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Increasing environmental sustainability in the clothing and textile industry by using circular economy business models

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Description

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Abstract

The clothing and textile industry is the second most polluting industry in the world after the oil industry. New trends and styles come up more frequently than ever before and the procurement of clothing has increased significantly. The amount of clothing and textile waste that is discarded is difficult to keep track on. The traditional way of producing, using, and disposing of clothing is not environmentally sustainable. Therefore, a comprehensive shift towards circular economy in the clothing and textile industry is needed as the scarcity of resources increases.

The objective of the research was to find out ways to increase environmental sustainability in the clothing and textile industry by implementing circular economy business models. The research was qualitative, and it implemented a multiple case study strategy. Secondary data was collected from the case companies' websites and sustainability reports. An adapted theoretical framework was drawn by the author based on the company's value chain activities, which was employed when choosing the research question, analysing data, and interpreting the results. The theoretical framework allowed the author to assess the case companies' operations and their environmental impacts throughout the value chain activities and helped to answer the research question and meet the research objective.

The findings show that by striving to decrease emissions and optimizing the usage of water, companies aimed to decrease their environmental impact. Moreover, they optimized their transportation and distribution, utilized textile waste and other forms of waste such as plastic bottles. Designing timeless products from ecological materials that are physically durable and easy to repair was considered important. Refraining from the usage of harmful chemicals and producing ecological packaging was also what many of the case companies did. Followingly, implementing take back systems and keeping the products in circulation as long as possible were some of the means to be more environmentally friendly. Collaborating with responsible stakeholders being transparent was also a means to contribute to environmental sustainability.

The research reflects on the importance of having circularity and a sustainable way of utilizing resources as the company's core values. They show that by doing this, companies can contribute to environmental sustainability since the environmental impacts are significantly lower when implementing circular business models compared to the traditional way of producing and disposing clothing and textiles.

Keywords/tags (subjects)

Circular economy, environmental sustainability, circular economy business models, clothing and textile industry

Miscellaneous (Confidential information)

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Kuvailulehti

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Ympäristökestävyyden lisääminen vaate- ja tekstiilialalla käyttämällä kiertotalouden liiketoimintamalleja

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Tiivistelmä

Vaate- ja tekstiiliteollisuus on toiseksi eniten saastuttava ala maailmassa öljyteollisuuden jälkeen. Uusia trendejä ja tyylejä ilmestyy entistä useammin ja vaatteiden hankinta on lisääntynyt merkittävästi. Vaate- ja tekstiilijätteen määrää on vaikea seurata. Perinteinen tapa valmistaa, käyttää ja hävittää vaatteita ei ole ympäristön kannalta kestävä. Siksi vaate- ja tekstiiliteollisuudessa tarvitaan kokonaisvaltaista siirtymistä kiertotalouteen resurssien niukentuessa entisestään.

Tutkimuksen tavoitteena oli selvittää tapoja lisätä ympäristökestävyyttä vaate- ja tekstiiliteollisuudessa kiertotalouden liiketoimintamalleja toteuttamalla. Tutkimus oli kvalitatiivinen ja se toteutettiin monitapaustutkimuksena. Tutkimuksessa hyödynnettiin sekundääridataa, joka kerättiin tapausyritysten verkkosivuilta ja vastuullisuusraporteista. Kirjoittajan laatimaa, yrityksen arvoketjun toimintaan perustuvaa teoreettista viitekehystä hyödynnettiin tutkimuskysymyksen laatimisessa, sekundääridatan analysoinnissa sekä tulosten tulkinnassa. Teoreettinen viitekehys antoi tutkijalle mahdollisuuden arvioida tapausyritysten toimintaa ja ympäristövaikutuksia koko arvoketjussa ja auttoi vastaamaan tutkimuskysymykseen ja saavuttamaan tutkimuksen tavoitteen.

Tutkimustulokset osoittavat, että yritykset pyrkivät vähentämään ympäristövaikutuksiaan vähentämällä päästöjä ja optimoimalla veden käyttöä. Lisäksi he optimoivat kuljetustaan ja jakeluaan, hyödynsivät tekstiilijätettä ja muita jätteitä, kuten muovipulloja. Ajattomien tuotteiden suunnittelu ekologisista materiaaleista, jotka ovat fyysisesti kestäviä ja helposti korjattavia koettiin tärkeänä. Tapausyritykset myös välttivät haitallisia kemikaaleja ja käyttivät ekologisia pakkausmenetelmiä. Lisäksi takaisinottojärjestelmien käyttöönotto ja tuotteiden pitäminen kierrossa mahdollisimman pitkään olivat keinoja olla ympäristöystävällisempiä. Yhteistyö vastuullisten sidosryhmien kanssa oli myös keino edistää ympäristön kestävyyttä.

Tutkimus heijastavaa sitä, kuinka tärkeää on, että kiertokulku ja kestävyys ovat osana yrityksen ydinarvoja. Ne osoittavat, että niin toimimalla yritykset voivat edistää ympäristön kestävyyttä, sillä kiertotalouden liiketoimintamalleja toteutettaessa ympäristövaikutukset ovat huomattavasti pienemmät verrattuna perinteiseen vaatteiden ja tekstiilien tuotantotapaan.

Avainsanat (asiasanat)

Ympäristökestävyys, kiertotalous, kiertotalouden liiketoimintamallit, vaate- ja tekstiiliala

Muut tiedot (salassa pidettävät liitteet)

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1 Introduction

1.1 Background

The clothing and textile (CT) industry stands out as the most widespread and globally integrated industry across the globe, as Anguelov (2015) states. According to the author, trends in the industry define and change what kind of garments consumers purchase and how people dress. Moreover, it is said that the creation and destruction of trends are outcomes of cultural change, although culture is slow to change whereas trends change frequently. As Anguelov (2015) points out, now trends change at an exponentially higher rate than only two decades before, and those changes are not spontaneous or natural, but rather calculated and based on retailer driven fashion seasons in order to increase sales. As Anguelov (2015) and Hellman and Luedicke (2018) describe these changing trends and addiction to newness causes consumers to purchase new clothing items more frequently than ever before.

Nowadays there are as much as 24 different seasons in fashion which increases production and consumption of clothing, and as a result, impulsive shopping has become commonplace in the clothing industry, as Anguelov (2015), and McNeill and Moore (2015) discuss. According to Anguelov (2015) and Claudio (2007) low prices and easy access also accelerate clothing consumption. In order to keep prices low, production costs also need to be low which in turn causes garments to be less durable and more disposable, which results in higher levels of waste. Both Anguelov (2015) and Claudio (2007) report that the production and promotion of such clothing is referred as fast fashion, which has become prevalent in modern society.

The correlation between cheap, unsustainable, and disposable clothing and throwaway mentality is evident, according to Anguelov (2015). McCollough et al. (2018) state that the throwaway mentality refers to throwing away products and purchasing new ones to replace them rather than repairing the old ones. This can be seen in the increased number of daily generations of municipal solid waste per capita, for example, in the US it was 3,66 pounds per day in 1980, but in 2010 it had risen to 4,44 pounds per day. Moreover, Laitala (2014) remarks that in the UK on

average 30 kilograms of clothing and textiles are discarded every year. According to Hellman and Luedicke (2018) and McCollough et al. (2018), new clothing is not that costly and the perceived time and effort to repair a product can be a reason why a new product is purchased rather than repairing the old one. Also, some clothing can become obsolete regarding quality or functionality, or out of style which leads to them being thrown away according to Hellman and Luedicke (2018). According to McNeill and Moore (2015), instead of opting sustainable and ethical choices or limiting one's consumption the desire to be stylish and fashionable often overcome the choice to be ethical and sustainable. Lack of knowledge about the negative environmental impacts of clothing industry is also a reason for this phenomenon as the authors state.

The CT industry has widespread and severe negative impacts on the environment, it causes notable amounts of waste and pollution around the globe, as Claudio (2007) and Niinimäki et al. (2020) report. In fact, the clothing industry is the second most polluting industry in the world after oil industry according to Moorhouse and Moorhouse (2017). The environmental impacts will be discussed in more detail in the Motivation subchapter 1.2. and further in the thesis. Sustainably produced clothing offers a solution for this problem. Environmentally sustainable clothing is becoming increasingly popular since the discussion about environmental impacts in the clothing industry is becoming more common and knowledge about these impacts increases, according to Eryuruk (2012). The concept of sustainability, as defined by the United Nations in 1987, refers to the notion of meeting the current needs of society while ensuring that future generations can meet their own needs without any compromise.(United Nations, n.d.). Moreover, environmentally sustainable clothing is produced without harming the planet by using ecological materials and processes aiming to extend the product life span of the garment thus mitigating the textile waste and pollution (Niinimäki & Hassi, 2011).

Throwing away clothing and procuring them to the extent of overconsumption is not the only problem, but the linear business model the whole clothing production and consumption is based on. That is why a shift from linear business models to circular economy (CE) is needed (Ellen MacArthur Foundation, 2013). According to the author, implementing circular business models in the CT industry not only reduces

environmental impacts and promotes environmental sustainability (ES), but saves resources and thus increases economic value. Patwa and Seetharaman (2019) state that shifting towards circular business models is a necessity because of scarce resources. They discuss that the fundamental intention to shift towards circular business models in the CT industry is aiming to a closed loop, diminishing all harmful pollution and waste, lengthening product life cycle, increasing recycling, avoiding the use of raw materials, and favouring renewable energy. All of this contributes to a greener, sustainable future.

1.2 Motivation

There are several reasons why finding solutions to increasing ES and shifting towards CE in the CT industry is important for the society. One of the reasons is that the CT industry produces a tremendous amount of pollution to the environment. (Moorhouse & Moorhouse, 2017.) While the CT industry has severe harmful impacts for the environment, on average procurement of clothing has increased 60% from the year 2000 to 2014. (McFall-Johnsen, 2019.) As much as 400% more clothing is produced than 20 years ago. On average, clothes are worn only 7 times before thrown away and studies show that most women consumers only wear 20 to 30 percent of the clothes they own. (Sustain Your Style, n.d.)

One major issue caused by the CT industry is water pollution. Toxic wastewaters from textile manufactories are directly released into natural waters in most of the countries where clothing is produced. Twenty percent of industrial water contamination is caused by the treatment and dyeing of textiles. Furthermore, textile dyeing causes a notable amount of water pollution globally, which annually loses up to 200 000 tons of colours to sewage. For aquatic life as well as the humans who live along riverbanks, the poisonous compounds in wastewater are particularly dangerous, this also contaminates seas all throughout the world. In addition, a substantial contributor to the polluting of water is the use of fertilizers in the cotton industry. (McFall-Johnsen, 2019 & Davis, 2020Sustain Your Style, n.d.) In addition to water contamination caused by the CT industry, high consumption of water is another major environmental issue in the industry. The CT industry is the second largest consumer of water globally. It takes up to 2 650 litres of fresh water to

produce a single cotton t-shirt. Growing cotton, dyeing textiles, and finishing processes of clothing all require massive amounts of fresh water. Up to 20 000 liters of water are required to create just 1 kilogram of cotton, and up to 200 tons of water can be used to dye one ton of fabric. The environment is affected severely by this. For instance, cotton production contributes to the Aral Sea's desertification. (McFall-Johnsen, 2019 & Sustain Your Style, n.d.). Nearly 20% of the wastewater comes from the CT industry. (Ro, 2020).

Another environmental issue caused by the CT industry is that microfibers are released into natural waters. A wash of a synthetic fabric like polyester or nylon releases 1,900 individual microfibers into the water. These microfibers are consumed by fish, who then pass them on to people through their consumption of fish. (Sustain Your Style; n.d.). According to a report by the International Union for Conservation of Nature, cited in McFall-Johnsen's (2019) article, approximately 500 000 tons of microfibers end up in the ocean each year as a consequence of washing textiles. The report also estimated that synthetic fabrics washing accounted for 35% of all microplastics found in the ocean in 2017. Creating textiles also involves the usage of chemicals. They significantly degrade soil, pollute freshwater and ocean water, and also bring about diseases and early deaths among cotton producers. Some of them are detrimental to the people who purchase the clothing. Additionally, the overgrazing of pastures due to the production of wood-based fibers, breeding animals for their wool, and deforestation all contribute to soil degradation and rainforest loss. Each year, plantations of trees used to create wood-based textiles replace hundreds of hectares of forests that have been cleared. (Sustain Your Style, n.d).

The CT industry plays a significant role in increasing greenhouse gas emissions, with estimates suggesting it contributes to around 10% of global carbon emissions (Sustain Your Style, n.d.; McFall-Johnsen, 2019; Davis, 2020; Ro, 2020). According to the Ellen MacArthur Foundation's 2017 report, cited by McFall-Johnsen (2019), if the industry continues on its current path, it could be responsible for a staggering 26% of global carbon emissions by 2050. This is primarily due to the energy-intensive nature of manufacturing and transportation processes involved in the production of garments, which generetases greenhouse gas emissions that are released to the

atmosphere. The majority of fabrics used in clothes are synthetic, which uses more energy in production than natural fibers. China, Bangladesh, and India, which are nations that use coal in manufacturing, are the countries where the majority of clothing is made. Coal generates the most of carbon emissions from all energy types. (Sustain Your Style, n.d). Due to these negative impacts explained in this subchapter, increasing ES in the CT industry through CE business models is crucial. These matters act as the research motivation.

Personal motive

I am highly interested in both fashion and clothing as well as combating environmental issues, in which the CT industry plays a big part in. In recent years, I have become more aware of the severe global impacts caused by the CT industry. It is clear to me that we as a society must take a more sustainable turn in this matter. I am sure this topic will open my eyes even more and make the impacts of the CT industry more concrete for myself. The topic of sustainability and CE are also of interest to me regarding my future career. I believe that the future of the CT industry should be and will be very different than it is currently.

1.3 Research approach and structure

Research problem and objective

As the discussion about sustainability and environmental issues has increased, companies, customers, and governments are considering these topics in their actions to a greater extent. As discussed in the previous subchapters and following Literature review, the consumption of clothing and its environmental impacts are notable, and a more sustainable, circular approach in the CT industry is needed. Procurement of clothing has ascended to an exceedingly high level and the linear production of clothing causes significant amount of waste and pollution around the world. The CT industry is the second most polluting industry after oil industry (Philip et al., 2020). A more ecological way of producing, acquiring, consuming, and disposing of clothing is vital for the industry and the environment. The objective of the research is to find out how companies can increase ES by using CE business models in the CT industry.

Research question and approach

This research aims to answer the following research question:

How to increase environmental sustainability in the clothing and textile industry by using circular economy business models?

The research will be a qualitative study by nature and will be conducted by reviewing relevant secondary data about multiple case companies implementing circular business models, which contributes to achieving validity and relevance. Secondary data suits the research well since it allows acces to large amounts of information and covers a comprehensive range of entities and topics (Bickman & Rog, 2008). Qualitative study suits the research because it provides a way to study complex phenomena within the context in question, as Baxter and Jack (2008) state. The authors describe that the use of multiple case studies allows researchers to investigate variations within and among cases, which suits the research well. Theoretical framework is implemented by reviewing product life cycle activities of companies implementing the CE business models. This way the level of ES can be evaluated because product life cycle shows all the activities that are needed to produce, distribute, and dispose a product (Walters & Lancaster, 2000).

Sturcture of the thesis

The thesis consists of five chapters, the first of which, Introduction, covers background information, the motivation for the research, the research approach, and the structure of the thesis. The second chapter, Literature Review, critically examines the thesis's primary topics: environmental sustainability, circular economy, circular economy business models and product life cycle while also presenting the theoretical framework that will guide the study. The third chapter, Methodology, goes over the research approach and context, as well as the data collection and analysis process and results verification. The fourth chapter presents the findings and results from the data collection phase. The fifth and final chapter is Discussion, which defines an answer to the research question, reviews practical implications and an assessment of the results in light of literature, considers the research's limitations, offers managerial implications and presents recommendations for future research.

2 Literature Review

In this chapter the main topics of the research will be discussed thoroughly, which are environmental sustainability and circular economy. Moreover, a theoretical framework is drawn based on the five CE business models and the seven value chain activities in the CT industry which are also explained in this chapter. These topics are highly relevant to the research and help the author to meet the research objectives and answer the research question. The data in the empirical study which was critically reviewed ensure the validity, reliability, and objectivity of the research. This also guided the author to form a research question and objective and draw a theoretical framework and plan the study approach and conduct the research. The data was retrieved from various academic sources such as journal articles and books. Secondary data from different organizations' and companies' websites and reports were also critically reviewed and analysed.

2.1 Environmental sustainability

The concept of environmental sustainability

Sustainability is divided into three different dimensions: social dimension, economic dimension, and environmental dimension (Ekins, 2000; Goodland & Daly, 1996). Ekins (2000) describes that the environmental dimension is about its contribution to the social and economic dimensions, and their impacts on the environment and natural resources. The generally approved definition of ES is that the current needs are met without risking the ability of future generations to meet their needs (Elleuch et al., 2018; Morelli, 2011). Moreover, Ekins (2000) states that the human lifestyle nowadays does not promote the notion of ES, because the actions of humankind are ruining the environmental conditions crucial for this continuation, and because the environmental effects of human behaviour and way of life cause social disruption and have negative impacts on human health. The environmental impacts encompass a range of issues such as climate change, acidification, toxic pollution, ozone depletion, depletion of both renewable and non-renewable resources, as well as the extinction of species.

As several studies have shown, there is no room for doubt when discussing whether there is a substantial need for promoting sustainability, as Morelli (2011) states. According to Goodland and Daly (1996) there are three different concrete actions that can be done to promote ES, which are Regeneration (reducing the current level of consumption of natural capital to promote its growth), Relief of Pressure (investing in cultivated natural capital to relieve pressure from natural capital such as natural forests), and Increase of Efficiency (increasing efficiency of products, infrastructure services and lifestyles).

Environmental sustainability in the clothing and textile industry

In the thesis introduction, it is mentioned that the CT industry is a significant contributor to environmental issues as the second most polluting industry. As environmental awareness and globalization continue to increase, there is a growing emphasis on prioritizing environmentally friendly options by consumers, organizations, and countries as Eryuruk (2012) explains. According to the author, the term "environmentally friendly" is used to describe products, policies, laws, and practices that aim to cause little to no harm to the environment.

Niinimäki and Hassi (2011) discuss that the development towards sustainability in the CT industry has focused on ethical issues and switching to ecological materials, although the production and consumption has remarkably increased. According to the authors, the benefits that stem from industrial and technological development have diminished because of the high volumes of production and consumption. The authors state that to make a significant impact on sustainability, a more comprehensive approach is necessary in clothing production and consumption. Niinimäki and Hassi (2011) propose design strategies to promote ES and prolong the lifespan of clothing. These strategies include emphasizing high-quality materials, durability, and timeless design for product satisfaction and long-term use. They also suggest creating emotionally engaging designs through customization, modular structures, co-creation, and open-source approaches. By adopting these strategies, the clothing industry can contribute to a more sustainable future. Furthermore, service design strategies such as custom-made clothing, renting or leasing options, and repair and upgrade services support the goal of prolonging clothing utilization. These strategies involve customer participation and foster a stronger connection

between customers and their clothing. In order to achieve a significant transformation towards ES, the environmentally friendly alternatives must be pleasant for consumers, as Niinimäki and Hassi (2011) note.

In a questionnaire conducted by Niinimäki and Hassi (2011) consumers' interests in different design strategies emerged. The questionnaire shows that repairing, modifying and upgrading garments and suitability for recycling proved to be the most interesting design strategies to consumers. Conversely, renting garments for long-term use or buying short-lifetime garments that do not require washing were not interesting alternatives to consumers. The authors proposed that the reason behind the levels of popularity within these design strategies were whether they were already familiar to consumers or not. Exceptionally, upgradeability, modularity and co-creation gained popularity despite being quite novel concepts. Similarly, exchange and organized return were pleasing to consumers. There is a continuous development of new strategies in the CT industry that are of interest to consumers and promote ES, according to the authors.

2.2 Circular economy

The concept of circular economy

The conventional linear business model is deemed unsustainable in the long run, according to the Ellen MacArthur Foundation (2013). This model poses risks to businesses in terms of supply issues and rising resource prices, while also harming the environment. To counter these challenges, the author emphasizes the need for a carefully designed and intentionally restorative industrial system. This system would involve a shift to renewable energy sources, the elimination of hazardous chemicals, and the complete eradication of waste. Hvass and Pedersen (2019) add that various factors, such as increasing consumption patterns, the emergence of new consumer generations, urbanization, stricter regulations, and technological advancements, are driving the transformation towards CE.

CE is based on a few core principles, which are designing out waste, building resilience by making customizable and adaptable products, using renewable energy, considering how different stakeholders affect each other and the entirety, and re-

establishing waste back into the biosphere, according to Ellen McArthur foundation (2013). Moreover, as per the author, CE benefits the economies, companies and consumers in different ways. Savings on material and energy prices, increased volatility and supply risk reduction, stronger multipliers as a result of sectoral shifts, potential employment advantages, and decreased externalities will all be advantageous to economies. Companies will gain from developing new profit streams, gaining a competitive edge, enhancing resilience to strategic difficulties, and expanding. Consumers will advance by acquiring more choices, getting improved service quality and experiencing less premature obsolescence of products. (McArthur, 2013)

Circular economy in the clothing and textile industry

Patwa and Seetharaman (2019) report that shifting towards circular business models is nearly a necessity because of scarce resources such as difficulties of meeting the needs of the growing population as well as the threat of unavailability of sufficient amount of drinking water. The authors state that the fundamental application of a circular business model in the CT industry is primarily to abolish all harmful substances and materials that release microfibres into the nature, to spread awareness in order to increase the product life, to increase the amount of recycling, refraining from using new raw materials, and favouring renewable energy. Followingly, as Niinimäki (2018) remarks, in order to shift towards CE all stakeholders must take part. This includes designers, researchers, policy makers, producers, manufacturers, suppliers, businesspeople and consumers.

As illustrated in Figure 1, a model developed in 2013 by Royal Society for Encouragement of Arts (RSA) in their “Great Recovery” programme could be useful for the CT industry.

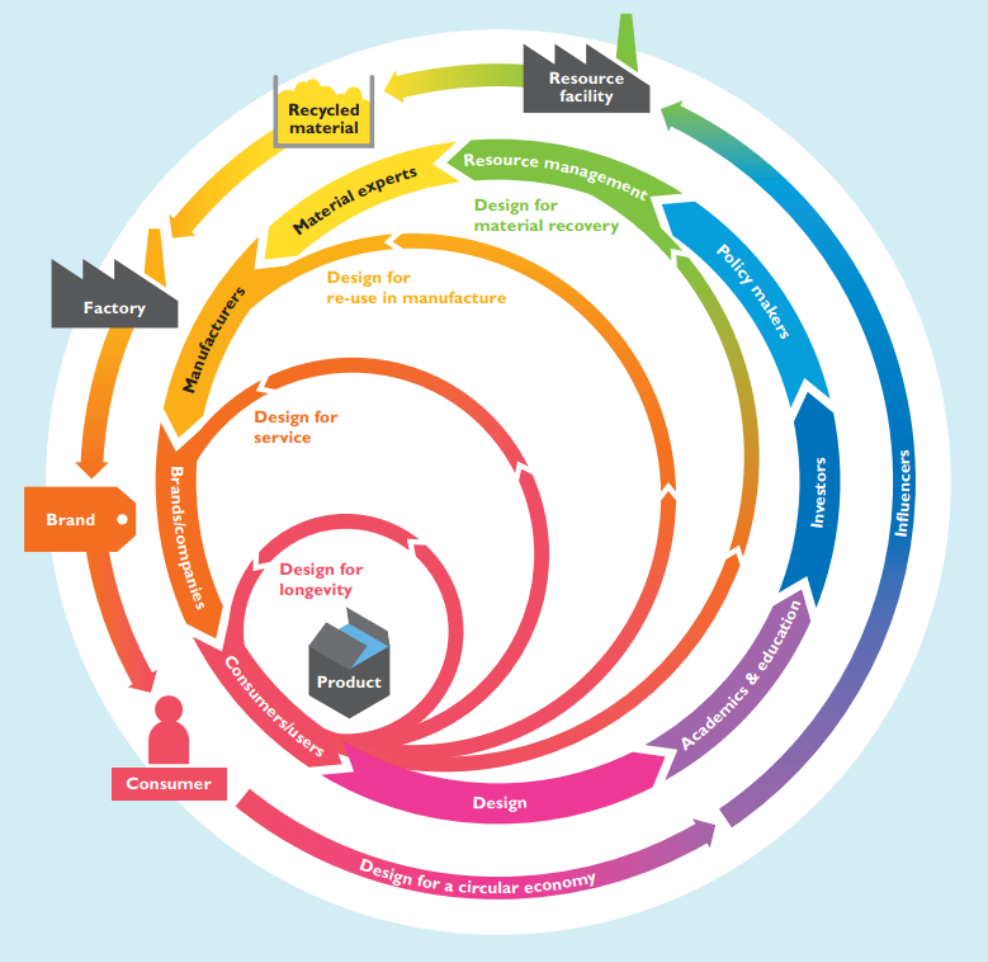

Figure 1. The four models of design in a CE (RSA 2016 as cited in Niinimäki, 2018, p. 19)

In Figure 1 the four models of design in a CE are illustrated. The models include design for service, design for longevity, design for material recovery and design for re-use in manufacture. Design for longevity is targeted at consumers and the aim is to prolong product use time, whereas design for service targets companies and new business models aiming to prolong or intensify product use. Moreover, design for re-use in manufacture is targeted for manufacturers aiming to extend the use time by remanufacturing. Lastly, design for material recovery is aimed at material experts to sort out the waste to manufacture new fibres and yarns. A lot of new development is currently taking place in the design for material recovery level to find out new ways to use textile waste in fibre production. (Niinimäki, 2018)

Similarly, Patwa and Seetharaman (2019) discussed the “expected outcome model” based in the 4R model of Ellen MacArthur foundation. The model emphasizes redesign, redistributing, reuse, recycling and additionally, verbund. Redesign refers to changing the current business or product design to increase value for customers, whereas redistributing means entering new markets or changing the ownership transfer mechanism. Reuse refers to utilizing materials for different purposes and extending their usage life, recycling refers to making new products of old ones, and lastly, verbund refers to finding uses for the by-products of the clothing making process. Four vocal points in pursuit of transferring to circular clothing rose from Patwa and Seetharaman’s (2019) research: implementing design strategies for cyclability, encouraging the collection of used garments by using collection points and reselling them encouraged by VAT reductions, and improving the classification of textiles to diminish unnecessary disposal.

Moorhouse and Moorhouse (2017) discuss examples of various clothing brands that practise CE in their operations. Several brands have acted towards more sustainable clothing through CE procedures, for example by recycling their products, using recycled materials and reusing them to make new garments as well as producing clothing by using biodegradable materials. Several denim brands are also practising CE procedures, for example by implementing a closed loop system by leasing jeans that are returned when they are no longer needed, by using recycled plastic bottles or cotton waste to make them, or by using technologies that use notably less water in production. Sportswear brands are also shifting towards CE in production. As an example, Nike and Adidas are using recycled plastic bottles in production and Nike is implementing a “CoulourDry” technology where clothing is dyed without using water. Nike also has a “Reuse a shoe” program that has recycled approximately 30 million pair of shoes. The brand is moving towards zero waste in a fast phase by using recycled and regenerated materials from old products. The authors also emphasise education in the CT industry to teach designers how to design sustainably and to shift towards circular business models. The authors state that while sustainable clothing is often seen as something that is led by consumers, clothing businesses must also take initiative towards a circular loop.

The differences between circular economy and sustainability

As Geissdoerfer et al. (2017) describe, CE and sustainability have some similarities. To name a few, they are both global models and emphasize commitments related to environmental issues. They also have system design and innovation at their core and see cooperation of different stakeholders as a necessity to reach the goals. Regulation and incentives are the key implementation tools in both concepts. The main differences are that CE is a more recent term than sustainability. Also, the goals between these two concepts are somewhat different as the author states, CE aims to a closed loop by eliminating resource, waste, and emission leakages whereas sustainability goals are more open-ended and dependent on the operative in question, as the authors describe.

According to Geissdoerfer et al. (2017) the main motives also differ. The fundamental goal of CE is that resources are utilized as efficiently as possible and waste and emissions are diminished through circular systems, whereas the main motivations of sustainability are based on previous trajectories, are dispersed and diverse and adaptable to different contexts. Sustainability aims to benefit the environment, the economy and the society. In comparison CE mainly benefits the economic counterparts that implement the system and the environment, the society benefits from it on the side. Finally, in sustainability the responsibilities are shared, whereas in the CE the responsibility is primarily on private business, regulators and policymakers.

2.3 Barriers, challenges and solutions related to environmental sustainability and circular economy

Barriers, challenges and solutions related to environmental sustainability

There are several challenges and barriers related to promoting ES in the CT industry. As Birtwistle and Moore (2007) remark, sustainable consumption is a familiar concept to many, but there is a lack of putting thoughts into action. Research by Harris et al. (2016) demonstrates that changing purchasing habits significantly requires more than just a focus on sustainability. This is because consumers' ethical preferences are too diverse, clothing is often not a purchase made out of altruism,

and clothing sustainability is thought to be too complex. Birtwistle and Moore (2007) note that the rapid change of fashion trends and market of clothing that is expected to be worn only a few times have created a so-called throwaway mentality. Clothing is purchased more impulsively and worn less than before, and eventually thrown away. An excessive number of garments still end up in the landfills rather than being recycled or repaired. The consumption of clothing has risen to an exceedingly high level.

Price, quality, and style are still prioritized over ethical concerns when buying clothing, despite the growing popularity of sustainability and ethical consumption habits (Iwanow et al., 2005). According to Connell (2010), Harris et al. (2016), McNeill and Moore (2015), there are both internal and external impediments to the use of sustainable apparel. Consumers' own lack of care for the environment, poor understanding of the effects that clothes manufacturing and consumption have on the environment, and limited knowledge of where to buy environmentally friendly clothing are examples of internal obstacles. The authors state that negative attitudes and perceptions towards sustainable clothing are also a barrier of since environmentally friendly clothing may be seen as less fashionable, less fitting and less comfortable compared to their mainstream options. Some demographic attributes such as level of education and age are also contributing factors.

Additionally, as Connell (2010), Harris et al. (2016) and McNeill and Moore (2015) explain, motivation, values, locus of control, and perceived time and effort are considered as internal barriers. Habits and mindsets of overconsumption and throwing away garments are also significant barriers. External barriers include a lack of infrastructure, social and cultural norms, and limited availability to access environmentally friendly clothing or limited access to environmentally friendly clothing with desired attributes. Price of sustainable clothing and economic constraints can also be barriers in acquiring sustainable clothing since they are usually more expensive. There is also a lack of transparency in the supply chain, which makes it difficult for consumers to trust these companies, according to the authors.

According to Connel (2010) and Harris et al. (2016), in order to defeat these barriers, consumers need more knowledge about the CT industry and its impacts in general. Adequate information also helps to transform consumers mindsets about sustainable clothing. Similarly, there should be more information about sustainable clothing, and eco-labels should be improved. Sustainable clothing should be made more appealing to consumers, as well as improving their marketing. As per the authors, acquiring sustainable clothing should be made easily accessible to decrease perceived time and effort. Additionally, making sustainable clothing more mainstream will lower the prices in the long run, which will defeat the price barrier and decrease economic constraints. Increasing awareness about sustainable clothing will eventually combat the barriers related to societal norms and perceptions. Clothing companies need to engage with consumers effectively and be transparent regarding supply chains to gain their trust. In addition to providing more information about the impacts of CT industry, providing recycling, renting and upcycling services would contribute to prevent overconsumption and unnecessary disposal of clothing, like Connel (2010) and Harris et al. (2016) note.

Barriers, challenges and solutions related to circular economy

The implementation of CE business models in the CT industry faces several barriers and challenges. According to Muthu (2018), cultural barriers are the primary obstacles in implementing circular business models in this industry.

Lack of awareness and interest among consumers and unwillingness to transition to circular business models in company culture are the main reasons within cultural barriers. The information barriers Niinimäki (2018) discusses relate to companies' lack of knowledge of recycling and collection of textiles and reverse logistics. In addition, lack of information and limited access of it regarding product content as well as inadequate communication between sorters and recyclers. According to Muthu (2018) and Niinimäki (2018), the main technological barriers include low scale of sorting or recycling technologies and low amount of investment in them. An effective mechanism of collecting used garments is also yet to be standardized. The process of moving to circular design model manufacturing is also very time-

consuming and there is also a lack of information, training and competence within businesses in order to transform to circular business models.

Moreover, market barriers refer to the complexity of the value chain of CT industry and restricted supply of recycled fibres and textiles as well as a lack of demand for them among clothing companies, as Muthu (2018) and Niinimäki (2018) discuss. The production of circular garments is also more costly, so the prices are not as affordable as the so-called traditional clothing options, hence the market for circular clothing is small. According to Niinimäki (2018) barriers related to material input include that little number of textiles are suitable for recycling. Increasing the number of suitable textiles requires commitment from many stakeholders which makes it complicated. Additionally, government regulations can prevent the shift towards CE. According to Muthu (2018) and Stewart et al. (2016) unclear messages and complex, varying and multiple regulations are some of the preventing factors. Inadequate pressure and lack of control from regulation as well as its limiting space for innovation also hinder the process. Koszewska (2018) states that a major challenge facing the CT industry is the reduction of waste creation and the minimization of waste ending up in landfills. Koszewska (2018) also discusses challenges such as disposal practises and recycling technologies as well as making sustainable and recyclable products that are also desirable. The author also states that product design and development, disposal practises, and technological factors influence the viability of recycling garments.

Hvass and Pedersen (2019) discuss challenges related to CE business models from the company’s point of view. They implemented a case study about in-store product take-back initiatives using collection bins. According to the findings of Hvass and Pedersen's (2019) research, some of the problems were a lack of consumer knowledge and acceptability, a lack of successfully conveying the effort to consumers, and a lack of engaging and inspiring people to engage in the reuse and recycling of clothing. A clothing company's infrastructure, internal capabilities, and relationships are insufficient for a product take-back system, necessitating the development of new organizational skills and competencies. The study showed that the product take-back initiative was not sufficiently linked to the strategy of the whole organization and neither the action plans nor value proposition were clearly

defined. Moreover, there were also financial challenges related to this matter. The take-back system is a long-term strategy and investment, the success of the initiative is difficult to measure, and the system is also costly for the company, although costs can be decreased by finding a partner to do reverse logistics. The authors state that one company alone cannot implement or run a circular business model successfully. Some of the challenges in implementing CE business models can be combated by the organization alone, but some of them are deeply rooted to the system and therefore more challenging to overcome.

In Figure 2 the challenges and solutions in implementing circular design models are illustrated. Some of the challenges and solutions shown in Figure 4 were discussed earlier in the thesis, although some of them emerged from an initiative called "circular.fashion". This will be explained in more detail below.

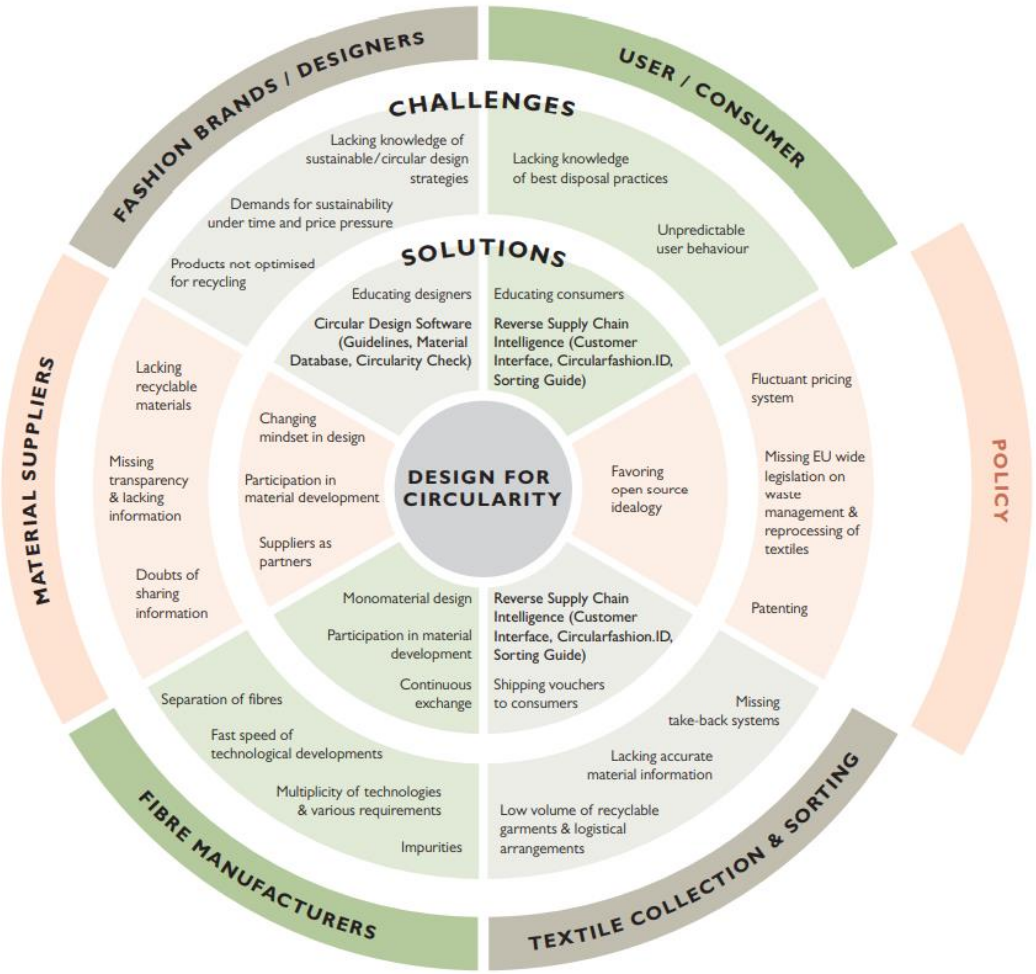

Figure 2. Challenges and solutions related to circular design (Niinimäki, 2018, p. 109)

According to Niinimäki (2018) the figure is based on findings from circular.fashion which is a sustainable design consultancy that focuses on full material recyclability. As per the author, the primary goal, design for circularity based on fiber-to-fibre recycling, is depicted in the diagram's center. The outer circle depicts the many stages of the circular textile value chain. Policy is viewed as an external influencer on waste management rather than a phase and it affects waste management and disposal practises the most which is why it is placed outside the circle. The challenges and solutions are placed in relation to the different phases of the garment.

Niinimäki (2018) explains that circular.fashion has developed a tool which is designed for all stakeholders involved in creating circular products. The system comprises two components: the Circular Design Software and the Reverse Supply Chain Intelligence. The Circular Design Software is a digital service that assists designers in creating circular products. It provides designers with Circular Design Guidelines, Circular Material Database and Circularity Check to show if the end product is recyclable. Reverse Supply Chain Intelligence focuses on the recycling or reusing phase of the garment. Each garment receives an ID label that guarantees its recyclability and can be purchased individually or from the certified suppliers. The ID is scannable which enables consumers as well as sorting and recycling companies to access the product cycle information of the garment. It also provides options for updating, reusing and recycling the garment.

This kind of system makes it notably easier and effective to practise CE in the CT industry. As discussed previously, lack of information among consumers, designers, clothing brands, and collectors and sorters as well as lack of materials among suppliers are challenges in transforming to CE. As Niinimäki (2018) states, change in attitudes towards circular practises and products, education, increasing access of information and having suppliers as partners can be solutions for these challenges. Also, because technology develops constantly, clothing companies must be prepared to ongoing exchange with textile sorters and fibre manufacturers. The shift towards CE requires building an open-source network that includes all stakeholders, so all parties need to be involved in the process.

2.4 Theoretical framework

In this study a theoretical framework will be adapted by having the value chain activities as a base of assessing the ES of the CE business models through the case companies.

2.4.1 The concept of product value chain – Porter's model

Kaplinsky and Morris (2000) and Porter (2001) define the value chain as all the activities involved in the full life cycle of company's products or services. According to Porter (2001), these activities are divided into five primary activities and four support activities, all of which are illustrated in Figure 3.

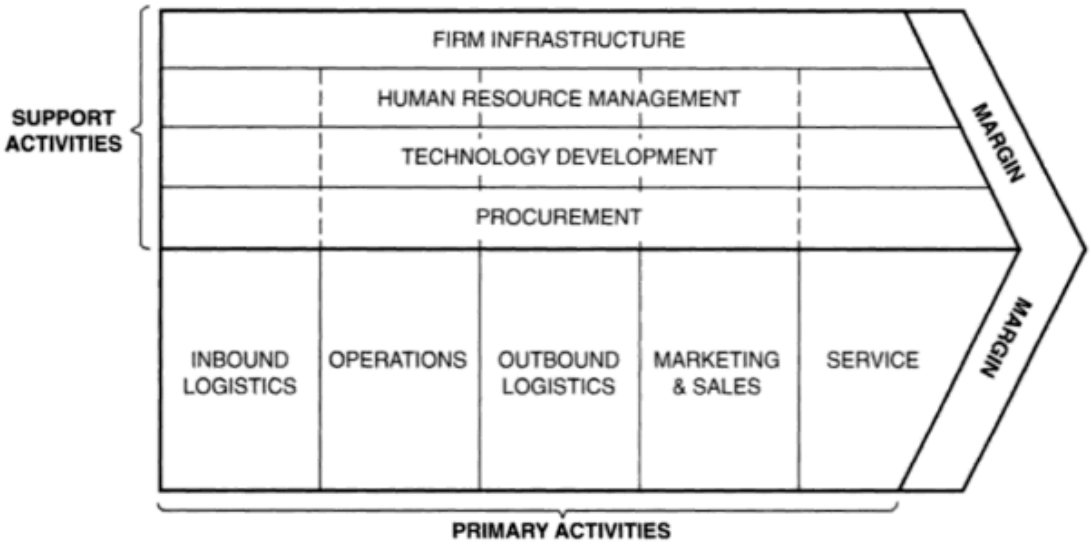

Figure 3. The generic value chain (Porter, 2001)

The value chain, as defined by Porter (2001), encompasses the activities involved in creating and delivering products or services. It includes primary activities such as inbound logistics, operations, outbound logistics, marketing and sales, and service. Inbound logistics involves receiving and managing inputs, operations transform inputs into final products, outbound logistics focuses on product distribution, marketing and sales promote and sell the products, and service ensures customer

support, as Porter (2001) explains. Additionally, as according to the author, there are support activities including procurement, technological development, human resource management, and company infrastructure. Porter (2001) notes that procurement deals with acquiring necessary inputs, technological development drives innovation, human resource management oversees workforce management, and company infrastructure provides overall organizational support.

2.4.2 Circular economy business models

There are five underlying CE business models which are Circular Supply Chain, Recovery and Recycling, Product Life Extension, Sharing Platforms, and Product as a Service (Lacy et al, 2014; Lacy & Rutqvist, 2016; Sitra, 2018; Setterwall Rydberg, 2016). These models are designed to reduce inefficiency and dependency on scarce natural resources as well as to create value for companies (Sitra, 2018; Lacy et al, 2014). As stated in Lacy et al. (2014), all these models have their own characteristics and can be used individually or in combination with each other. These five business models in CE are illustrated in Figure 3.

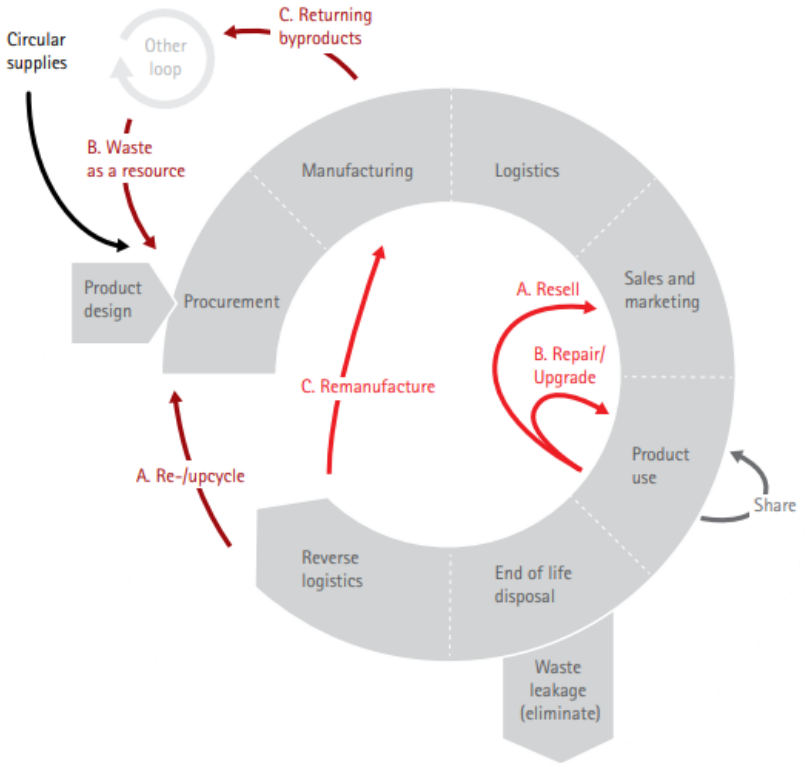

Figure 4. The CE business models (Lacy et al, 2014, p. 12)

As Lacy et al. (2014) describe, black color refers to Circular Supply Chain, dark red refers to Recovery and Recycling, bright red refers to Product Life Extension, dark gray refers to Sharing Platforms, and lastly Product as a Service is marked in light grey which can be applied to product flows in any part of the value chain. All the CE business models will be described further in following paragraphs.

The Circular Supply Chain model

As stated in Lacy et al. (2014), Lacy and Rutqvist (2016), Sitra (2018), and Setterwall Rydberg (2016), the Circular Supply Chain model is based on supplying renewable, recyclable, biodegradable, and nontoxic materials to replace their linear and non-recyclable substitutes. According to Lacy et al. (2014) the Circular Supply Chain model is most useful for companies concerned with scarce materials and companies that have a notable environmental footprint. The model offers a more foreseen, long-lasting, and profitable source for manufacturers as Lacy and Rutqvist (2016) remark. According to the authors, it also offers companies a competitive advantage on demand because most customers would like to choose sustainable alternatives if the price and quality are comparable to their non-sustainable counterparts. As the authors state, this model can be used to either produce energy and materials for other organizations, which is more typical, or to produce for a company's own operations.

As stated in Sitra (2018), it can be divided to two sub-models: Build to last, and Circular supplies. The Build to last model is about designing products that are long-lasting and easy to repair, whereas Circular supplies model is based on using recyclable materials in production, which increases recovery rates. On the other hand, according to Lacy and Rutqvist (2016) the Built to last sub-model can also be applied to the Product Life-Extension model which will be described in more detail later. Lacy and Rutqvist (2016) also note that scaling for the Circular Supply Chain model requires long-lasting research and development as well as an extensive amount of capital. Collaborating with sources of innovation such as universities and R&D institutions is also crucial.

The Recovery and Recycling model

According to OECD's (2019) article, Lacy et al (2014) and Sitra (2018), the Recovery and Recycling model is based on recovering resources and energy from discarded products and side products, and utilizing waste into new materials, hence decreasing the amount of waste from final disposal, and lowering the usage of natural resources. Lacy et al. (2014) state that this strategy is best suited for enterprises that generate substantial amounts of by-product and can reclaim and reprocess waste materials at a low cost. Lacy et al. (2014) and Lacy and Rutqvist (2016) suggest that implementing a CE model in the CT industry can prevent material leakage and maximize revenue potential. This can be achieved by optimizing every by-product and waste stream and establishing a two-way supply chain in which products are returned by consumers after use. This enables businesses to recover practically any resource output to a level equal to their initial investment and provides customers with handy options to dispose of unwanted products. It also increases the frequency with which companies and customers engage because product disposal and new purchases can be combined.

According to BIR (2008) as cited in OECD, producing recycled materials into new ones instead of using non-renewable natural resources can reduce greenhouse gas emissions by 90%, so the environmental benefit could be substantial. As Sitra (2018) and Lacy and Rutqvist (2016) state, Recovery and Recycling model can be divided into two different sub-models. One is about recovering end-of-life products and either reselling, refurbishing, restoring, or reusing them in production while the other variation is about recovering waste and by-products and utilizing them as new manufacturing material.

Product Life Extension model

As Lacy et al (2014) report, Product Life Extension model extends the lifecycle of products and components through repair, upgrade, remanufacturing, and reselling. It allows companies to maintain or improve values that would otherwise be lost. Lacy and Rutqvist (2016) describe that this model creates value through longevity instead of volume and features such as durability, functionality and quality are valued more.

As a result, these products often have a higher up-front cost, but this model also enables companies to generate additional revenue streams. Built to last, refurbish, take-back to remarket, upgrade, refill, and repair are the six key operations identified by Lacy and Rutqvist (2016) within the Product Life Extension model that enable to increase value and utility. Build to last refers to producing high-quality, long-lasting products. Refurbishment refers to restoring used products to their original condition, whilst take-back to remarket refers to collecting old products in order to trade or resell them. Upgrading is adding new features, fashion, or functionality to a product instead of fully replacing it. Refill means replacing a function to product that depletes faster than the actual product, such as refillable packaging. Lastly, repairing products that are broken is also a way to increase value and extend life of the product.

According to the authors, there are three roles companies can take on in the Product Life Extension model. One of them is an industrial manufacturing company that creates the products, another one is a company that establishes and operates a platform or community that helps find new owners to products that are no longer needed, and lastly the “field service” companies that provide repair, upgrade, maintenance and refurbishment services.

The Sharing Platforms model

According to various sources including Lacy et al. (2014), Setterwall Rydberg (2016), Sitra (2018), and Lewandowski (2016), the Sharing Platforms model enables the sharing of products through online platforms, connecting owners who no longer need their items with consumers or organizations who want to use them. This model reduces the need for new manufacturing, addresses issues of excessive volume and underutilization of products, and enhances productivity and value creation for users. Lacy and Rutqvist (2016) highlight that the model facilitates various forms of sharing such as exchanging, renting, swapping, lending, and gifting. The platform owner generates revenue by charging a percentage fee on transactions, while not offering products directly.

Another type of sharing model is the Centralized Platform, where the platform owner owns the product and sets the price. This model overlaps with the Sharing Platforms

model and the upcoming discussion on the Product as a Service model. Decentralized Platforms involve the platform facilitating transactions for product owners who set the terms and prices, while Hybrid Platforms combine aspects of both Centralized and Decentralized Platforms, with product owners adhering to the platform's standards. Sharing Platforms can also offer services and other assets, not just products. Lacy and Rutqvist (2016) refer to recent research which states that consumers choose Sharing Platforms for three different reasons: more convenience, lower prices, and better quality. They note that trust is also a significant factor, and something that requires a lot of consideration since it is a key challenge for this model.

The Product as a Service model

The Product as a Service model, as described by Lacy et al. (2014) and Sitra (2018), involves providing customers with access to products through leasing, rental, pay-for-use, or performance agreements while the service provider retains ownership. According to Lacy and Rutqvist (2016), leasing allows customers to use the product over a longer period, while renting provides short-term access. Pay-for-use involves purchasing the product based on usage metrics, and performance agreements ensure a specified level of service and quality, as Lacy and Rutqvist (2016) explain. The authors state that the model emphasizes the importance of design, use, maintenance, reuse, remanufacturing, and recycling to ensure the ongoing usability of the product. Lacy et al. (2014) suggest that consumers are increasingly interested in purchasing the desired function or performance of a product for a specific duration rather than owning it outright. This model is particularly suitable for customers who have occasional or limited usage needs, lack the resources or space to own the product, or require assistance with maintenance and repair. According to Lacy and Rutqvist (2016), the Product as a service model fits well with most of the other CE business models as well, and is usually blended with one or more of them, often with the Product Lifecycle Extension model or the Sharing Platforms model.

2.4.3 Product life cycle in the CT industry

While the base is similar to Porter's value chain, there are some specific characteristics regarding product life cycle in the CT industry. Muthu (2020) discusses that the clothing and textile product life is complex since the product life span varies substantially based on the purpose and durability of the product. There are also many segments within the clothing sector. Eryuruk (2012) describes that when it comes to producing eco-friendly clothing, the life cycle of the garment and its environmental impacts need to be considered. All different stages that are included in the textile product life cycle are considered. These different stages are shown in Figure 5 below.

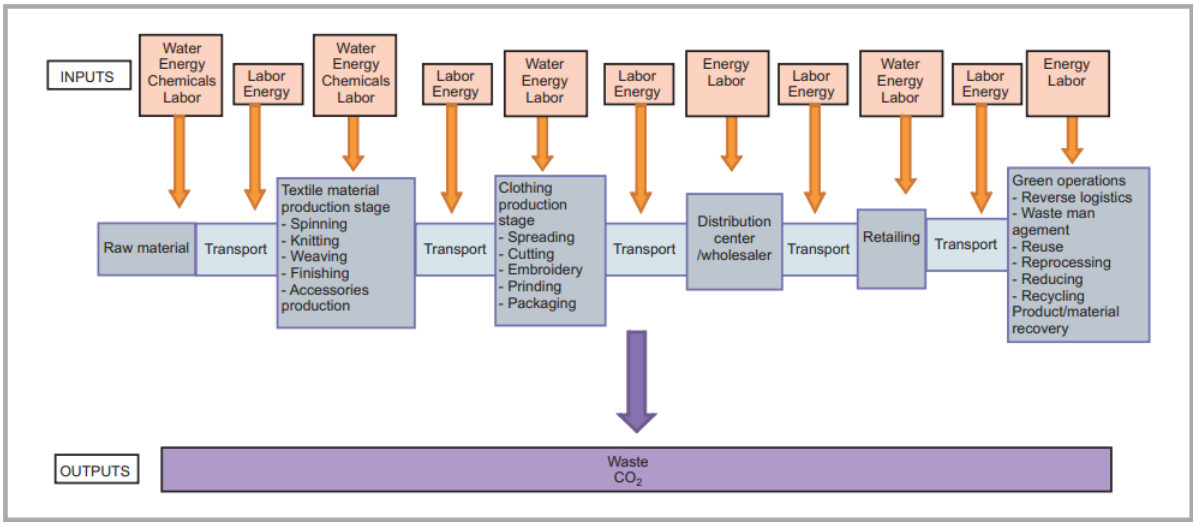

Figure 5. Product life cycle activities in the CT industry (Eryuruk, 2012, p.23)

This figure shows all the activities of textile product life cycle which include designing for the environment, acquiring raw materials, production, distribution, retailing, waste and reverse logistics, and transport. As Eryuruk (2012) states, key inputs and key outputs displayed in the figure are vital in the green life cycle process, and the level of eco-friendliness is evaluated throughout the whole product life cycle. Eryuruk (2012) explains that when designing garments**, life cycle assessment (LCA)** is commonly used by producers to identify the most eco-friendly option when designing clothing. LCA is a tool that is widely used to evaluate the environmental impacts of a product throughout its entire life cycle, as Muthu (2015) also notes. It is

capable of measuring various environmental impact indicators, such as carbon footprint and energy use, as described by both Eryuruk (2012) and Muthu (2015). Eryuruk (2012) reports that packaging also needs to be considered, favouring recycled and recyclable materials and efficient use of materials are more environmentally friendly.

According to Eryuruk (2012), green operations is a vital part of sustainable textile product life cycle. The concept of green operations encompasses several operations including manufacturing and remanufacturing, reverse logistics, network architecture, and waste management, all aimed at reducing a product's environmental impact as described by Eryuruk (2012). The reduction and recycling of materials are among the techniques used in green manufacturing, while remanufacturing involves the reuse and recovery of products and materials. Reducing aims to minimize the consumption of scarce resources and energy, recycling aims to recover materials from products, reuse involves using parts of old products for manufacturing, and product recovery as well as material recovery refers to activities that recover the value of a product at the end of its life cycle, by repairing, refurbishing or disassembling. Lastly, waste management refers to managing waste turnout and its impacts by source reduction, pollution prevention and disposal.

The empirical study will be implemented by assessing the example companies, each implementing five CE business models through the seven concrete clothing life cycle activities which are acquiring raw materials, textile material production, clothing production, distribution, retailing, waste and reverse logistics as well as transport. Product life cycle actions of example companies for all the five circular business models will be evaluated in the Results chapter.

3 Methodology

In the Methodology chapter an in-depth insight about the research approach, research context, data collection, and data analysis will be discussed as well as verification of the results. As stated in the Introduction chapter, the objective of the research is to find ways to increase ES in the CT industry by using CE business

models. The research question is: "*How to increase environmental sustainability in the clothing and textile industry by using circular economy business models?".*

3.1 Research approach

The researcher has the option to choose a quantitative or qualitative approach when beginning to design their research, according to Kothari (2004) and Saunders et al. (2009). The quantitative approach focuses on gathering and analysing numerical data, whereas the qualitative approach involves methods that generate non-numerical data, such as textual or visual information. The combination of both quantitative and qualitative methodologies is known as a mixed method study, as the authors explain.

The research is adapting a qualitative approach. The concepts of qualitative research are usually ambiguous and complex, and less possible to quantify. Moreover, qualitative approach is analysed using conceptualization. (Saunders et al., 2009). Qualitative research approach is suitable for this research because of those reasons. The objective of the research is to identify ways to increase ES through activities related to CE business models, so qualitative approach is a fitting choice. Solely quantifying such data would be extremely difficult, since the research will be looking at the whole product life cycle of companies' that are implementing or starting to implement circular business models. Qualitative data enables a more holistic and reliable way to examine the relationship between ES and product life cycle activities of companies implementing circular business models.

The research is adapting a multiple case study approach. Yin (2011) explains that the case study approach is utilized to acquire an extensive comprehension of one or a limited number of examples in their actual circumstances. Differentiating between a single case study and multiple case studies is simple, under the multiple case study technique, more than one case is included as Saunders et al. (2009) state. The authors discuss that when implementing a multiple case study, it is commonly necessary to determine whether the findings of the first instance occur in other situations, as well as to generalize from the findings. Therefore, a multiple case study may be preferable to a single case study.

Multiple case study is suitable for this research since it is analysing example companies implementing the five different circular business models. This way any differences can be recognized, and a pervasive understanding of the topic can be discovered. Kothari (2004) explains that the primary objective of the case study method is to identify the factors that explain the behavior of the unit being studied. According to Saunders et al. (2009) case study can also help answering questions such as “why?”, “how?”, and “what?”, so it is suitable considering the question of the research. The data collected is mainly secondary data from companies’ websites and sustainability reports.

3.2 Research context

In this chapter, an in-depth review of literature and overview of the research context will be explained, which in this case is the CT industry and more precisely the case companies. Each of the case companies represent one of the five CE business models, which were explained in Theoretical framework chapter. These CE business models, and their represented companies are Sharing platforms (Emmy), Recovery and recycling (Pure Waste), Circular supply chain (Infinited Fiber), Product life extension (Vaatelaastari), and Product as a service (Lindström). The companies representing the five CE business models were selected from Sitra’s website by searching CE companies in the CT industry. The companies representing each circular business model were chosen from Sitra’s “Most interesting companies in the circular economy in Finland 2.1” list (Sitra, 2022).

According to Gardetti and Torres (2013), **the CT industry** encompasses a broad range of activities including acquiring and processing raw materials such as textile fibers, producing yarns, manufacturing fabrics, finishing processes such as bleaching and dyeing for example, and finally, transforming textiles into either fashion or non-fashion garments. Figure 6 illustrates these processes.

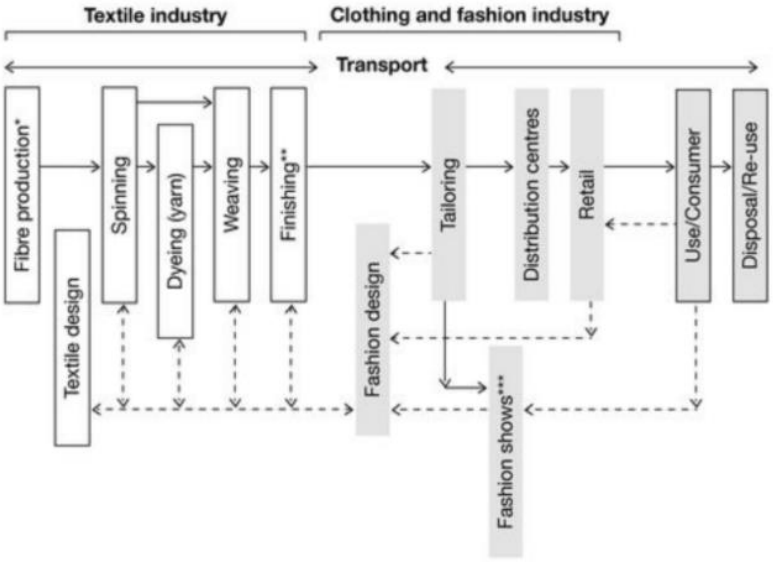

Figure 6. Textile, clothing and fashion industry (Gardetti & Torres, 2013, p. 5)

In Figure 6 the above-mentioned processes are illustrated. As Gardetti and Torres (2013) describe, the dotted lines represent information flow. Goods and services flow are represented by continuous lines. The direction of the arrows illustrates a demand driven system.

According to the European Commission, as cited in Gardetti and Torres (2013) The CT industry is a complex and varied industry that encompasses various activities, including the production of fibers, yarns, fabrics, and clothing. As noted by Nordås (2004), the clothing sector can be viewed from two perspectives: one being a labour-intensive industry with low wages, and the other being a dynamic and innovative sector that depends on the particular market segments involved. In the ladder, the industry is highly flexible, utilizes modern technology, and has comparatively well-paid workers and designers. Conversely, as the author notes the other segment of the CT industry involves mass production of low quality and standard products such as basic t-shirts, which are often manufactured in developing countries.

As for **the case companies**, one of which is Emmy representing Sharing platforms model, is an online store that specializes in selling recycled clothing. The turnkey principle is used to prolong the lifespan of clothes. (Sitra, 2021a). Emmy was founded in 2015 and is based in Lohja, Finland. It is a small sized company, currently there are

about 40 people working in Emmy (Emmy, n.d.a). The company offers a means to sell high-quality pre-owned clothing in their online shop (Sitra, 2017b). The concept is that consumers send clothing to Emmy they no longer need or want. Then, it is made sure by the company that the items are in a sufficient condition to be sold before adding them to the online shop. Clothes that cannot be sold are donated to charity. The seller gets the sold price after the commission and delivery charges have been decreased (Sitra, 2017b). Only high-quality clothing is sold in Emmy's online shop, so fast fashion products that are not durable and become worn quickly are excluded from the selection. Emmy is currently a partner with several fashion companies whose returned items and model pieces they sell, and the company is aiming to expand to international markets and increase their cooperation with fashion brands in the future. (Sitra, 2021a).

Infinited Fiber, which is representing Circular supply chain model (or Renewability model as stated in Sitra (2021b), is a company focused on creating new textile fibers using waste materials, particularly cotton-rich textile waste and other waste streams that are cellulose-based, such as paper. (Sitra, 2021b). The concept for Infinited Fiber was conceived in 2015 when Ali Harlin and Petri Alava made the decision to commercialize the already developed technology with the intention to make new textile fiber from cellulose. The company was founded in 2016 and is based in Espoo, Finland. Infinited Fiber is a medium sized company, as stated in Sitra (2021b). The company offers fiber manufacturers a means to expand their product portfolio by selling the technology license to their patented Infinna manufacturing process and thus enabling fiber manufacturers to add Infinna fiber to their product range. The company also has plans to open their own flagship factory which should be operating in 2024.

Lindström, representing Product as a service model, provides workwear as a service for companies (Sitra, 2021c). The company was founded in 1848, first as a yarn dyeing plant, then as a laundry, and already in the 1930's by renting out workwear. The focus on the textiles as a service business began in the 1990's more widely. With Lindström, companies have access to the textiles they need, and the products are cared for throughout their life cycle. The company designs and manufactures durable products only for their customers' needs. Lindström operates in 24 countries in all of

which they have significant opportunities for growth. Lindström is based in Helsinki, has a turnover of 388 million euros and as much as 4550 employees. (Sitra, 2021c). For Lindström, the revenue logic and benefits are that contracts are typically three years, ensuring steady revenue streams. Additionally, it provides opportunities to sell other services. Lindström's customers do not have to allocate resources to work uniforms or their maintenance and management. (Sitra, 2017d).

Pure Waste, representing Recovery and recycling (or Resource efficiency and recycling, as stated in Sitra, 2022) manufactures and sells clothes, yarns, and fabrics from 100% recycled material. The company was originally created to provide material to Costo, founding shareholder Jukka Pesola's previous company that was producing clothing and accessories from surplus fabrics. (Sitra, 2021d). Pure Waste was founded in 2013 and is based in Helsinki, Finland. It is a medium sized company, having 8 employees in Helsinki, Finland, and about 60 employees in the factory in India (Pure Waste, n.d.a). The company collects and sorts out material that would otherwise end up as textile waste and use it to manufacture their products. They are also offering a service to take back products the customer no longer needs, although it is still in the early stage. (Sitra, 2021d). Pure Waste's main customers are B2B companies, consumer brands, and retail stores. The company offers material options, product design, consulting services, and a manufacturing process. (Sitra, 2017c).

Vaatelaastari, representing Product life extension model, is a company that sells adhesive patches for textiles. Merino wool, reflective fabric and recycled polyester made from plastic bottle waste are used in the making of the patches. All kinds of garments, even footwear, can be patched with this simple method without sewing or ironing. The company was founded in 2018, and is based in Oulu, Finland. It is a small sized company, having 3 employees and several different partners which they seek growth from in the future. By September 2021, they had sold more than 400 00 patches. (Sitra, 2021d).

3.3 Data collection

Saunders et al. (2019) suggest that the examination of secondary data is becoming more prevalent in the quest for information to answer research questions and achieve research objectives. Secondary data, as the authors clarify, pertains to data

that was initially collected for a different purpose. It may come in the form of either quantitative or qualitative data sourced from different materials like books, journals, and government publications. Furthermore, they stated that in case studies within business research projects secondary data are used most frequently, which is fitting for this research also, since it is a multiple case study.

The research is looking to find how to increase ES in the CT industry by using CE business models. As mentioned in 3.1 Research approach, the study is adapting multiple case study approach in order to investigate each of the five CE business models through their example companies. Desk research from Sitra's "Most interesting companies in the circular economy in Finland 2.1" list was conducted to find example companies for each circular business model. Sitra is a future fund founded by Finland's government in 1967. Sitra's main object is to promote prerequisites for a sustainable, fair, and successful Finland, therefore a valid and reliable source for desk research (Sitra, 2021f). The data was mainly secondary data collected from Sitra's websites, the example companies' websites, and the companies' sustainability reports (Emmy, Pure Waste, Infinited Fiber, Vaatelaastari, Lindström).

3.4 Data analysis

The data analysis chapter further explains how the author analysed and assessed the qualitative data obtained from secondary data sources. The author summarizes, categorizes, and analyses the secondary data collected during the data collection process using a theoretical framework created by the author. The data analysis process of qualitative research was used. Although, as mentioned previously the data that was analysed were secondary data, so it is not necessarily raw data but rather compiled data which is data that has been selected or summarised in some way as Saunders et al. (2009) state.

Moreover, the author collected secondary data from the case companies' websites and sustainability reports. Then the author developed codes based on the Theoretical framework they made themselves and read through the data to gain a full picture of the main topics and themes they found out from the gathered data.

Table 1. Codes

Business model 1: Sharing platforms	**BM1**
Business model 2: Recovery and recycling	**BM2**
Business model 3: Circular supply chain	**BM3**
Business model 4: Product life extension	**BM4**
Business model 5: Product as a service	**BM5**
Value chain activity 1: Acquiring raw materials	**VCA1**
Value chain activity 2: Textile material production	**VCA2**
Value chain activity 3: Clothing production	**VCA3**
Value chain activity 4: Distribution	**VCA4**
Value chain activity 5: Retailing	**VCA5**
Value chain activity 6: Waste and reverse logistics	**VCA6**
Value chain activity 7: Transport	**VCA7**

The codes (see Table 2) were derived from the adapted theoretical framework the author created themselves. Saunders et al. (2009) describe that categorising data has two activities. According to the authors, these two activities include developing categories and assigning these categories into chunks of data. This is a fitting way to categorise data, as the authors state the categories can be derived either from the data or from theoretical framework. In this study the categories are derived from the Theoretical framework which are the five different CE business models and seven different value chain activities.

3.5 Verification of results

Validity

As Saunders et al. (2009) explain, validity refers to the extent to which the results are meaningful and answer the research question, as well as the extent to which they can be generalized.

The author derived the theoretical framework themselves after reading various sources of academic literature during the introduction and literature review phase. The research question was also considered when implementing the theoretical framework. In addition, the research approach was selected based on the research question, objectives, and theoretical framework. Subsequently, the theoretical

framework served as the foundation for gathering and analysing data, coding data, and connecting data to themes and descriptions. The adapted theoretical framework supported answering the research question. Moreover, the author was able to find the ways the example companies are operating that promote ES and reduce negative environmental impacts through CE business models. Thus, the author was able to answer the research question. The research approach was also carefully selected and justified after reviewing academic literature about methodology. Only secondary data was used from the company websites and sustainability reports to yield the results. The author made sure to use credible secondary sources which were websites and sustainability reports of the case companies. No primary data was collected e.g. by interviewing company representatives, since the author felt they might yield in similar findings and secondary data would be highly competent in answering the research question.

The research aimed to find ways how to increase ES by using CE business models in the CT industry. The findings can be generalized to other contexts to some extent, but since the context is the CT industry and the case companies were derived from the "Most interesting companies in the CE in Finland 2.1" list (Sitra, 2022), to generalize the findings the context is ought to have similar attributes as in this research. So, the findings can be generalized for companies that are starting to implement or already implementing circularity in their operations.

Reliability

Saunders et al. (2009) explain that in research, reliability pertains to the degree to which the techniques used for data collection and analysis can generate consistent outcomes. This can be determined by ensuring whether the same measures can produce the same results on separate occasions, whether other researchers can arrive at similar observations, and whether it is transparent how the results were derived from the original data.

The data gathered for this research was secondary data. The author used sources from Sitra's pages about the case companies that were derived from the "Most interesting companies in the circular economy in Finland 2.1" list. Information about

the companies was collected from that list's articles about the companies as well. Sitra is Finland's future fund that promotes experimentation and new operating models as well as facilitates cooperation. (Sitra, 2021f). It is nationally and internationally influential and accordingly can be seen as a reliable source.

Moreover, data was collected from companies' websites and sustainability reports, which can also be seen as reliable secondary data sources. As Saunders et al. (2009) state, organizations websites and reports are documentary secondary data sources, which can be seen as reliable. Using multiple sources of secondary data about various case companies increases the reliability of the research. There was no primary data used which could have increased the reliability even more. The author believes that interviewing representatives from the companies could have produced similar results to those yielded from the secondary data sources utilized in this study. The same findings could be reproduced by other researchers using the same sources.

Objectivity

The research objective was to provide valid, reliable, and objective answers to the research question "*How to increase environmental sustainability in the clothing and textile industry by using circular economy business models?"*

It must be acknowledged that there is always a possibility for subjectivity when analysing data and intepreting and proving results. ES is at the centre of the research question, and being a broad concept it can affect the objectivity of the research. The author aimed to minimize this possibility for subjectivity by reviewing accurate literature, deriving a theoretical framework from the literature related to the research question and applying research methodology that is suitable for the nature of the research and helps answer the research question. The data analysis techniques were chosen after reviewing credible research method literature and are applied as described previously in this Methodology chapter. Therefore, it can be noted that other researchers can achieve the same findings from the same data as the author themselves.

Ethical Issues

According to Creswell (2013), ethical concerns in research relate to various factors, including the disclosure of personal information, the credibility and authenticity of the research, the researcher's role in cross-cultural contexts, and privacy issues. The author states that ethical considerations are extensive and require increased attention nowadays.

As Creswell (2013) described, a research problem that will benefit participants, in this case the society as a whole and the CT industry, was identified. Increasing ES benefits everyone. Since only secondary data sources were used in this research, the ethical issues related to interviews or observing people are eliminated. While analysing the data, the author avoided supporting only certain perspectives or disclosing only positive results by showing contrary findings, which was mentioned by Creswell (2013). The validity, reliability and objectivity are clearly explained and the limitations of the research are described in chapter 5.4.

An accurate narrative of the authorship, evidence, data, findings and conclusions are provided, which was also mentioned by Creswell (2013). Moreover, APA insturcions were followed with citations and in the reference list to avoid plagiarism. The author strived to communicate in appropriate and clear language that is understanable for the reader.

4 Results

In the Results chapter the author describes the research findings of the empirical study that were derived through the adapted theoretical framework. The results are drawn from secondary data sources such as company websites and sustainability reports. The author researched how the five CE business models increased ES throughout the value chain activities (VCA) which are: acquiring raw materials (VCA1), textile material production (VCA2), clothing production (VCA3), distribution (VCA4), retailing (VCA5), waste and reverse logistics (VCA6) and transport (VCA7).

4.1 Sharing platforms: Emmy

First, the research investigated the sharing platforms business model through the case company Emmy. As explained in the chapter 3.2 Emmy is an online store for pre-owned clothing which extends the lifespan by implementing the turnkey principle. According to their website, Emmy is Finland's biggest marketplace for pre-owned branded clothing for all ages and genders as well as shoes and accessories. They have around 90 000 hand checked items in their collection and add thousands of new items every week (Emmy, n.d.b.). According to Emmy, the most sustainable way to operate in the clothing industry is to use every high-quality item as long as possible from the start of its life cycle to the end of it. As said in chapter 3.2 Emmy offers the seller a way to make use of their old clothing and for the buyer a means to buy sustainable clothes second hand. (Emmy, n.d.c.).

Emmy states that there is no damage to the environment caused by producing clothing since the clothes sold on the website are pre-owned. (Emmy, n.d.d.) As for the VCA's, acquiring new materials, textile material production and clothing production are completely out of the picture since nothing new is being produced. So, the environmental effects of at least three out of seven VCA's are eliminated. Also, the clothing sold at Emmy is high quality, so waste is notably decreased since the likelihood of them ending up in recycling centres is not as likely as it is for fast-fashion products. (Emmy, n.d.d.) Also, there is no wholesaler or distribution centre, since the people who dispose of their old clothing are the ones sending them to Emmy. Although, one could say that Emmy's warehouse where they check the items and send them to customers is replacing the distribution centre. Retailing is also replaced by the online shop.

Doubling the time of usage of a piece of clothing or accessory decreases the carbon footprint by 49% and is said to be the most effective way to diminish emissions. (Emmy,n.d.e.) So, Emmy is implementing an effective way to diminish emissions and be a sustainable operative in the clothing industry. They also do charity and donate the clothing and accessories that are not sold for those in need since they are collaborating with various charity organizations. (Emmy, n.d.f.) As for transport as well as waste and reverse logistics, the sellers send the items to Emmy, and they are

transported to their warehouse. They aim to decrease returns so there would be no extra emissions, although the return policy is 14 days since it is not possible to try on the item before buying it. They do this by giving specific information about the items such as estimation of its condition, critical measurements, materials and other fundamental information. If the item is returned, it goes back to sale or if there is no selling time left is returned to the owner or donated to charity. (Emmy, n.d.g.)

When it comes to the VCA's, the figure below shows if the environmental impacts are eliminated, decreased, or increased in all the seven different activities which are acquiring raw materials, textile material production, clothing production, distribution, retailing, waste and reverse logistics and transport. The red lines across the VCA's illustrate that the effects of those VCA's are fully eliminated, while the red minus signs represent the environmental effects being smaller.

Figure 7. Emmmy's operations' effects on value chain activities

In Figure 8 the effects on value chain activities that the traditional life cycle of clothing production consists of are shown. As can be seen, with Emmy's business model the three first value chain activities are eliminated since there is no production of new items. There is also less resources used for distribution and retailing, since the sellers send the items to Emmy's warehouse, and they are sold in an online shop and sent to customers. Waste and reverse logistics are also decreased since Emmy sells high quality clothing that lasts long and aims to give a new home for pre-owned clothing. Although, it is possible to return the clothing back which is similar to almost any other online clothing store. As for transport, the items sold are transported inside of Finland to Emmy, so there is no overseas transport. Then they are transported to the customers inside of Finland, and if returned they are

transported back to Emmy or to charity. The transportation effects are similar or lower than in other online stores since they are not shipped overseas.

4.2 Recovery and recycling: Pure Waste

Pure waste was used as an example company for the Recovery and recycling business model. As mentioned in chapter 3.2 Pure Waste manufactures and sells clothing, yarns and fabrics made from recycled materials.

In their Sustainability Report and on their website Pure Waste states that their production process uses 99% less water and generates only 50% of the CO2 emissions than those garments made from virgin materials. Also, the overall consumption of energy is decreased by half. Normally, one t-shirt requires 1 426 liters of water and 2,1 kilograms of carbon dioxide. Pure Waste uses only 1,2 liters of water and 1,1 kilograms of CO2e. They also promote sustainability by focusing on durability, quality, and timeless design. All their raw materials are 99% recycled, not just clothing and fabrics. They aim to keep manufactured products in use for as long as possible such as cardboard boxes and bags. By December 2021 they have already saved 4 460 139 664 liters of water and 2 779 206 kilograms of CO2 emissions as well as recycled 590 119 kilograms of textile waste by making it into new clothes. (Pure Waste, n.d.b. & Pure Waste, 2021) Pure Waste mainly uses cutting waste in their items or discarded clothes and polyester from recycled bottles. All the materials and the whole production, 60% of which is cotton and 40% of which is polyester comply the Global Recycled Standard certification. Also, the materials are checked and traced, and no harmful chemicals or dyes are used in the processes. Moreover, the European REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) legislation prerequisites are fulfilled. (Pure Waste, 2021)

According to Pure Waste (2021) garment care is also something the company keeps important. They have made comprehensive instructions that are available on their website and in their store in Helsinki on how to take care of the products in a sustainable and environmentally friendly way. Pure Waste is also very transparent about their carbon and water footprint and saving calculations since all products are marked with the precise numbers. The company also has a take back system where

they are committed to take back their used products that are at the end of their product life cycle. (Pure Waste, 2021)

Production is mainly in India because of various reasons. An old cooperation partner Vardhan Industries was interested in this business idea and the operations started in 2014. They also had what the company needed, competent textile professionals and ability to supply their primary raw material which is cotton cutting waste. There are around 3 000 sewing factories in the Tamil Nadu state where they operate. They take care of the factory's ethicality and sustainability. It has various certificates to prove it, for the GRS (Global Recycled Standard) certification for the whole production and all materials. Their shareholders make sure the standards are met. They communicate with the factory daily and visit at least four to five times a year. (Pure Waste, n.d.c.) Because of high demand, some of the products are manufactured in Bangladesh at a BSCI-audited factory. In 2019, Pure Waste India was founded in India, and the goal is to incorporate the operations of Vardhan Industries as a part of Pure Waste India. (Pure Waste, 2021)

According to Pure Waste (2021) approximately half of Pure Waste's goods are transported by sea but most of the greenhouse emissions come from air fright. The company aims to increase the share of sea fright in warehouse products to 100% and for customer orders to 80%. In Helsinki, they use an electric cargo bike to transport goods between the warehouse and shop when it's possible. They also use transport companies like Posti, DHL and A2B transports, the CO2 emissions are compensated. (Pure Waste, 2021)

When it comes to the VCA's, the figure below shows if the environmental impacts are eliminated, decreased, or increased in all the seven value chain activities.

Figure 8. Pure Waste's operations' effects on value chain activities

Regarding acquiring raw materials, the environmental impact is decreased to the minimum. According to Pure Waste (2021) 99,7% of all the materials used in production is recycled. Accordingly, the number of raw materials used is minimal, therefore you could state that the environmental impact of VCA1 is fully eliminated. The environmental impact of textile material production (VCA2) and clothing production (VCA3) are also decreased which is symbolised with the minus sign. As said before, Pure Waste uses 99% less water and generates only 50% of the CO2 emissions and half of the overall consumption of energy compared to those who use virgin materials. As for distribution (VCA4) and retailing (VCA5), the environmental impact is not decreased notably since the production is mostly in India, and the items are distributed to the warehouses or to customers from there. There is one concept store in Finland, Helsinki as well. (Pure Waste, 2021) The same applies to transport (VCA7) as well which was already discussed before. Waste and reverse logistics' (VCA6) environmental impact is lower, as discussed before the company promotes utilizing waste since its primary material is cotton cutting waste and recycled polyester. They also make their own waste into new fibres and from that to new yarns. (Pure Waste n.d.c.)

4.3 Circular supply chain: Infinited Fiber

Infinited Fiber is the example company that represents the Circular supply chain business model. It is biotech that produces high-quality textile fibers made from cellulose-rich waste, the technology is patented. (Infinited fiber, n.d.a.) Figure 10 shows the company's operations' environmental impacts throughout the value chain activities.

Figure 9. Infinited Fiber's operations' effects on value chain activities

In Infinited Fiber's textile fibers, anything from cotton T-shirts to cardboard boxes or even rice can be used in production for their Infinna fiber which feels and looks like cotton. It is 100% made from discarded textile waste or other cellulose-rich waste streams. No new raw materials need to be acquired to create it, while being biodegradable and containing no microplastics. It also takes dyes better compared to cotton. Moreover, only a fraction of the water that would be needed to grow cotton is needed for Infinna fiber. The fiber is fully circular. It can be recycled with other textile waste and made into new fiber again. Animal feed grade urea is replacing the toxic carbon disulfide used in viscose production. Thus, no organic solvents are needed. (Infinited Fiber, n.d.a. & Infinited Fiber, n.d.c.) These operations abolish the need for acquiring raw materials (VCA1), decrease the amount of waste (VCA6) and make textile material production (VCA2) more environmentally friendly.

Infinited Fiber does not produce clothing themselves, but many leading CT companies cooperating with them have already made products out of Infinna fiber. Therefore, clothing production (VCA3) and retailing (VCA5) can be excluded. The Infinna fiber is delivered to the yarn producers and from there to the fabric producers, or to nonwoven producers which can be made into cleaning cloths for example. (Infinited Fiber, n.d.b.)

4.4 Product life extension: Vaatelaastari

Vaatelaastari, an example company of the business model Product life extension is a company that sells adhesive patches for textiles as discussed in chapter 3.2. This solution is very simple and requires only little number of materials. In the figure below, the environmental impacts throughout the value chain activities are showcased.

Figure 10. Vaatelaastari's operations' effects on value chain activities

Vaatelaastari (n.d.a.) explains in their website that their objective is to keep the textile in use as long as possible. Their patches are targeted to customers that value quickness and ecological design. Using a Vaatelaastari patch decreases the usage of new raw materials, energy consumption and transportation, so it can be said that it makes the environmental impacts of VCA1 (acquiring raw materials), VCA2 (textile material production), VCA3 (clothing production) and VCA7 (transport) smaller, while fully eliminating the clothing production part. As explained in their website, Vaatelaastari has also shifted from using cotton to organic cotton and furthermore to fabric made from PET plastic bottles, which also decreases the impact of acquiring raw materials and the amount of waste. As Vaatelaastari (n.d.a.) states, they have committed to the ILO Code of Conduct and expect the same from their partners.

Vaatelaastari (n.d.a.) claims that over 99% of their purchases are located in Finland, where the products are also manufactured. They have a warrant to use the Avainlippu-symbol in their products, which is granted to those companies that manufacture their products in Finland. Moreover, Vaatelaastari has a warrant to use Design from Finland-symbol since their patterns are printed in Finland. They state in their website that their production chain is more ecological compared to the traditional printing methods, and it consumes less water and energy. The fabrics used in their basic collection comes from Finland and since 2021 only fully recycled textile material is used in them. Otherwise, they are acquired from operatives in Europe that meet the environmental standards. The yarns come from Germany and Turkey from certified operators. This also decreases the environmental impacts of acquiring raw materials, textile material production as well as transport since the purchases are located mainly in Finland.

Moreover, as stated in Vaatelaastari (n.d.a.) the company meets Europe’s chemical legislations. The glue that is used in the patches is vegan and does not contain harmful substances. The company also takes environment into consideration regarding packaging and tags. The reusable bags are made in Finland from renewable material, sugar cane. The tags are made from EU Ecolabel cardboard. The post envelopes are also produced ecologically in Edita Prima’s factory.

When it comes to VCA4 (distribution), VCA5 (retailing) and VCA6 (waste and reverse logistics) it can be said that the environmental impacts are also smaller. As said earlier, 99% of the purchases are made inside Finland as well as the manufacturing and design of the products. Also, the product is simple, and the volume of textile used in the patches is small so there is little waste. Also, there is a return policy of 14 days as said in Vaatelaastari (n.d.b.) website, but since it is not a piece of clothing but a patch, it is not as likely that customers would return these items.

4.5 Product as a service: Lindström

Lindström, implementing the Product as a service business model, is a company that offers textile services ranging from workwear, cleanroom textiles, industrial wipers, mats and washroom products to textiles for restaurants, hotels and healthcare. The service includes the textiles, washing and maintaining them as well as recycling, Lindström (2022) describes. Followingly, the figure below illustrates the environmental impacts of Lindström's operations throughout the VCA's.

Figure 11. Lindström's operations' effects on value chain activities

Lindström (2022) says, that CE is at the core of their business as they intend to avoid overproduction, optimise the use of raw materials and natural resources, and aim to keep the textiles in use as long as possible to avoid needlessly producing new ones. Lindström uses durable materials which they ensure by test washes and user trials. They also consider reusability, durability and repairability already when designing the products, with adjustable features for example and collaborating with their recycling partners and suppliers. Lindström makes sure that the number of surplus textiles and producing unnecessary textiles is reduced by focusing on product life cycle management and producing orders on demand as well as cross-using textiles

between service centers. In 2022, the company repaired over 4,6 million textile pieces. These actions reduce the use of raw materials (VCA1), textile material production (VCA2), clothing and textile production (VCA3) as well as waste and reverse logistics (VCA6).

About waste management, in Figure 12 is Lindström's waste hierarchy is illustrated. The Figure is explained further below.

Figure 12. Lindström's waste hierarchy (Lindström, 2022, p. 35)

Lindström (2022) explains in their Sustainability Report that when their textiles are no longer of use, they aim to recycle the waste to where it was generated to their best ability. Energy incineration becomes relevant when there is no suitable recycling option in nearby regions. The percentage of discarded textile in 2022 was only 2.1% while 68,3% of the textiles were recycled, and the rest was incinerated. The discarded textile was cutting waste which is more difficult to recycle because of plastics and pattern papers. Products like mats are also more difficult to recycle and in some local markets the level of recycling solutions differ a lot. Overall, the

company is highly transparent about their environmental impacts, the waste they generate is sorted into appropriate waste containers and recorded monthly. For example, in 2023 Lindström is planning to collaborate with mat recycling partners and suppliers in order to test new closed-loop recycling solutions. These actions also decrease the environmental impact of waste (and reverse logistics) (VCA6).

Lindström (2022) mentions water being a vital resource for their operations. The company strives to optimise water usage in their washing process. For example, in 2022 water recycling practice in 80% of their laundries and water is recovered from rinsing phases and used again in the washing phase in most of their laundries among various other optimising practises. Managing wastewater responsibly is also strived for in the company's practises, by for example using filters, monitoring the quality of wastewater and having wastewater treatment plants in laundries if necessary. These practises decrease the amount of waste (VCA6). Lindström is optimising transport routes by having local service centers which keeps the transportation routes short while utlizing local transport services. They strive to have as low emissions as possible, and for example deliver textiles and pick up dirty laundry at the same time. This will reduce VCA4 (distribution) and VCA7 (transportation) emissions.

5 Discussion

The aim of the study was to determine in which ways CT companies can increase ES by implementing circular business models throughout their value chain activities. This objective was met, and the author managed to find answers to the research question: *How to increase environmental sustainability in the clothing and textile industry by using circular economy business models?*

5.1 Summary of the main findings

This research has shown several ways companies can improve ES while implementing circular business models in the CT industry. From simple and easily manufactured patches to cover holes and stains on clothing and other items to a holistic textile and clothing service for businesses. Offering means to utilize clothing that is no longer needed for customers looking to by sustainable and high quality pre-owned

products, utilizing waste and producing a new kind of fiber from discarded textile or other cellulose-rich waste also turned out to be suitable ideas. Lastly, turning cutting waste and plastic into new clothing and cutting emissions and usage of water significantly.

These companies also had similar ways to increase sustainability in their operations. They strived to decrease emissions and optimize the usage of water in their production and services so the environmental impact would be lower. Moreover, they optimized their transportation and distribution, utilized textile waste and other forms of waste such as plastic bottles. Also, designing timeless products from ecological materials that are physically durable and easy to repair is an aspect many of the case companies considered important. Refraining from the usage of harmful chemicals and producing ecological packaging and tags was also what many of the case companies did. Followingly, implementing take back systems and keeping the products in circulation as long as possible were some of the means to be more environmentally friendly. Lastly, the companies collaborated with responsible stakeholders and tracked emissions while striving to be transparent in their operations.

5.2 Managerial implications

The research findings of this study show valuable management implications for companies in the CT industry, but also in other industries to some extent. They show that by striving for circularity throughout the value chain, a significant contribution to a more sustainable future can be made. These operations show that by maximizing the use of materials and keeping products in the loop as long as possible, remarkable improvements can be achieved. Designing for circularity and having sustainability as one of the organization's core values from the first step to the end of the circle is the attitude all of the case companies have shown in their goals and core values.

Research has shown that companies must opt to sustainability and circularity in order to sustain our future. The findings suggest a variety of different actions that ought to be taken to shift towards CE. As said before, sustaining the environment should be considered at the core of the company's operations and clear ambitious goals must be set to obtain this. Transparency about the operations and reliable

measurements of the impacts is important when striving to implement a circular business model. Furthermore, there is a significant amount of CT companies that have not yet incorporated circularity and sustainability as their core values in their operations. This applies to other industries as well.

The findings of this research encourage to strive to a closed loop and re-evaluate the company's values and principles. It shows that economic success can also be obtained by circular business models. It also shows that the traditional business model is not sustainable or even possible in the future since there is an increasing scarcity of resources and raw materials.

5.3 Assessment of the results in the light of literature

Previous research about sustainability in the CT industry by Pandit et al. (2020), Shen (2014), and Savage (2022) show that companies can increase ES and implement circularity by utilizing old clothing and waste, having less wasteful practises throughout the value chain as well as using eco-friendly materials and designing for longevity.

As was found from this study, Pandit et al. (2020) also recognized that discarded materials that are converted into something new decrease the use of energy and raw materials, which is seen as a good way to increase sustainability. Pandit et al. (2020) and Savage (2022) also found that making new yarn from old clothes and using sustainable textile fibers that are biodegradable, such as cellulose rich fibers, as well as retrieving from using harmful chemicals contribute to more ecological clothing. This is something Infinited Fiber and Pure Waste implemented for example. Moreover, the research suggests that selling used clothing significantly contributes to ES, which was agreed by Pandit et al. (2020) as well. The authors also found that reducing usage of water and energy, optimizing the amount of clothing production as well as saving in transportation by e.g., utilizing local vendors are contributing to sustainability. These findings were also found from this study.

Designing an efficient transportation and distribution system was also found to decrease emissions and contribute to ES, which was found by Shen (2014) as well. The author stated that efficient and green modes of transportation is a means to

reduce the negative impact of transportation and distribution. Take-back systems where clothing can be returned to the company was also found in this study to reduce waste, which was also discussed by Shen (2014).

5.4 Limitations of the research

This study is no exception when it comes to the limitations of research. Limitations existed primarily in the search for academic sources such as articles. Moreover, there is limitations regarding objectivity and validity to some extent. The author has endeavored to minimize limitations as much as possible by reviewing and citing credible sources, applying appropriate research methods, and deriving and using an appropriate theoretical framework to answer the research question.

Access to the secondary data about the case companies was achieved without any troubles. Although, some companies provided less information in their websites than others. When conducting the empirical study some articles and books that seemed appropriate for the research were not accessible. Followingly, the theoretical framework which used value chain activities in the CT industry as a base could not fully be applied to some case companies since some of them do not produce clothing. Although, this does not make any harm and they are still operating in the industry, just differently than traditional CT companies. The author derived the theoretical framework themselves, which can add to some limitations. Although, the theoretical framework was carefully drawn based on comprehensive academic literature as well as the research question and objectives in mind.

The data gathered was exclusively secondary data, and as said in chapter 3.5, this can be a bit one-sided. Although, the author thinks that similar results from the secondary data sources used in this study could have been derived by interviewing company representatives. On the contrary, the bias that can come from primary data such as interviews is ruled out. Limitations regarding the validity of the research were reduced to the minimum. Appropriate methodology literature was reviewed and appropriate research approach which suited the research was applied.

As the study is applying a multiple case study strategy, there is limitations regarding that. The research findings can only be generalized to other contexts to some extent.

The findings of the study show how CT companies can increase ES through their operations by implementing CE business models. Similar findings about increasing ES can be found in other contexts outside the CT industry, but the companies ought to be implementing circular practices in their operations.

Ethical issues were considered in the study. The author strived to disclose an accurate narrative of the authorship, evidence, data, findings and conclusions. Moreover, the author strived to communicate in appropriate and clear language and avoided reporting biased information or taking sides when analysing data. Since the findings were retrieved from secondary data outlets, ethical issues related to interviews or observing people were eliminated.

5.5 Recommendations for future research

Regarding future research, it would be beneficial to research how to promote sustainability and utilize CE in other contexts as well. Also, it would be important to incorporate other aspects of sustainability as well which are human, social and economic, not only the environmental part. In this study, the focus was on the environmental aspect so the scope of the research would not be too broad. To study CE business models even more closely and specificly, other researchers could focus on only one or few of them. Moreover, it could be interesting to study how sustainability and CE can also benefit companies. Research about the negative societal, economic, human, as well as environmental impacts in the CT industry context is also beneficial, although it is already being done increasingly. In conclusion, there is still several important issues and questions regarding these topics and new ones are arising. To sustain our future, research about sustainability and CE is vital.

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