environmental impact	Single-use HDPE plastic bag	Reusable LDPE plastic bag (used 4×)	Reusable LDPE plastic bag (used 20×)	Single-use paper bag
Non-renewable energy	1.0	0.7	0.1	1.1
GHG emissions	1.0	0.6	0.1	3.3
Solid waste	1.0	0.7	0.1	2.7
Water use	1.0	0.6	0.1	4.0
Acid rain	1.0	0.7	0.1	1.9
Eutrophication	1.0	0.7	0.1	14.0
Ozone formation	1.0	0.3	0.1	1.3

In previous study analysis performed in Scotland was compared the environmental impact indicators between single-use HDPE plastic bag, reusable LDPE plastic bag, when using it four times or twenty times and single-use paper bag. This study revealed that reusing plastic bags has quite low environmental impact and to gain positive environmental impacts, the plastic bags have to be used more than four times. Such environmental impacts as water use

and waste among others were reduced more than 90 percent compared to single-use plastic bags, when reusable bags were used more than 20 times (Greene, 2014: 167-167). Nevertheless, this study was based on plastic bags used in groceries and the size of them was around 20 liters and therefore it is not directly equivalent to the context of this study. In most of the markets there would have to be considered the cost and emissions of reverse flow of materials in case the materials would be considered to be reused.

Based on Kano's theory Löfgren and Witell (2005) have divided perceptions of packaging regarding packaging functions and materials into five categories: must-be, one-dimensional, attractive, indifferent and reverse qualities. Must-be qualities are such aspects, which are taken for granted and if they are not fulfilled it would mean dissatisfaction from customer side, but these type of qualities still don't create the customer satisfaction. This type of qualities can be, such as if the packaging has needed information about the content or whether it protect the good properly. One-dimensional qualities provide satisfaction, when they are fulfilled and then instead if they are not fulfilled, the customer would be dissatisfied. These type of qualities are, such as if the packaging is easy to recycle or if the content of the packaging is easy to empty from it. Attractive qualities are giving customer satisfaction, but they are not expected by the customer, so in case they are not fulfilled, they still won't cause dissatisfaction. Indifferent qualities are, such that customers see them neutral and these do not cause satisfaction nor dissatisfaction. Reverse qualities are such aspects, which cause high level of customer dissatisfaction, if they are not fulfilled in packaging (Lindh, Olsson & Williams 2016) and therefore these perceptions have to be considered, when evaluating different options for packaging.

Communicative function of packaging is significant, since incorrect handling of incorrect goods creates unnecessary costs and inefficiency. Mostly this type of mishandling creates economic burden, but also environmental, when wasting resources. In order to enable correct recycling of materials and with efficient process, the packaging material should be communicating the way it is supposed to be recycled. For example plastic packaging should

provide information with a recycling code to identify, what kind of plastic it is and therefore it to be recycled accordingly (Lindh, Williams, Olsson & Wikström 2016).

In order to develop sustainable packaging, both perspectives should be taken into consideration, the product and the packaging perspective and consider the whole system in the development plan. In case of using sustainable packaging materials, it should be informed in the packaging itself, since otherwise the customer may not know that there has been put effort in this mean (Magnier & Schoormans 2015).

2.3 Value creation

Definition of value relates to organizations' customers and therefore it is important for them to be defined. Creating value requires both decisions and implementing based on them. The task of decision is to identify potential value for customer and then implementation further makes it into action and into real value for the customer (Spetzler, Meyer & Winter 2016: 119).

Regulations and taxes are one way to pressure organizations to become more sustainable and consider their businesses. European Union is taking acts within this topic and setting directives (Campos et al. 2017).

The study of Campos et al. (2017) revealed that pressures, which market, regulations and other companies on the same market and on the same geographical area create, have an impact on the market behavior, when considering the company's sustainability. The study results within this study performed by Campos et al. showed that the requirements set by European Union were one of the strongest drivers for the German companies to improve their Supply Chain sustainability among sustainability improving the companies' competitiveness on the markets. Instead the Brazilian companies within the study had the customer requirements and their pressure as one of the strongest drivers to improve their supply chain sustainability as well as the sustainability standards in the multinational business

environment. This shows that social drivers have a high impact on driving the sustainable development in organizations.

2.3.1 Social and environmental responsibilities in value creation

Decades ago sustainability could be seen as an exclusive part of corporate social responsibility, but nowadays sustainability can be seen as a necessity from organizations in order to maintain their market share and keep the customer relationships (Emblem, 2012: 67). Social and environmental responsibilities are for organizations ways for showing that they care about their customers and surrounding communities. These both factors are presenting opportunities for organizations to reach higher levels of competitive advantage (Jacobsen, 2011: 10-11).

Environmental responsibility is referred often with sustainability from long-term perspective and it is often considered in organizations from these three perspectives: technological, biological and physical. Environmental sustainability is often measurable and exact and therefore easier to measure than social responsibility, but still when organizations are environmentally responsible, they are also socially responsible, since the consequences are related to social groups. In economic development worldwide affecting factors have been identified to be the availability of resources and the price of them (Jacobsen, 2011: 12-13).

Jacobsen (2011: 13 & 16) has risen that if the organizations want to be sustainable, they need to be responsible of factors within material usage in their business operations. This requires considering all material aspects in their products including services with the products, such as packaging, as well as considering them from all perspectives: technological, biological and physical perspective.

CSR is often associated with ethics and values of business as well as sustainability (Haynes, Murray & Dillard, 2012: 7). Organizations may improve their reputation by adopting CSR as part of their strategy and ecological sustainability may also be included in this strategy and

by this way they may consider the necessary actions within their environment of doing business (Haynes et al. 2012: 175-176).

In order for organizations to develop ecologically more sustainable, it has to be as part of their agenda on the strategy level. In practice it may consist of areas as changing products and consumption within business actions towards more sustainable, but in order to communicate this to customers and other stakeholders, it has to be visible in the organizations' strategy and in the marketing strategy (Haynes et al. 2012: 185-186; Borland 2009).

By having social and environmental responsibilities as part of organization's strategy, an organization may create this way more value to its stakeholders. In order to follow the common guidelines, the companies may set a "Code of Conduct", which to follow throughout the organization, but also to require this from suppliers, subcontractors and other parties involved with the business of the organization. By following code of conduct all the areas of sustainability are also able to be defined and fulfilled in an organization (Jacobsen 2011: 10-16 & 42).

2.3.2 Value creation through sustainability

Recycling is one of the main factors in waste management. It has several environmental benefits, such as reduction of greenhouse gases, but also saving in energy and materials, which have an economic impact. Post-industrial waste can be recycled, when it is clean and consists of same material, meaning different types of materials have been separated from each other. Usually this type of waste is recycled in open-loop or closed-loop mechanical processes. These ways differ from each other by the quality and, how the recycled materials are applied (Horodytska et al. 2018). It is suggested that minimizing the variety of materials can improve environmental efficiency, since it increases the material's recyclability percentage and recycling efficiency (Ullwer et al. 2016: 102–103). Still it is more sustainable

to reduce or avoid waste, rather than to dispose it. Therefore prevention is important in building more sustainable supply chains.

Usually the responsibility of disposing the waste from packaging material falls on the end user of the product or in other words on the customer. There are laws and regulations, how each material needs to be disposed of and this leads to the end customer having the responsibility of correct disposal or recycling and cost. Recycling is quite expensive, since it requires separation and sorting of different waste materials from each other. More preferred option for recycling could be re-using of packaging material and prevention of waste by choosing the material more carefully (Beitzen-Heineke et al. 2017). Customers are increasingly interested in knowing, how much their purchasing choices affect environmentally and how emissions could be minimized. Therefore organizations are becoming more aware of this and how these factors affect the organization's image with stakeholders (Ullwer et al. 2016: 103). Prevention of waste and pollution also affiliates with the topics of total quality management and lean supply chain, and all these result with improvements in operational performance, when overall costs are decreased and inputs are utilized in more efficient way (Ullwer et al. 2016; Golicic & Smith 2013).

When considering the environmental impact of packaging, the focus to handle these has mostly been in recycling the packaging material and minimizing it, but packaging has not been seen as a complete system and other ways to handle the environmental concerns have not been considered much. The European packaging legislations also mostly focus on facing the issues caused by packaging by focusing on the packaging materials and it does not consider the whole system of what packaging consists of with its features. (Verghese, Horne & Carre 2010; Lindh, Olsson & Williams 2016)

Sustainability has been a topic under discussion for years and it can be said that it is not some trend that would be going away in near future, it is rather the way of doing business in future despite the industry. Due to this reason in order to stay in the competition, organizations should focus on developing their supply chains and business operations towards more sustainable direction. The only purpose of business is not making profit, but rather creating

a value cycle that is continuous and lasts and where all the parties involved with it are benefiting and able to participate again in the cycle (Pullman & Sauter 2012: 16-17 & 29). Sustainability may also be included in value creation by such ways as using renewable sources and responsible suppliers (D'Amato et al.).

Differentiation is a one way to implement sustainable development in the strategy level. In this case the customers are paying for the received value and the organization is able to develop its business, in this case towards more sustainable direction. An organization can implement this type of value-adding activities with several ways, such as by investing in process design related concerns by performing life cycle assessment or by investing to develop the usage of materials to more sustainable, even it may require investing more money on material costs or by considering to have a take-back program and this way make sure that the products or materials are processed and recycled accordingly after they have served their purpose (Pullman & Sauter 2012: 31-32).

Haynes et al. (2012: 185-186) introduce two different strategies for organizations to adopt ecological sustainability into the strategy: transitional and transformational strategy. Transitional strategy can be considered by 4R activities, which are reduce, reuse, recycle and regulate. This type of strategy aims to reduce the amount of resources in doing business and after their usage to either reuse or recycle them appropriately. This is though not an optimal strategy from sustainability point of view; it is only reducing the negative impact of businesses, but not really attacking to solve it.

Transformational strategy instead considers the eco-efficiency as complete and considers the used resources and processes as a loop or cycle in order to use them again and without using such that include toxic materials Haynes et al. (2012: 185-186). If an organization aims to reach transformational strategy, it has to have sustainability included in its vision and see itself as being part of maintaining the ecosystems and environment for the future. Teece (2007) suggest that companies have to engage with social and physical ecosystems to increase their sustainability and by this way maintain the competitive advantage also for the future generations.

Pullman and Sauter (2012: 34) argue that developing more sustainable supply chain improves managing risks and threats, increases communication and cooperation between the partners of supply chain as well as enables cost reductions due to ecoefficiencies.

3 METHODOLOGY

Research methodology can be defined as systematic way to find solution to the set research problem. Research methods are a part of research methodology as well as all the decisions related to the way to study the research problem (Kothari, 2004: 8).

This chapter explains the way research problem was decided to approach and describes the process of the data collection and the way of analyzing it. It explains the reasons, why the study was performed by using such methods and what was the aim of the data collection by using these chosen methods.

3.1 Research strategy

This study is implemented to solve the identified research problem and in order to find solutions there are both quantitative and qualitative data used. This study was conducted as having features from the descriptive and the exploratory study. The aim of exploratory study is to define the current situation as well as the transition and change between the current and future stage of a studied issue. This way it enables to see the context in future and enables to solve the focused issue. It is a useful way to find out more precise information about the researched topic and by this way gain a better understanding of the overall problem. The descriptive study instead can be used in setting an exact profile, for instance for some certain situation, therefore a descriptive research may be used in supporting exploratory research (Saunders, Lewis & Thornhill 2009: 139-140 & 321-339).

In the beginning of the research it was decided that there will be interviewed three customers and the party responsible of packaging these spare parts. The customers were chosen based on their size and volume as well as possible interest towards the topic of sustainability and replacing single-use plastic. The customers were contacted by email and there were eventually made an agreement for an interview with three customers out of five contacted

ones, who accepted to give an interview. All the interviewees are on a manager position and familiar with spare parts packaging and sustainability.

In order to get a good overview of the current packaging processes and materials, these were observed in the location, where the packaging of spare parts is done. In observation method information can be gathered by observing without asking directly from respondent (Kothari, 2004: 96). This method is a way to gather the overview of current situation and it tends to avoid subjective bias from evolving. It can be though a limited method to gather information and therefore it was only used as an additional method to gain knowledge over, which development opportunities could be seen realistic and possible to implement for the current practices in the future. Observing the process was also supported by another set of questions regarding the current packaging processes and used materials to gain information for necessary details to decide, which concepts would be decided as a result in the end.

The quantitative part of the study is based on data provided by the Third party service provider, who is responsible of packaging the spare parts. This part was performed by analyzing the packaging material data from year 2018 to gain an overall picture, what plastic materials currently are being used and in what kind of amounts.

3.2 Data collection and analysis

The quantitative part of the thesis was conducted by using the data of used plastic packaging material in total during year 2018. This data was received in raw format from the third party, who is responsible of packaging and then it was further modified into analyzable format by modifying all different materials into kilograms and separating the total amount of each material from each other. This data included only the parts that are packed in between the supplier and the end customer.

In addition to this type of packages, there was identified that some of the packages only go through directly packed by the supplier or manufacturer of the item and it is sent in the same packaging to the end customer. The amount of this type of items was taken out from the ERP

system as a report to identify, how many different items there are going directly as a direct material flow from the supplier to customer without repackaging in between this process. This percentage of this type of items was separated from the items in total sent. Then this percentage of used plastic was measured from the plastic packaging data analyzed from the received data to gain an approximate including then also these packages being delivered without repackaging.

The data of packaging materials was provided on Excel and it was also further analyzed with Excel. The data provided the information of the packaging materials as a material code, what was the size of each material as well as the amount in quantities, how many was used in 2018 and how much usage of each material costed during this year. There was also provided the material supplier and based on every material code, it was possible to see from the suppliers' website more precise information about each packaging option. On the supplier's website was provided, such information about each packaging material code as out of which material was the packaging made of, what were the dimensions of it, price and for some packaging items it was also provided, how high percentage of it can be recycled or if the packaging material was somehow environmentally more friendly, it was informed under this packaging material code.

One of the aims was to find out the amount of used plastic in kilograms that was used for packaging spare parts during year 2018 in company X. Since this information was directly not available, it had to be calculated and partly also estimated based on using the available information. For some of the materials the thickness of the material was provided as mm, such as for plastic bubble wraps, but for some plastic packaging it was only informed, how many microns the thickness of it is. For these materials the thickness was modified from microns to millimeters based on using a data source from online. By having the length, width and thickness of the plastic items it was possible to calculate the material amount in cubic centimeters and cubic meters. Since the material supplier informed the material used for the packaging on the website it was possible to find out from another online source, how much each material weighs by cubic centimeter or cubic meter. In order to find out each plastic

packaging material’s consumption in year 2018 in kilograms, each material was calculated by calculating first the cubic meter of it and then by multiplying this with the material’s weight in kilogram per cubic meter and then by multiplying this with the quantity of each material consumed within this year. By these calculations it was possible to find out the overall plastic consumed during year 2018 by using kilograms as the measurement unit. The way calculations were performed are also visualized in the table below.

Table 3. Visual explanation of data calculation process to solve consumption of plastic.

size provided	cubic cm size	quantity (qty)	qty in cubic cm	material	material weight (g/cubic cm)
cm*mm*mm	cm*cm*cm	provided	cubic size in cm*qty	provided	from online source
mm*mm*mm					
cm*cm*mm					
mm*mm*micron					

total kg of each type of packaging material
qty in cubic cm*material weight

The interviews were structured before conducting the interviews, but after the research process these interviews had also features from semi-structured interviews. Structured interview means that the interview is flowing in a structured way and the questions are set and decided before the interview itself is done (Kothari, 2004: 98). The used interview type was rather structured, since all the customer respondents were asked the same set of 15 questions in same order. Only fulfilling or guiding questions were asked in between these set of questions to direct the discussion to correct direction or to confirm that the respondent’s answer was understood correctly. The order of the questions was designed, so that they went from more general to deeper in the topic and at first seeing the customer organizations’ point of view in sustainability and how it impacts on their promises and choices and then further

on transitioning to, how they see company X and its current way of operating and current stage from sustainability point of view. There were used open questions in these interviews, which often can be used, when the wanted answer is to be for instance developmental. But instead some of the questions asked were also specific and closed type of questions. (Saunders et al. 2009: 139-140 & 321-339). For the interview of the manager of the party responsible of packaging these 15 questions were modified a bit to match the aim, but the goal was to gain similar information as from the customer interviews.

The customer interviews were conducted between mid-September and mid-October 2019. Each of them was done one to one by having an online meeting and they were recorded. An online meeting was decided as a way of performing the interviews, since all the three customers were located in different countries within Europe. The interview of the manager of the party responsible of packaging was conducted on face-to-face in November 2019 and it was also recorded. The conducted interviews were non-standardized, which is a common way to gather data for qualitative analysis. There are two types of non-standardized interviews: semi-structured and in-depth (Saunders et al. 2009: 321). In-depth and semi-structured interviews are used often to study opinions and emotions over certain topic. They do not necessarily offer the exact truth about the topic, but it is a method to find out someone's point of view over this certain topic under study (Longhurst 2009). In this case the aim was to hear these particularly chosen companies' point of view over the research topic by interviewing them, therefore this method was chosen for this study.

Before the interviews were conducted, there were set 15 questions for the interview, to which the answer from the customer was wanted to be gained. These questions were sent for review before the interviews, so the interviewees could be able to prepare themselves for the topics that wanted to be discussed with them. In each interview the questions were asked in same order and with the same voice and tone and the interviews were conducted in English. In case the answer for a question was short or unclear, what the person had meant with the answer, there were asked fulfilling questions to find out the truthful answer without

misunderstandings. These fulfilling questions were not planned beforehand. They were presented just by the situation.

The interview questions were constructed based on the starting meetings and what kind of information the company X would like to gain with these interviews. It took three rounds to get the questions settled and the way they were constructed and the order of them the way that they were to answer the aimed questions for the thesis. The aim of the interviews was to find out, if the customers are having sustainability as part of their organizational strategy, vision, mission and values and whether sustainability has a role in, how they choose their suppliers. The interviews were to provide such information as, if it is seen as an important driver in the supplier selection and if it is being measured in the customer organizations. The customers were also asked, how they see the current packaging and how the packaging material received with the spare parts deliveries is currently being recycled or if it is being reused. The customers were also being asked, whether handling the received packaging material creates an additional cost for them. Then instead they were asked, if they have any suggestions or recommendations for the future for more sustainable packaging of spare parts and for replacing single-use plastic packaging. The goal for the interviews was also to find out, if higher level of sustainability increases the created value to customer, but also to view the topic as from benchmark point of view by viewing, whether the other suppliers on the same industry are packaging their spare parts differently and could there possibly be something that company X could learn from these other suppliers handling similar business operations.

After conducting and recording the interviews they were listened through and written completely open word by word in case of using direct quotations in the work later on. This way of writing everything word by word can also be called as Transcribing. Transcribing requires careful listening, which is repeated and observing the data throughout the whole recorded audio. It is time consuming and approximately one hour of talk requires three hours to transcribe it. (Bailey 2008.) It is a commonly used method to present audio-form data as written form and also to get it into a form that it can be analyzed; it is the first step into

analysis of this audio-form of data. Transcribing is commonly being used, when the data for research is collected by different interviews and discussions (Tietoarkisto).

During the transcribing process the data was written in anonymous form, which was agreed with the interviewees; therefore the customers were named as customer 1, 2 and 3 and the party responsible of packaging was named as company 4. All the geographical locations were as well made anonymous. The tone, mood or such of an interviewee was not transcribed. Only each word said during the interview was written and transcribed from the audio.

All of the three customer interviews differed from each other. When simplifying the interviews of three customers, there can be seen some similarities in the interviewees answers. Each interview and the answers were very different from each other, but by simplifying and collecting some repeating keywords from each one of them, they can be more also comparable with each and other by finding similar features from their results (Alasuutari, 2011: Havaintojen pelkistäminen). Another way these interview results were reviewed, was to find some answers from the interviews, which would significantly differ from the other answers.

3.3 Validity and reliability

The current validity and reliability of the study and its results are accurate. This study and its results are valid currently, but in case this same study would have been, for instance performed five years ago or would be repeated in five years, the results could be different. Some development projects or events within the research topic could also be another factor changing the results in addition to the time of conducting the study (Saunders et al. 2009: 156-157).

The use of various methods to collect information about the topic also support the validity and reliability of the results, since it can be notified that they are having same patterns. The

use of different methods also provides a wider perspective of the research problem and enables that there is a holistic view over the studied problem.

Since the aim of these interviews was to gain the point of view from the chosen organizations within the research topic, the results are reliable and there was no assumed answer from them on the pre-phase of these interviews. If again same questions would be asked from a representative of another company or another person in the same company, the answers would most likely vary, but with the goals of this study the answers are reliable still.

4 RESULTS

This chapter shows and discusses the results of this study. This chapter defines the current stage of packaging including the processes and materials. Moreover, it focuses on the customer interview results and evaluates them with theoretical base and previous research of the studied topic. Further based on these results gained, this chapter includes the discussion for the future direction that could be taken in order to develop more sustainable supply chain management solutions and to replace the single-use plastic packaging in the machinery spare parts deliveries.

4.1 Current state

In this chapter the current packaging process and the usage of packaging materials is evaluated based on the calculations on materials used in year 2018 and from observing the packaging processes and materials. One of the aims was to find out the amount of used plastic in kilograms that was used for packaging spare parts during year 2018 in company X. This amount of plastic is expressed by comparing to the amount of used carton.

There was identified also another group of items, which are not packed by this third party service provider, but they arrive directly from the supplier of the spare parts ready packaged and they just go through without re-packaging to the end-customer of the supply chain. The amount of this type of packages during 2018 was X percent from the shipped spare parts. There are too many different suppliers and spare part items to find out the exact amount of plastic used in these items' packaging as well as there is no standardized guidelines for packaging for suppliers. The percentage of shipments going through without re-packaging is known value and therefore the amount of plastic used in these packages is estimated to be the same percentage of the measured plastic amount from the calculations.

4.1.1 Packaging process

The warehouse does not know exactly, what is coming from suppliers and when it is coming and therefore when the goods are received from supplier or manufacturer, it separates different packages based on the size of the shipment by separating large and small packages to separate area. After that each package and the parts inside are checked and compared to the ERP (Enterprise Resource Planning) system and there is printed out slip for the parts to compare, if the right item and quantity are received. The slip contains information, if the part is supposed to be repacked and how the part should be re-packaged and based on the repacking code of the item, the item is being dispatched to its repacking area and is being repacked. This slip also informs, whether there are currently open sales orders to fulfill for this item, but it does not provide the information regarding, how many pieces of the item are still open. In order to make this process more efficient between receiving the good and forwarding it to customer, it should be evaluated, if it could be developed in the system to get the quantity of open sales item printed on this slip in the future.

What comes to packaging process, currently there does not exist a standardized packaging process or standardized set selection between packaging materials. In many cases the packaging instructions are vague and leave the decision on the person performing the packaging of the item.

Currently nearly all of the items received from suppliers are being repacked at the warehouse before sending them to the customer. The packaging materials in which they arrive in are mostly going to recycling and the parts are packed again into new materials. Only materials that are being reused are paper filling inside packaging or wooden pallets, when they are Euro-pallets or half-pallets, which are accepted by the carriers. All the carton and plastic received in supplier packaging is being recycled. There are different recycling bins for plastic, paper, carton and one for mixed waste. Recycling of different materials is all taken care of by the same service provider, which is an external company. The only task the member responsible of packaging has to do, is to sort the waste to correct bins and then it is further being collected by this member taking care of the waste handling.

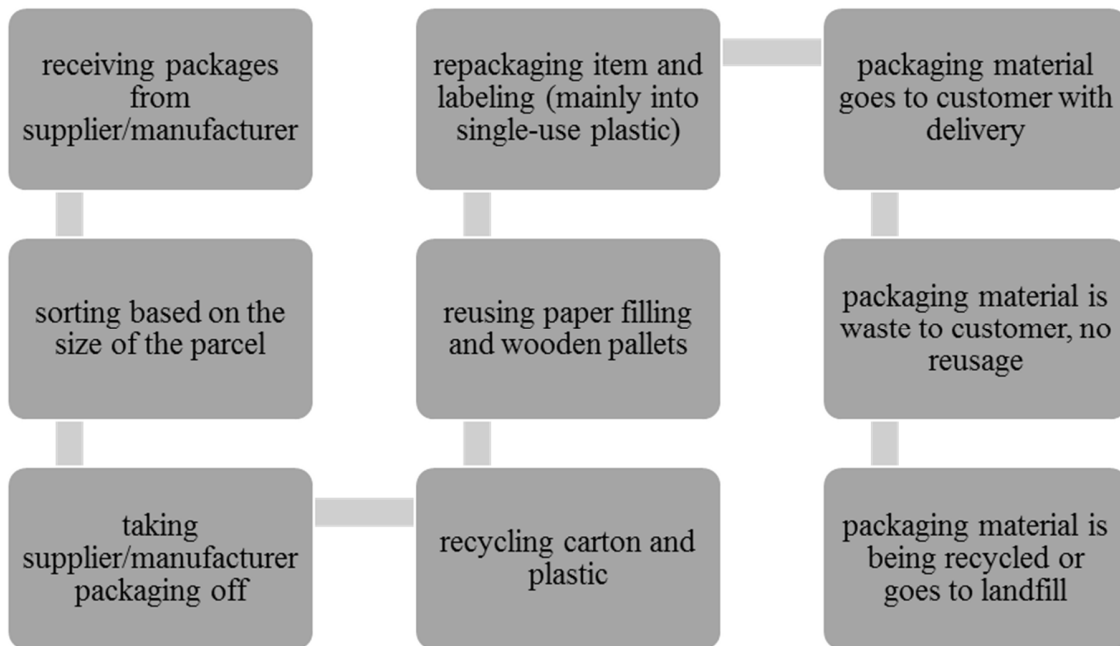


Figure 5. Repackaging and packaging material process.

The packaging of the spare parts happens in different stations depending on the item, its size and what its defined repacking code is. All of the items are packaged the same way and with same material no matter, what the transportation mode is. For example even if a package goes as a road freight it is still packaged the same way in plastic. This could be considered that there would be created different kinds of instructions for packaging based on the different transportation modes and also depending on the geographical area or distance in order to reduce the amount of single-use plastic packaging. It can be identified that for overseas shipment and especially for shipments that go as ocean freight need to have a proper anti-corrosion protection used in order to maintain the quality of the items during transportation.

However, one of the main reasons for using so high amount of plastic bags in packaging is due to labeling of the items and without this bag the labeling and identifying of the parts would be more difficult and uncertain. Customer 3 points out also that parts are often packaged in plastic bags, since there has to be attached labeling on the part to be able to identify, which part it is. The desire is that these plastic bags could be removed, but the

labeling would then need to happen somehow differently as well. Customer 3 sees though that sometimes removing plastic is not more sustainable, since also for them it is important to receive their spare parts, for instance in right quality. Their point of view is that, if there has to be still used plastic, there should be paid more attention to gain higher recycling of the plastics. But customer 3 also says that it is difficult to tell one answer that would solve the problem with single-use plastic in packaging.

This issue of, how the labeling of parts could be done, would have to be considered because the plastic bags cannot just be removed. Still when a shipment is going as a road freight within Europe without expose to high humidity or the high risk of corrosion, there should be considered if the amount of plastic could be changed into another more ecological option, since in these cases the use of plastic bag is mainly due to the efficient and definite labeling of the part.

4.1.2 Packaging materials

The Third Party provider for the packaging materials is having eco-responsibility as part of their agenda in their packaging solutions they provide to the customers. Sustainability and various of used materials being eco-responsible is mentioned in the material details in several different ways, such as for carton boxes the cardboard is supplied from sustainably managed forests and they have given a statement that all their carton boxes can be recycled with the promise of 70 percent. For some of the carton boxes the materials are said to be ecological and that the used material is made of 70 percent recycled paper and that it can also be recycled completely. The company X products are packaged in six different types of carton boxes provided by this material supply company. All of these boxes are different sizes, but consist of same material.

There has been used four different types of envelopes, which can be enclosed with the package itself by glue on the other side of the envelope. The most commonly used envelope is made of polyethylene film and to attach it to the parcel, there has to be taken off a slip,

which is made of silicone. There is a more green option for this envelope from the same material supplier and with a same size. This envelope's material is a combination of polyethylene film and adhesive film and the supplier claims that these can be recycled up to 60 percent. This green version also includes a silicone slip. The glue to attach the envelope in a parcel, is made of sunflower -base and it consists of renewable raw materials up to 70 percent. Printing on this envelope is done by using biodegradable ink. This type of envelope has been though used only once in packaging in company X within the year 2018. The supplier of these packaging materials is not providing more information, how these materials should be recycled, even it claims them to be recyclable with considerably high percentages. When the packaging material data from year 2018 was observed, there could be seen a lot of usage of envelopes to enclose the packaging information and shipping documents with the parcel. Already within this year there has been made an improvement within this matter and these envelopes are no longer used in as many shipments as before. They are currently used only, when the parcel is going overseas and requires special documents for the customs and other purposes on the way. Before these envelopes were used also to enclose packaging documents in the parcel, but currently these have been given up and the documents are placed inside the package and there is no need to use these envelopes made of plastic, which also would create an additional cost. This is also another positive act towards using less single-use plastic.

The current overall material usage in packaging reveals that the most common material used is polyethylene or LDPE. The most commonly used packaging materials are plastic bags and during the year there has been used 160531 single-use plastic bags, when the anti-corrosion bags are excluded from it. Then instead the amount of carton boxes has been 11880. This means that plastic bags have been used nearly 14 times as much as carton boxes in packaging. Based on the calculations and the data analysis the result of the overall amount of plastic consumed during 2018 was possible to gain as well as the amount in euros, how much there has been spent to purchasing plastic packaging.

From cost perspective the most expensive material in euros per piece are the different types of envelopes that can be attached to parcels. They were used, for example to attach shipping documents to the shipments this way. The highest cost for one material is coming from one of these envelopes. The cheapest packaging materials per piece are the regular transparent plastic bags and carton boxes. The prices of these different size plastic bags vary quite a lot, since some of the bags are resealable and include anti-corrosion feature. All the plastic used in packaging is transparent from its color, besides in the three plastic nets, which are all different colors.

During 2018 in company X's packaging has been used eight different bubble wraps, which all are different sizes and with different sizes of bubbles to protect items. All of these bubble wraps have the same thickness, which is 4 mm and they all consist of LDPE plastic film. The third party company is also using colorful plastic nets to protect items, which are different shapes. There has been used three different plastic nets, which all are different colors: red, brown and blue, and they all are different sizes. The packaging material provider does not inform, which type of plastic these nets are made of, but it claims that these nets would be recyclable after they have been collected to recycling.

There has been used three different kinds of tapes in packaging during 2018 and none of these items include any details about recycling of them or their impact on the environment. Two of these tapes are made of polypropylene and their glue is made of water-based acrylic glue. One's material is PVC and its glue is made of natural rubber. Tape is no longer though in usage in packaging. Instead, the cardboard boxes are closed with a wrap, which enables less usage of plastic and the package is more convenient for customer to open.

Another positive observation from sustainable perspective made from the current packaging is that as a filling material there is used only recycled paper and in larger parcels wood and plywood to avoid the movement of parts during transportation. The paper used as filling is either recycled or the filling material received with other shipments, which is then being reused. No plastic is being used as filling material in parcels.

Wooden materials used in packaging are only used once, when sent to customer and currently there is no return process in any of the packaging materials. This option is raised to be considered, if for instance these wooden and plywood boxes could be taken as a return back to the warehouse to use them again. This packaging material return process could also be considered with some plastic materials.

Different sizes of plastic bags are taking a big part of the overall packaging materials of the year 2018. In total there are 15 different sizes plastic bags and all of these plastic bags' material is polyethylene film. They are transparent from their color and the material provider is not informing anything about these bags' recyclability or their impact on environment. In addition to these plastic bags there are three different types of anti-corrosion protection bags. The anti-corrosion bags are colorful.

In addition to these commonly used packaging materials, the third party packaging provider has used some special packaging materials, such as plastic ribbon and other protection for items, which need high security in transportation. These both items are made of plastic (LDPE and ABS). A study from the UK has shown that in industrial packaging, LDPE is the most commonly used plastic material (WRAP 2016), which also can be seen from the results of the data, since nearly all used plastic packaging is made of LDPE.

4.1.3 Data analysis results of amount of used plastic

The results of the data analysis showed that the total amount of single-use plastic in 2018 was 7900 kilograms and 191085 pieces during the year as can be seen in the table X below.

Table 4. Overall amount of single-use plastic in year 2018 from the data.

Year	Total kg	Total pcs
2018	7900	191085

Since some of the packaging material information was lacking or provided only in kilograms or percentages, these materials were approximated in addition to this accurate information. The approximated overall amount of use in 2018 can be further seen in the table X below. This amount of approximated to be more towards the realistic amount of overall plastic packaging usage in 2018, but still based on approximation from the accurate data with the real numbers of the consumption.

Table 5. Overall amount of single-use plastic in year 2018 with including approximated plastic material consumption.

Year	Total kg	Total pcs
2018	8900	271816

In the table X below can be seen, which kind of different single-use plastic packaging materials are the majority of the total plastic amount in year 2018. It can be seen, how variety of different sizes plastic bags are the major item in single-use plastic materials.

Table 6. Pieces per year in 2018 of different kinds single-use plastic packaging materials.

Item	pcs/year
plastic envelopes	104
bubble wraps	112
tape	1449
polyurethane foam	28772
plastic bags	160531

4.1.4 Sustainability in packaging

Sustainability is not part of the party responsible of packaging organizational strategy, mission nor values. Sustainability is also not in the guidelines of the organization, but it can still be seen in their way of acting and environmental considerations in every day-actions. The organization has some key metrics they measure on a monthly basis and these are related to sustainability. Acting sustainably for the organization is driven by the law and it can be seen in, such as it has a high level of recycling their waste, which is one of the metrics followed. The party responsible of packaging is sorting their different types of waste. Different sorting is divided into plastic, cardboard, paper, wood, metal and as last the other waste (Interviewee 4). Recycling is on really high on their agenda:

“... You need to recycle your waste...”

- Interviewee 4

Currently the percentage of recycling waste is 90 percent and this is followed on a monthly basis based on, how high percentage of created waste can be recycled per month and this metric is followed between different months and years. Another KPI (Key Performance Indicator) that is being followed is their water consumption and this metric is followed on annual basis. The third followed metric is, how much CO₂ emissions is coming from their heating system in each facility. The goal is naturally to improve in terms of these three metrics and be able to follow and compare the performance between different facilities. In other terms, the company 4 is not measuring its sustainability or its operations' sustainability (Interviewee 4).

The organization responsible of packaging does not have sustainability as part of their customer promise to their customers, but they operate based on their customer requirements and wishes. If the customer is requesting for improvements in sustainability, they can evaluate and see, how their customer's aimed improvements could be possible to implement and they may make some proposals. The organization responsible of packaging sometimes also makes this type of proposals proactively, when they see that there could be another way

of doing something within the process or another material that could be used. These proactive proposals are driven by the fact the organization has also acknowledged:

“We are conscious that we need to protect the environment also. Whatever we do can have a negative impact, so we try to limit our impact.”

- Interviewee 4

Sustainability drives the supplier selection in company 4. They try to source suppliers of packaging materials, who are able to provide already recycled materials. They considered this fact, when choosing the supplier for filling material for cardboard packages and did tender between different suppliers for the material to see, if they could be able to have this filling material supplied cheaper from somewhere else. This other supplier offered the material cheaper, but only five percent cheaper, and the paper was not recycled, so the company 4 decided to pay five percent more and choose the recycled option. Interviewee 4 though assumes that, if the price difference between two options would be 50 percent or more, then most likely the decision between materials would go for the lower cost material and the environmental role would not have the power in this decision making (Interviewee 4, 2019).

Sustainability is not number 1 criteria driving in supplier selection for company 4 and supplier sustainability in general is not being measured in company 4. But it is still important as interviewee 4 states: “Definitely it is in the top 5 criteria, so this is something we consider.”

They currently have one target material to be replaced, since it is not environmentally friendly and they are sourcing to find another option for to fulfill this material’s role in packaging. They are using blocking material to prevent fragile parts from moving during transportation and this packaging material is made of polyurethane foam. The aim is to replace this with something similar with same features, but so that it would be made of different material. This optional material has same dimensions, same strength, but it is made of material, which is environmentally sustainable. There are also some general targets, such as replacing wood by

cardboard in some packaging contexts, since it is environmentally more ecological in transportation as well as it is more efficient and safer for the staff responsible of packaging to pack this way. Moreover, cardboard also has the higher rates of recyclability than wood. Replacing some of the plastic bags made of traditional plastic has also been sourced, how much it would cost to replace these by plant-based plastic bags.

“We looked at plant-based plastic, but it was five times more expensive. It was decided not to go for it. It is quite big cost.”

- Interviewee 4

What comes to reduction targets in packaging sustainability for company 4, their target area is to recycle as much as possible. An outsourced company is taking care of the waste handling of their created waste. They have three different containers for collecting the waste: one for plastic and cardboard, the second for wood and the last for waste, which cannot be recycled and this one goes to landfill. Company 4 has the responsibility to sort all the waste according to given instructions and there is high motivation to sort correctly, since recycling does not have an additional cost, but wrong sorting has an additional cost. If the company 4 mixes cardboard into the wood container, they will get a fine. None of the packaging material that is received with the deliveries from suppliers and manufacturers is being sent back, but filling material received with supplier packaging is being reused for customer shipments (Interviewee 4).

Company 4 suggestions, how spare parts could be packed more sustainably are to consider the supply chain already from the beginning from supplier and manufacturers side and request them to do things correctly. This would reduce the amount of redoing and removing the packaging. One of the main reasons also for repacking items is that suppliers are branding their parts very strongly in visual sense and therefore the packaging has to be removed and the part has to be repacked again before sending it to the customer of company X. Company 4 also suggests that in some markets returnable packaging could work, for example in form of returnable totes. There is though identified that this requires quite wide and well-

functioning database in order to follow up, where the totes are going and there would have to be implemented a penalty program, if a customer does not return the returnable packaging tote, there would be some payment for that. Returnable packaging system would also bring an additional cost for reverse material flow in terms of transportation. Besides these facts, company 4 considers that returnable packaging system would be feasible in European markets, to which this study is limited to as geographical limitation. Having the reverse material flow would be the easier and cheaper to do by having road transportation as a shipping mode (Interviewee 4).

Company 4 sees replacing single-use plastic as difficult and raises the issue that often, when a part is without packaging, it is then typically not identified. The plastic bag as a packaging has an important role in enabling the accurate labeling of the items. If the plastic bag would be removed, there raises such a question as, how to be able to check the item is, what you have ordered.

“The plastic bag is the way to put a label and identify the part. It is very difficult to take out.”

- Interviewee 4

Company 4 sees the current way of packaging is done well, when considering the industry type. If deliveries would be going to suppliers or to production plants, it would be different, since the packaging does not have to be considered and the parts can be sent in big amounts. But when parts are sent to customers based on the customer order, packaging has an important role in several ways during the transportation as well as with branding, when the customer receives the part (Interviewee 4).

4.2 Sustainability in B2B customer organizations

In customer 1 organization's overall strategy, mission and values sustainability is included throughout the whole organization as well as in each business area unit. For them it is a very important factor in their business (Interviewee 1).

“We call us renewable material company. Sustainability is really high on agenda.”

- Interviewee 1

One of customer 1 organization's goals for future is to make the future free out of fossil fuel-based materials and it is one of the current sustainability statements they give (Interviewee 1).

In the organization the sustainability is clustered into three different areas: social, environmental and economic agenda. Social agenda consists of such factors as employees and wider workforce, community and business ethics in general. Environmental level of sustainability in customer 1 organization is a lot about materials. Its focus areas are consumption of water and energy, as well as carbon dioxide and forest and land use. Economic agenda then instead focuses the whole value chain, the customers, suppliers and investors and it is viewed from all of these perspectives (Interviewee 1).

In customer 2 organization sustainability is part of strategy, mission and values, but it is not equally important factor in the whole global holding level of the organization, but instead in some geographical areas it is seen more important, and in this European location it is becoming more important every day. Customer 2 sees that sustainability is on higher agenda more in some of the geographical locations than in others, and it sees that from the current location they will spread it more into international level also within the organization.

Customer 2 does not have some specific guidelines with sustainability, but it is a topic they are looking into. They are looking into adding solar power to their warehouses in order to get their own green power supply. What comes to spare parts, they are not looking into packaging yet, but there are other sustainable focus areas, such as the machines and equipment and what their environmental footprint is. Their goal is to get as much electrified as possible (Interviewee 2). Sustainability is part of customer 3 organization's overall strategy. The main office has its strategy and then each different geographical location is included in this, so that sustainability is being considered on high level as well as on local level in each location. The

specific focus on sustainability is currently on ocean protection and each area has its specific KPIs within sustainability that are analyzed and followed (Interviewee 3).

For customer 3 organization sustainability is part of the customer promise for their customers and they see it is becoming increasingly important to their customers that each organization operates in sustainable manners (Interviewee 3). For customer 2 sustainability is not publicly part of their customer promise to their customers.

“It is lacking a bit in this field of industry, but we are creating sustainable solutions to our customers in terms of logistics.”

- Interviewee 2

Sustainability is an important part of the customer 1 organizations' promise to its own customers. Their aim is to have it highly on the agenda and provide sustainable products to their customers. They focus on delivering products to their customers without plastic. They rather focus on different options produced of wooden products and fiber among others (Interviewee 1). Customer 2 organization is getting more into sustainability and environmental part of doing business and it states that the topic is becoming more important also for their customers, when the time is progressing (Interviewee 2).

Sustainability is not a major driver in supplier selection for customer 2, but their main goal is to reduce costs and the fuel consumption. The main driver for it is savings on fuel, rather than savings on the emissions of the machines, therefore electrifying is an important improvement area for them. Everything electrified is cheaper than diesel. Customer 2 organization's procurement does not set currently any guidelines for spare parts regarding their sustainability, but they see that sustainability needs and requirements are increasing, what comes especially to using fossil fuels.

“The first step will be in this industry as well and that’s the shift I see now that the machinery is being replaced and it is coming up as on the agenda that we need more and more environmentally friendly equipment.”

- Interviewee 2

In supplier selection sustainability is an important factor for customer 1 organization. Sustainability is important for them in choosing the supplier of raw materials for wood and fiber supplies. They have 100 percent of their wood controlled, so that they know where and from whom it comes from and, whether it has been produced and handled sustainably. On non-wood supplier side, sustainability is controlled by a code of conduct by suppliers needing to register into their system first before delivery of materials is even considered. When the customer 1 organization has checked the supplier and accepted them, the supplier engages to follow their guidelines and policies within this area in order to be able to supply materials to them. These suppliers are also then further measured with such measures as, how many suppliers have signed this supplier code of conduct and how high percentage of raw materials are coming from certified suppliers. The measuring of suppliers is handled with an online tool and the suppliers have to take an online training about customer 1 organization’s code of conduct and sign as a promise to take commitment with the set guidelines. This way they are able to guarantee for the customers that they deliver in sustainable manners and the materials are environmentally friendly (Interviewee 1).

Customer 1 organization’s point of view is that there is still a lot of plastic used in spare part deliveries and that this should be changed and get rid of using plastic in packaging. Currently all the packaging material they receive with spare parts is being collected and put into different recycling channels and none of it is being reused somehow. The recycling of packaging materials causes an additional cost for the customer 1. Customer 2 is recycling cardboard boxes received with spare parts deliveries, but plastic is not currently being recycled. Recycling of cardboard is driven by the pure costs, since leaving it without recycling and putting it to a mixed container the customer 2 organization would have to pay for that, but since they recycle cardboard, they do not have to pay additional cost for that.

Regarding recycling of plastic there does not exist some specific regulation or additional cost, when they would leave it without recycling and therefore it is not being recycled separately. It is placed to regular mixed container after used once and it is also not being reused (Interviewee 2). Customer 3 is recycling all of the material received with spare parts deliveries and they are not reusing any of the packaging material, since there is nothing they could do with them. All the packaging material is therefore waste and it is being recycled by customer 3 and also all the cost from disposing it is on customer 3 responsibility. Currently they have separate recycling bins for metal, timber, fiber and plastic, but in the geographical location, there is no infrastructure to, for instance separate different types of plastics into different containers. Replacing usage of single plastics has to be considered somehow and customer 2 raises that either there could be used more sustainable plastics to decrease the environmental footprint or the recycling or using of plastic could be improved, so these both ways would already improve the packaging more sustainable and create smaller environmental footprint due to packaging (Interviewee 2).

Within machinery industries the other suppliers so far have not focused on sustainable supply chain development with packaging nor with replacing single-use plastic packaging, but some steel industries are considering sustainability and environmental factors under their focus highly, since their business is already polluting so much, and they aim to focus on doing as many things as right as they can (Interviewee 2). With spare parts deliveries, the customer 1 organization does not have so far any initiatives, so that they could set some certain percentage of plastic packaging to be reduced from the spare parts. There are no reduction targets considering suppliers of spare parts, but they currently focus on their wood deliveries to be packaged plastic free (Interviewee 1) therefore it can be identified that they have actions towards within this matter and it has been acknowledged already in actions and this supports the fact that there is a need for this kind of development to reduce plastic in packaging.

It can be seen that this topic is important and that it should be taken under serious development to be able to deliver spare parts more sustainably and without single-use plastic. Customer 1 states that the problem is plastic and that suppliers should put effort to get rid of

it. Customer 3 organization has such suggestions, how spare parts could be packed more sustainably as using an alternative option, which would be more environmentally friendly to replace the items wrapped in plastics. Customer 3 states that they do not want to increase their carbon footprint and therefore they do not want to receive plastics in their deliveries. But customer 3 also notifies that it is difficult to consider each item and each material on one by one basis to tell, where there could be sustainable improvements done, but still sees this as necessary to be done in the future to develop the packaging more sustainable and to replace the single-use plastic in them.

4.3 Value creation to customer through more sustainable and efficient packaging

Interviews showed that all three customers were thinking about sustainability and it was part of their organizations' strategy, mission and vision. They all had an opinion that the current issue with packaging is usage of plastic and it should be replaced with some other material solution in the near future.

"... change all the packages that are nowadays packed in plastic and try to replace it with other solutions and offer other solutions to customers..."

- Interviewee 1

All three customers said they want plastic to be removed, but they were not able to make an exact example of what the new solution for this could be and they had not done actions themselves to find replacing material for plastic. This also supports the motivations for this study and the importance of this topic to be studied further, but it also explains the complexity of the topic of sustainable supply chain development and replacing the issue with single-use plastic.

Historically sustainability has not been that important in this field of industry, besides in measuring the footprint for the machines itself. There can be seen a change and sustainability and environmental consideration is becoming more important (Interviewee 2).

“We see a shift in these marketplaces, where the customers are. They are asking for more of this type of sustainable thinking and rating.”

- Interviewee 2

It can be seen that they all value sustainability and it is seen as a positive feature, but it would have to be implemented in the organization throughout the strategy to all the way to operations. Packaging can be seen as an important factor in delivering value to customers and also customers are raising this in the interviews.

“Packaging plays a big role for what you deliver to your customers.”

-Interviewee 1

Customer 3 does not have sustainability as one of the drivers in supplier selection. It sees the ability to deliver goods and services in right quantity, quality, right time and when they need them as the most important drivers in supplier selection as well as the general supplier competence. Supplier sustainability is currently not being measured in neither customer 2 or 3 organizations. Currently supplier sustainability is not as one of the priorities in selecting them, but customer 3 states that it is becoming more important for them as well, when evaluating suppliers.

4.3.1 Concept 1 – circular economy and reverse packaging material system

Due to several arguments (EC 2018; Interviewee 3 2019; Farooque et al. 2019) pro for reusing materials, there is proposed the practices of circular supply chain as one of the solutions to develop supply chains. This solution would mean reusing the packaging materials by taking them back from the customer site with a reverse material flow. In this case, there would be set a limitation for this to be only applicable to European customer orders and deliveries, since it is easier and cheaper to execute. This system is proven to be viable and it is currently being driven further in various industries, such as in previously mentioned consumer good industries. The empirical study through the interviews supports

this solution to be viable due to the fact that this type of solution is being used by some supplier of customer 3 already currently as this supplier takes the plastic packaging back from the customer and reuses them again. The interview with the party responsible of packaging also supports this option viability, but also identifies that this would have to be implemented on limited geographical area and it could not be applied to deliveries globally. These kinds of practices to take the packaging material back would not make sense to be implemented in all kinds of parts, such as larger or heavier from size, but it would be useful for especially medium sized parts that are being often shipped within Europe.

Customer 3 sees that supplier supply chains are moving big towards more sustainable operations and some of their suppliers let them to return the packaging and then supplier is further reusing the packaging. Any of the other suppliers have not gone further with sustainable packaging development than having a packaging system, where they take the materials back from the customer site and reuse them in packaging again (Interviewee 3).



Figure 6. Packaging process with a circular material flow.

There are different ways, how the reverse packaging material flow could be done. It could be done with the currently used packaging materials, such as wooden or plywood boxes that would be sent back or there could be developed some completely new system with some other packaging modes and materials, such as with plastic totes. In case there would be made a decision for such new material option that is to be reused, it would mandate a one-time larger investment for purchasing them and therefore this would also require a penalty system, when the customer does not return the tote. This reverse material flow would require an implementation of a database to follow, where the materials are and there would have to be either a rewarding system or a penalty system to motivate customers to return the materials.

“Reusing the packaging would be better than recycling.”

- Interviewee 3

It is though identified that even, if the parts would be delivered with a returnable packaging, they would have to be labeled before this and the label has to be possible to attach to the part. This still requires an optional solution for parts being packaged into single-use plastic bags in order to enable to correct labeling of each part.

This option would increase the cost and emissions in transportation, when there would have to be reverse flow. The receiving and recovery of packaging materials would also have to be considered in terms of additional cost and effort from the party responsible of packaging. The returnable packaging would also need space for receiving the materials. One company in the study by Molina-Besch & Pålsson (2016) had tried returnable containers in packaging, but since the company was on food industry, it had hygienic issues with recovery of the containers. Other issues were not raised with this type of packaging within the study. Since machinery field of industry does not have this type of issues in the nature of the industry, it also supports the possibility to develop this type of packaging system.

4.3.2 Concept 2 – replacing use of plastic in packaging by increasing the use of other currently used materials

It was observed from the customer interviews that single-use plastic is seen as the major issue in packaging and it is seen as the most burden environmentally, when comparing different packaging materials. It can be identified that the customers do not yet mandate sustainability from their suppliers and they have not set some specific target in ecological terms concerning spare parts suppliers.

In order to remove the single-use plastic another solution could be to replace plastic with other materials. The customer interviews showed that wood, plywood and cardboard are seen as ecological materials and the attitudes towards their usage are positive from the customer side. Any wooden and fiber-based materials are seen as positive and therefore in cases, where

plastic is being used, it could be replaced by this type of materials in packaging. Customer 2 organization sees that current packaging of spare parts includes a lot of plywood, cardboard and wooden pallets and built wooden frames. Currently used type of wood and cardboard are seen sustainable from customer 2 point of view. Only material seen as environmentally unfriendly is plastic (Interviewee 2).

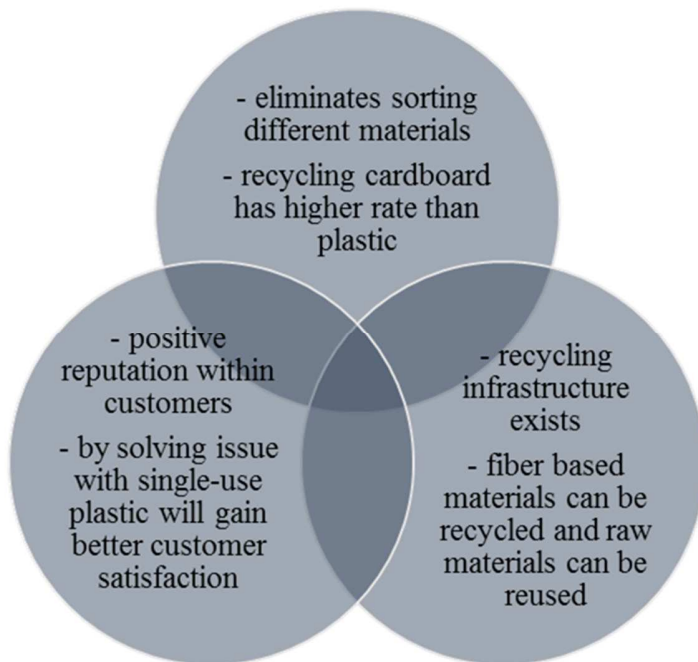


Figure 7. Sustainable development gained from increase of cardboard and other fiber based materials in packaging to replace usage of single-use plastic.

It was identified from the packaging materials during observing them, that there is a need for adding smaller sizes of carton boxes in addition to these current six different sizes. This was also stated from the packaging responsible side that there could be packaged more into carton instead of plastic, if there would be smaller sizes of cardboard boxes available. Even such small parts as bolts and screws were seen to be possible to pack in carton, if there would be available size as an option. Currently it is not possible, since otherwise the fill rate of packaging would be very inefficient and there would have to be using excess amount of

packaging material. Based on the observation made from the packaging, some parts have to be currently sent in supplier's branded packaging due to the fact that the company X does not have this small size carton boxes as a packaging option. These facts prove that there is a need for adding such option in the future.

Adding smaller carton boxes into packaging selection would enable more efficient packaging of these spare parts and enable more smaller parts to be packed into cardboard instead of small plastic bags. In these cases, if a small cardboard box would only include one part, could the label of the part be attached for example inside in the small cardboard box. Customer 3 raises that often small parts come with containing plastic bags with them and these parts' packaging should be taken under evaluation. Customer 3 organization has not set any specific reduction targets in packaging sustainability, since it sees that there is not yet another option for plastic packaging in every delivery context. Customer 2 also raises that especially electrical components and other smaller components that are sensitive for damage in transportation are often packaged in plastic, but it is to mitigate them from damaging and this factor has to be considered.

The customer 1 organization has various ongoing packaging material sustainability activities, such as their aim is to replace all the current plastic packaging with other solutions to their customers and this goal is heavily tried to be driven in the packaging solutions they provide to their customers. The possible solution for future could be that the plastic packaging would be in future replaced with carton or fiber-based materials (Interviewee 1). Customer 2 suggestions, how spare parts could be packed more sustainably, are using more of cardboard and get rid of plastics.

In study conducted by Molina-Besch & Pålsson (2016) one of the studied companies had developed packaging only from cardboard to enable the customer more efficient recycling of materials and eliminate the need for sorting different packaging materials. This could also be seen as a positive improvement and value adding for the customer of company X, since currently cardboard was seen as good packaging material from packaging as well as from environmental perspective. Moreover, all the customers answered that cardboard is being

recycled in their site, increasing it in use would also increase the rate of recycled packaging materials within the supply chain. Carvalho et al. (2014) also suggests that, when the aim is to have environmentally friendly packaging the materials could be, for instance bags, carton pallets or carton boxes, which are easy to recycle. Other features environmentally friendly packaging may have are that it is reusable, returnable or degradable. Environmental costs and waste caused by the business operations are simultaneously reduced in order to improve customer satisfaction. Since wood and plywood are currently being used in various ways in shipping, it is also seen as a possible option to use boxes made of these materials, therefore increase of these materials from previous state is supported.

It should be notified that even, if a material is recyclable, it does not mean that it will be recycled. Different geographical areas and different companies have different kind of infrastructure for recycling and collecting waste, and therefore the material considerations should be made by thinking the whole cycle of the material from the beginning till disposal of them (Molina-Besch & Pålsson 2016).

4.3.3 Concept 3 – replacing single-use plastic with optional materials and optimizing the packaging process and use of materials

Packaging industry has variety of opportunities to develop in terms of efficiency and sustainability. Maximizing fill rate is seen as one of the major ways to decrease the environmental impact of packaging. By this way the additional volume and the weight are minimized as well as the material usage for packaging the product, but still the role of packaging to protect the good cannot be forgotten. In study by (Molina-Besch & Pålsson 2016) all of the customers had considered fill rate of packaging as well as optimizing the packaging material use in their packaging development.

“... the problem is plastic...”

Spare parts deliveries have to take this seriously and search for solutions.”

- Interviewee 1

Packaging causes negative environmental impact also by the emissions from transportation. These can be decreased by more efficient volume usage in packaging and the weight efficiency by choosing lighter packaging materials and more efficient packaging solutions (Molina-Besch & Pålsson 2016).

Customer 3 organization's point of view is that there should be considered any alternatives to decrease single-use plastic and the ideal would be to have no packaging at all or to remove plastic completely from any kind of packages. Customer 3 also points out that, when the packaging materials would be environmentally friendly this should be labelled on the package to pass this message also to customers. Currently customer 3 sees that the packaging materials should be worked out to be more sustainable and add environmentally friendly labeling to them to inform the customer about the details of the packaging.

The previous literature divides green packaging into two categories: win-win approaches and approaches, which have a positive environmental impact, but no positive economic impact. In the win-win situation a company gains positive impact on both and the most common example of this type of situation is the maximization of fill-rate (Molina-Besch & Pålsson 2016).

4.3.4 Direction in future

These previously presented solutions as a form of concept answer both research questions. There would be various other answers to these questions as well due to variety of sustainable development opportunities in terms of packaging in supply chains. Since the target set in the beginning was to come up with three viable improvement solutions, the answering to these research questions is limited by introducing only these three options.

Table 7. Summary of the three concepts.

	Concept 1	Concept 2	Concept 3
<i>Environmental</i>	<ul style="list-style-type: none"> - Reusage of the packaging materials(+) - Increased emissions from transportation with reverse material flow(-) 	<ul style="list-style-type: none"> - Cardboard and paper have high rate of recycling(+) - Eliminates sorting many different materials(+) 	<ul style="list-style-type: none"> - Less emissions in transportation, when the parcel weight lighter(+) - Minimized raw materials and waste(+)
<i>Economic</i>	<ul style="list-style-type: none"> - One time purchase for packaging materials, no continuous purchase cost(- / +) - Implementing the system and the database(-) 	<ul style="list-style-type: none"> - Recycling infrastructure exists(+) - Fiber-based materials can be recycled and raw materials reused(+) 	<ul style="list-style-type: none"> - Less cost for material(+) - Less cost for transportation, when the parcel weight lighter (+)
<i>Social</i>	<ul style="list-style-type: none"> - No need for customers to recycle / handle the materials after use(+) - More efficient use of raw materials(+) 	<ul style="list-style-type: none"> - Positive reputation within customers(+) - Solves the issue with use of plastic(+) 	<ul style="list-style-type: none"> - Less waste to recycle for customer from packaging materials(+) - Solves the issue with use of plastic(+)

This study proved though that there is variety of possibilities to develop packaging and by this way develop more sustainable supply chain, but different options depend on, such factors as, what are the main targets, what is the chosen strategy, if the option costs more, how much there is willingness to invest and also it depends on the features of the goods being shipped and their geographical area of shipping. As can be seen from these three chosen concepts in table 7, all of them have a variety of positive impacts in terms of sustainable development,

but it can be identified that the first concept requires much more resources and is more complex and costs more to implement than the other two concepts. Due to this fact, concepts two and three would be more viable to implement and with a shorter timeframe and less investment.

Another option that could be considered with the packaging is to create different types of packaging and that customer could decide, when ordering items, how they want them to be packaged. If they for example want to have a package as plastic-free, it could be then packaged without plastic by using optional materials, such as carton-, paper- or other fiber-based materials. It is though identified that this could work within the same continent, but when going overseas this option cannot be considered. But since this study has a geographical limitation to consider only the shipments and customers within Europe, making different packaging options for customers could be a solution to consider in order to provide the parts to customers the way they want to receive them. In choosing between these different packaging options there could be provided information regarding, how ecological different options would be compared to each other.

When asking the target of packaging material sustainability activities in customer 3 organization, there is a clear target:

“At the moment the focus is on minimizing single-use plastic for anything more environmentally friendly”

- Interviewee 3

This statement clearly supports the need for this kind of study and development in the industries and in company X (Interviewee 3).

Emblem (2012: 79-80) calls vague phrases, such as “environmentally friendly” or “can be recycled” greenwash. Even if packaging materials are having high possible recyclability, if there is not correct infrastructure in the current country for that, there cannot be done correct recycling of materials.

Customer 2 suggests that, when needing to use plastics still, plant-based plastics could be another better option than oil-based plastics. Company X has already investigated in cooperation with the company responsible of packaging the current opportunities to use bio-based plastics instead of traditional plastics. This was decided not to take in use, since the cost was five times more expensive and the environmental benefits would not be still as significant that could be gained with some other material options. In this current moment this option is therefore not considered as an option for the final chosen concepts, but this is seen as an optional sustainable development for the future packaging, but it should be investigated that, if implementing bio-based plastics into use that they are biodegradable or compostable and that there is an accurate infrastructure for recycling them.

“Biodegradable and compostable plastic packaging is actually not any better in most circumstances. That is normally not an alternative. It still contains plastic and still causes bigger environmental footprint.”

- Interviewee 3

Lindh, Williams, Olsson and Wikström (2016) have also stated that there is high potential for sustainable packaging development. In order to drive changes in supply chains more into action, stakeholders should communicate with each other and together create more sustainable supply chains by new innovations and solutions. Customer 2 mentions that there are two ways to tackle the problem with plastics, either process improvement or material changes, but no matter what the used material is, the appropriate recycling of material would help in minimizing the waste on environment.

Customer 3 opinion is that each supplier has a different supply chain and processes within it and the supply chain is installed in a different way, therefore each organization has to find the best practices to develop their supply chains more sustainable including the developments within packaging processes and material usage, but the fact is:

“supply chains need changing”

- Interviewee 3

5 CONCLUSIONS AND FUTURE RESEARCH

This chapter summarizes the findings and results gained from this study. The whole process of the study is considered and the findings are reflected to the theoretical background of the topic as well as the arguments of the author. This chapter provides suggestions on further research that is seen to be important in future and what kind of study within this topic still could be done.

5.1 Conclusion and results

Sustainability can be said to be a trending topic currently in various different industries, but it is the future and it has high potential for development from economic and environmental aspects within businesses and by this way impacting on social aspects. It can be seen that several companies discuss about the importance of sustainability and how doing business needs to be responsible, but still the practical actions are lacking behind. It is already proved that packaging material can be used more efficiently in several ways and the decisions between different materials have an impact on environment as well as the cost related matters with packaging material. What was observed during this study about sustainable development, there is no one right solution, but rather they all have their advantages and disadvantages. Every organization aiming to develop their supply chain operations sustainably have to choose their strategy and how they want to approach this topic.

This thesis was a study on, how supply chains can be developed to more sustainable direction and what sustainable supply chains solutions could be viable to improve machinery spare parts supply chain towards more sustainable in terms of packaging. The packaging perspective was considered both from the process and the material point of view within supply chain. The empirical part of this thesis was studied by using both qualitative and quantitative sources. In the qualitative part there were interviewed customers and the party responsible of the packaging and supplying the materials for packaging in order to gain wider

view throughout the spare parts supply chain and to observe, whether the different members have the same patterns on the view over the topic. The goal of the interviews was to find out, as how important factor is sustainable development within supply chain operations seen and what kind of solutions there could be to implement in practice. In order to gain a good picture over the current process and materials the process was observed at the location, where the packaging is done and it was also supported by conducting an interview. In order to find out the amount of plastic used in packaging, the packaging data was analyzed based on the total amount of year 2018. This study was possible to be conducted as planned in the research plan phase. The results introducing three concepts for sustainable development within packaging were able to answer the set research questions.

5.2 Evaluation of research results

This thesis was able to answer to both research questions, which were constructed followingly:

- 1) How could plastic be used more sustainably and efficiently as packaging material?
- 2) What packaging options are there to develop more sustainable supply chain?

There are various answers to these questions and this study proved, how wide the topic is and how it cannot be explained with one solution. Firstly, literature review revealed that various research considers closed loop supply chain as well as circular supply chain as possible solutions to use any kind of material, including plastic, more sustainably and efficiently in case it still needs to be used to maintain the delivery of goods correctly to the customer. Secondly, other materials and new innovations in materials are seen as an answer to develop supply chains more sustainable. These two research questions were further answered by introducing three concepts that are seen viable to implement in industrial supply chain operations.

5.3 Future research

This study showed that there is a lack of research over the plastic usage in heavy industries. Since this fact, there was not existing a reference, which would show another material to replace plastic use as a packaging material in this type of industry and business context. Future research has high potential in focusing on practical solutions of single-use plastic minimization and replacement in packaging context and circular economy in Supply Chain Management context.

One way to measure the environmental impacts of businesses or business processes is a method called carbon footprinting, which was also mentioned in the customer interviews. The carbon footprint is expressed as in grams or kilograms of carbon dioxide as a measure (Emblem 2012: 84). This could be a way of evaluating this topic further and to gain comparable data for evaluating the development status in comparison to current situation, but it was excluded from this study in addition to LCA analysis, which was already previously mentioned and suggested also as a method to further investigate within this topic.

Several researches had acknowledged that there is a need for performing more cross-country study within topics of sustainability and changes in future packaging in order to view it in global business perspective. Most of the previously conducted studies within these topics were on B2C (Business to Customer) markets and the respondents in such as surveys were consumers. Future research could therefore focus also on B2B (Business to Business) markets and have such studies conducted to customers, who are companies and not consumers. The study results could vary more, since B2B customers maybe have more advanced knowledge and perspective over the topic than a regular consumer does and therefore the result of the study would also rely more on facts and not emotions.

REFERENCES

- Amini, M. & C.C. Bienstock (2014). Corporate sustainability: an integrative definition and framework to evaluate corporate practice and guide academic research. *Journal of Cleaner Production* 76, 12-19.
- Andrady, L. (2015). *Plastics and environmental sustainability*. John Wiley & Sons: New Jersey. ISBN: 9781118312605.
- Alasuutari, P. (2011). *Laadullinen tutkimus 2.0*. Vastapaino. ISBN: 9789517685030.
- Bailey, J. (2008). First steps in qualitative data analysis: transcribing. *Oxford Journals*. [online] [Cited on 22.10.2019]. Available: https://www.researchgate.net/publication/224973591_First_steps_in_qualitative_data_analysis_Transcribing
- Beitzen-Heineke, E.F., N. Balta-Ozkan & H. Reefke (2017). The prospects of zero-packaging grocery stores to improve the social and environmental impact of the food supply chain. *Journal of Cleaner Production* 140, 1528—1541.
- Borland, H. (2009). Conceptualizing global strategic sustainability and corporate transformational change. *International Marketing Review* 26:4/5, 554-572.
- Campos, J.K., F. Straube, S. Wutke, & P.A. Cardoso (2017). Creating value by sustainable manufacturing and supply chain management practices – a cross-country comparison. *Procedia Manufacturing* 8, 686-690.
- Carvalho, H., K. Govindan, S.G. Azevedo & V. Cruz-Machado (2017). Modelling green and lean supply chains: An eco-efficiency perspective. *Resources, Conservation and Recycling* 120, 75—87.
- Castro-Jiménez, J., D. González-Fernández, M. Fornier, N. Schmidt & R. Sempéré (2019). Macro-litter in surface waters from the Rhone River: Plastic pollution and loading to the NW Mediterranean Sea. *Marine Pollution Bulletin* 146, 60—66.

D'Amato, D., S. Veijonaho & A. Toppinen. Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. *Forest Policy and Economics*, Article in Press.

EC 2018. A European strategy for plastics in a circular economy.

EC 2016. Closing the loop. New circular economy package.

Emblem, H. & A. Emblem (2012). *Packaging Technology: Fundamentals, Materials and Processes*. Elsevier Science & Technology. ISBN: 9780857095701.

EMF (Ellen MacArthur Foundation) (2012). Towards the Circular Economy. [online] [Cited on 20.9.2019]. Available:

<https://www.ellenmacarthurfoundation.org/publications/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an-accelerated-transition>

European Commission (2014). Attitudes of Europeans towards waste management and resource efficiency.

Farooque, M., Zhang, A., Thüerer, M., Qu, T. & D. Huisingh (2019). Circular supply chain management: A definition and structured literature review. *Journal of Cleaner Production* 228, 882-900.

Golicic, S.L. & C.D. Smith (2013). A Meta-Analysis of Environmentally Sustainable Supply Chain Management Practices and Firm Performance. *Journal of Supply Chain Management* 49:2, 78–95.

Greene, J.P. (2014). *Sustainable Plastics: Environmental Assessments of Biobased, Biodegradable, and Recycled Plastics*. John Wiley & Sons. ISBN: 9781118899496.

Hahladakis, J.N. & E. Iacovidou (2018). Closing the loop on plastic packaging materials: What is quality and how does it affect their circularity? *Science of the Total Environment* 630, 1394–1400.

- Haynes, K., A. Murray & J. Dillard (2012). *Corporate Social Responsibility: A Research Handbook*. Routledge. ISBN: 9781136256493.
- Herbes, C., C. Beuthner & I. Ramme (2018). Consumer attitudes towards bio-based packaging – A cross-cultural comparative study. *Journal of Cleaner Production* 194, 203–218.
- de Castro Hilsdorf, W., C.A. de Mattos & L.O. de Campos Maciel (2017). Principles of sustainability and practices in the heavy-duty vehicle industry: A study of multiple cases. *Journal of Cleaner Production* 141, 1231-1239.
- Horodytska, O., F.J. Valdés & A. Fullana (2018). Plastic flexible films waste management – A state of art review. *Waste Management* 77, 413–425.
- Interviewee 1, customer 1, 13.9.2019.
- Interviewee 2, customer 2, 1.10.2019.
- Interviewee 3, customer 3, 11.10.2019.
- Interviewee 4, company 4, 18.11.2019.
- Jacobsen, J. (2011). *Sustainable Business and Industry: Designing and Operating for Social and Environmental Responsibility*. ASQ Quality Press. ISBN: 9780873898102.
- Jambeck, J.R., R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. Narayan & K.I. Law (2015). Plastic waste inputs from land into the ocean. *Science* 347, 768–771.
- Kothari, C.R. (2004). *Research Methodology: Methods and Techniques*. New Age International Ltd. ISBN: 9788122424881.
- Li, W.C., H.F. Tse & L. Fok (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*: 566–567, 333–349.

- Lindh, H., A. Olsson & H. Williams (2016). Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development? *Packaging Technology and Science* 29, 3–23.
- Lindh, H., H. Williams, A. Olsson & F. Wikström (2016). Elucidating the Indirect Contributions of Packaging to Sustainable Development: A Terminology of Packaging Functions and Features. *Packaging Technology and Science* 29, 225–246.
- Longhurst, R. (2009). Interviews: In-Depth, Semi-Structured. [online] [Cited 23.10.2019]. Available: https://www.researchgate.net/publication/288218013_Interviews_In-Depth_Semi-Structured
- Löfgren, M. & L. Witell (2005). Kano's theory of attractive quality and packaging. *Quality Management Journal* 12:3, 7–20.
- Magnier, L. & J. Schoormans (2015). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology* 44, 53–62.
- Meherishi, L., S.A. Narayana & K.S. Ranjani (2019). Sustainable packaging for supply chain management in the circular economy: A review. *Journal of Cleaner Production* 237, November.
- Melkonyan, A., K. Krumme, T. Gruchmann, S. Spinler, T. Schumacher & R. Bleischwitz (2019). Scenario and strategy planning for transformative supply chains within a sustainable economy. *Journal of Cleaner Production* 231, 144-160.
- Molina-Besch, K. & H. Pålsson (2016). A Supply Chain Perspective on Green Packaging Development-Theory Versus Practice. *Packaging Technology and Science* 29, 45-63.
- Nestlé -website. What is Nestlé doing to tackle plastic packaging waste? [online] [Cited on 26.11.2019]. Available: <https://www.nestle.com/ask-nestle/environment/answers/tackling-packaging-waste-plastic-bottles>

- Nilsson F., A. Olsson, & F. Wikström (2011). Toward sustainable goods flows – a framework from a packaging perspective. Proceedings of the 23rd Nofoma Conference: Harstad, Norway, 2011.
- PepsiCo -website. Circular future for packaging. [online] [Cited on 26.11.2019]. Available: <https://www.pepsico.com/sustainability/sustainable-food-system/packaging>
- PlasticsEurope (2016). Plastics – the facts 2016 an analysis of European plastics production, demand and waste data.
- Pullman, M. & M. Sauter (2012). *Sustainability Delivered: Designing Socially and Environmentally Responsible Supply Chains*. Business Expert Press. ISBN: 9781606493199.
- Pålsson, H., C. Finnsgård & C. Wänström (2013). Selection of Packaging Systems in Supply Chains from a Sustainability Perspective: The Case of Volvo. *Packaging Technology and Science* 26, 289–310.
- Rokka, J. & L. Uusitalo (2008). Preference for green packaging in consumer product choices – do consumers care? *International Journal of Consumer Studies* 32:5, 516–525.
- Saunders, M., P. Lewis & A. Thornhill. (2009). *Research Methods for Business Students*. 5th ed. Pearson Education Limited: England. ISBN: 978-0-273-71686-0.
- Seuring, S. & M. Muller (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Clean Production* 16:15, 1699–1710.
- Srivastava, S.K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews* 9:1, 53-80.
- Spetzler, C., H. Winter & J. Meyer (2016). *Decision Quality: Value Creation from Better Business Decisions*. ISBN: 978-1-119-14467-0.

- Steenis, N.D., I.A. van der Lans, E. van Herpen & H.C.M. van Trijp (2018). Effects of sustainable design strategies on consumer preferences for redesigned packaging. *Journal of Cleaner Production* 205, 854–865.
- Sulapac -website. [online] [Cited on 24.10.2019]. Available: <https://www.sulapac.com/about/>
- Teece, D. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance, *Strategic Management Journal* 28, 1319-1350.
- Tietoarkisto: Aineistonhallinnan käsikirja. Kvalitatiivisen datatiedoston käsittely. [online] [Cited on 22.10.2019]. Available: <https://www.fsd.uta.fi/aineistonhallinta/fi/kvalitatiivisen-datan-kasittely.html>
- Ullwer, J., J.K. Campos & F. Straube (2016). Waste and pollution management practices by German companies. *IFAC-PapersOnLine* 49:2, 102–107.
- Unilever -website. Rethinking plastic packaging – towards a circular economy. [online] [Cited on 26.11.2019]. Available: <https://www.unilever.com/sustainable-living/reducing-environmental-impact/waste-and-packaging/rethinking-plastic-packaging/>
- Vergheze, K.L., R. Horne & A. Carre (2010). PIQET: the design and development of an online ‘streamlined’ LCA tool for sustainable packaging design decision support. *International Journal of Life Cycle Assessment* 15:6, 608–620.
- Women in Tech Forum 2019. Keynote speech: Sulapac challenges plastic. Laura Tirkkonen-Rajasalo, CCO, Co-founder Sulapac. [online] [Cited on 22.10.2019]. Available on: <https://www.youtube.com/watch?v=U-HYDrLhWCA>
- World Commission on Environment and Development (WCED) (1987). *Our Common Future*. Oxford University Press.
- Young, S. (2008). Packaging and the environment: the shoppers’ perspective. *Brand Packaging* 12:1, 24–30.

Zhang, M., Y.K. Tse, B. Doherty, S. Li & P. Akhtar (2018). Sustainable supply chain management: Confirmation of a higher-order model. *Resources, Conservation and Recycling* 128, 206–221.

APPENDIX

Interview questions for the empirical part to collect information from the customers

1. Is sustainability included in your organization's overall strategy, vision, mission and/or values?
2. What kind of sustainability guidelines does your organization have?
3. Is sustainability part of your customer promise to your customers?
4. How does sustainability drive supplier selection?
5. How important driver is sustainability to your organization in supplier selection?
6. Do you measure supplier sustainability? If yes, how?
7. What are the packaging material sustainability activities in your organization?
8. Have you got specific reduction targets (in packaging sustainability)?
9. How do you see the current packaging of company X spare parts? (including pallet, collars, lid, plywood, cardboard box and stuffing used in packaging)
10. How do you currently recycle and/or reuse all the packaging material received with spare parts' deliveries?
11. Does this generate an additional cost for you?
12. Have you got some suggestions, how spare parts could be packed more sustainably?
13. Have you got any recommendations for replacing single use plastic?
14. What changes do you see necessary/critical with spare parts packaging?
15. What could company X learn from other suppliers' packaging?

Interview questions for the empirical part to collect information from the party responsible of packaging

1. Is sustainability included in your organization's overall strategy, mission and/or values?
2. What kind of sustainability guidelines does your organization have?
3. Is sustainability part of your customer promise to your customers?
4. How does sustainability drive your supplier selection?
5. How important driver is sustainability to your organization in supplier selection?
6. Do you measure supplier sustainability? If yes, how?
7. Do you measure your organization's sustainability? If yes, how?
8. What are the packaging material sustainability activities in your organization?
9. Have you got specific reduction targets (in packaging sustainability)?
10. How do you currently recycle and/or reuse all the packaging material received with spare parts' deliveries (when they come from supplier / manufacturer)?
11. Does this generate an additional cost for you?
12. Have you got some suggestions, how spare parts could be packed more sustainably?
13. Have you got any recommendations for replacing single use plastic?
14. What could company X learn from other suppliers' / organizations' packaging?