Building towards circularity
The role of business collaboration in the transition towards a circular Dutch textile industry

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ABSTRACT:
The Dutch government is striving towards a fully functioning circular economy in the year 2050. To reach this goal, many improvements must take place in industries. The textile industry is known as one of the most polluting industries worldwide, with little improvements made regarding circularity. This research focusses on the role of business collaborations within the textile industry and their influence on a successful circular economy. A framework by Lieder and Rashid (2016) provides insight on the interaction between governments, societies and industries to work towards a circular practise. A qualitative research with innovation centre Texperium and their collaborations is conducted. It is found that collaborations contribute to knowledge spreading regarding textile recycling and an increased use of recycled materials in textile production. It is argued that there is opportunity for governmental bodies and society to further contribute to the implementation of recycled materials by increasing the pressure regarding circularity in the Dutch textile industry.

KEYWORDS:
Circular Economy, Textile Industry, Sustainability, Recycling, Business Collaboration, Supply Chain Management
Summary:

The textile industry is one of the largest polluting industries in the entire world. Cotton production accounts for 16% of total pesticide usage and 7% of all herbicides used. On top of that, it holds a large environmental footprint on water usage, chemical usage and land use. Other materials oftentimes derive from crude oil, which is the most polluting industry in the world. Recycling of textiles therefore holds a large environmental relevance, however textile recycling only takes place on a fairly low scale. Texperium is a knowledge and innovation centre located in Haaksbergen, the Netherlands. Their objective is to increase the percentage of recycled content used in the Dutch Textile industry. By working on the basis of the Triple Helix approach, which consists of collaborations with businesses, education institutes and governmental bodies, Texperium tries to spread knowledge and skills regarding post-consumer textile recycling.

This research focussed on the current state of circular textiles, what incentives for collaboration businesses have and what effect the collaborations have on their business regarding circularity. With the support of different scientific theories regarding the influence of business collaborations in a circular economy, it was found that Texperium is a business that is of major importance in transitioning a regular industry into a circular version. One of the major challenges in circular textiles is the improvement of textile recycling. Currently, the quality of mechanically recycled materials are inferior to virgin materials. This hinders the adoption of recycled materials for major fashion brands. New technological innovations therefore can stimulate the implementation of recycled materials.

Collaborations with Texperium often derive from a certain consciousness within the business regarding sustainability. This means that most of the business collaborations are with businesses that already implement a variety of sustainability and circularity measures. However the collaborations further add on this business model with addition of new technological innovations and knowledge regarding material recycling. A multitude of businesses expressed their plans on further implementing these new skills and knowledge into other collaborations. This has the possibility of further spreading the message of textile recycling, which can contribute to the transition towards a circular textile industry.

A pyramid scheme on successful circular economy was provided by Lieder and Rashid (2016), which showed the importance of a top-down and bottom-up approach. Societal and governmental pressures account for the top-down approach, while the market mostly represents the bottom-up. It was found that many businesses experience no, or hardly any, pressure from governments and consumers regarding their environmental performance. This is not surprising since the Dutch government expresses a form of soft-governance which consist of non-binding laws and rules that try to stimulate sustainability in different industries, but they lack strict hard-governance laws that pressure businesses to actually improve on their environmental performance. Regarding the consumers, it was noted that sustainability becomes more and more important but actual behavioural changes regarding textile purchases are yet to be found. Sustainable textile businesses remain a small niche market. If the Dutch government wants to reach 50% circularity in 2030, sustainable or circular textile production must become mainstream. For now, the limited governmental and societal pressure hinder the successful adoption of circularity measures and it is not expected that circularity in the Dutch textile industry will become mainstream in the near future.
Preface

Sustainability and textiles are two of my passions, which are combined in this thesis. Since my Bachelor thesis, I have been focussing my individual papers on sustainability in fashion. This research extends this by focussing on textile production as a whole, which has taught me a lot since I mainly focussed on fashion while textile production is done for a wide variety of reasons. Circularity has been an important topic in both my Bachelor and Master, so it only seemed fitting to combine sustainability and textiles with a focus on circularity. On top of that, the Dutch government strives towards full circularity in 2050 so it is very relevant to take an outlook on circularity in textile production.

I have always thought that a master thesis was something I was not able to produce, since it requires a lot of hard work, data and patience. Writing my thesis has not been easy and it took longer than I had hoped, however truthfully I was not shocked that it took me longer. In the end, I am proud of what I have been able to produce and to see that I was able to write a report of more than 60 pages is still somewhat shocking.

I want to thank my supervisors at Radboud University for guiding me through this difficult assignment, and I want to thank Stichting Texperium for their guidance and data provision as well. Without Texperium, this research would have been much harder to execute.
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1. Introduction

1.1 Introduction

The textile industry is known as one of the largest, but also most polluting industries in the world (Haug and Busch, 2016; Koszewska, 2018). In 2016 it had a total revenue of €1.5 trillion in apparel and footwear sales, and it employed around 60 million people throughout the whole value chain (Pulse of the Fashion Industry Report, 2017). Being one of the largest industries in the world, the textile industry also holds a large environmental impact. For example in the fashion industry, part of the textile industry, many fashion brands have relocated their production to low-wage countries since the consumer demands low prices. These low-wage countries often lack adequate (environmental) laws. The raw materials often used, such as cotton, require high amounts of pesticides, water and land and the processing and manufacturing of these materials (such as dyeing) hold a large environmental impact as well (Alay, Duran, Korlu, 2016). Inadequate waste disposal leads to harmful substances leaking into open water and thus harming nearby communities (Haug and Busch, 2016).

On top of that, the textile industry has been known for their focussing events that uncover the harsh reality of the working conditions for factory workers. A focussing event like Rana Plaza in Bangladesh, which killed at least 1200 people, clearly showed the inhumane conditions for the employees, and brought to light all the social problems in the industry (Sinkovics, Hoque, Sincovics, 2016). A change in the current practise is nothing more than necessary. A report by the Global Fashion Agenda (2017) describes the way in which the textile industry impacts the environment, these factors will be further explained in the literature review below. A more sustainable approach also holds economic benefits, since many new technologies require less materials, less waste and less energy (Hasanbeigi and Price, 2015).

The goal of this research is to give insight on how business collaborations, especially with a knowledge and innovation centre, can contribute to the transition towards a circular textile industry. The current linear approach of take-make-waste, will no longer be viable and a transition to a circular approach will be inevitable (Lieder and Rashid, 2016). This research focusses on collaborations regarding mechanical textile recycling. What challenges, possibilities and necessities are present in the shift towards a circular industry? Currently only 20% of the textiles get recycled, most of which gets cascaded into a lower function such as isolation materials. Of the total amount of recycled textiles, only 1% gets recycled into actual new clothing, while the rest of all discarded textiles are landfilled or incinerated (EllenMacArthur Foundation, 2017). The Dutch government has set a goal that in 2030, at least 50% of the Dutch economy must function according to the circular economy principles, and in 2050 the whole economy must be completely circular (Rijksoverheid, 2016). It can thereby be stated that the recycling of textiles will have to become a normal routine for every major textile business. However, many businesses do not have the knowledge on how to implement such new innovations or do not make the shift towards the implementation of recycled materials (Interview Texperium, 2018). That is where innovation centres play a key role, one of which is Texperium.

Texperium is a knowledge and innovation centre located in Haaksbergen, the Netherlands. Their main purpose is to provide assistance and knowledge about recycling to fashion brands and other
companies within the textile industry. Texperium has an innovation plant where discarded post-consumer textiles are mechanically treated in order to recapture the fibres within. Those fibres are then treated and made into new yarn for new use. Collaboration with different companies is one of the main ways in which Texperium tries to make the textile industry more sustainable. However, only a small amount of textiles is currently being recycled. If the Dutch government wants a fully functioning circular economy by 2050, the use of textile recycling must be stimulated.

The main question for this research will be:
How can business collaborations, particularly those with innovation centres, contribute to a circular textile economy?

The main question will be answered on the basis of the following sub questions:

- In what way do businesses perceive top-down governmental and societal pressure regarding circularity?
- What drives a business to pursue collaborations within a sustainable textile industry?
- What is the relevance of a knowledge and innovation centre such as Texperium in business collaborations?
- What is currently the biggest obstacle for creating a circular textile industry, and what is needed to combat this?

In literature, there has not been done extensive research on the topic of textile recycling and the textile industry with regards to the circular economy concept (Franco, 2017). The role of this research will therefore be to broaden the knowledge on the textile industry and the challenges and changes it will face when evolving into a circular, more sustainable, industry. For the succession of a fully functioning circular economy, policy changes must be made that can enable the implementation of circular economy features. Current laws can restrict the use of discarded textiles, since the textiles are seen as waste and therefore must be treated like waste (Interview Texperium, 2018).

The main scope of this research is on the textile industry in the Netherlands since the Dutch government has set goals on circularity in 2030 and 2050, and the textile industry was once one of the largest industries in the Netherlands. In the first chapter there will be an outlay on the current state of the fashion industry worldwide, this will give an overview on the current state and the wicked problem (Rittel and Webber, 1973). Later on, the focus will shift towards the textile industry in the Netherlands. An extensive literature study is executed, as well as interviews with partners of Texperium that participate within in the Dutch textile industry. Texperium also provides reports on several of their projects which are analysed as well. Literature is found through the Radboud University Library and Google Scholar. Keywords such as Green collaboration, Circular Economy, Sustainable Textile Industry and Green Innovation are used in order to find useful literature and reports. For this research, Texperium acts as a guide and provides necessary contacts and reports in order to generate enough data.

Scientific relevance
Scientific research on general environmental issues have been covered extensively, with plentiful researches focusing on greenhouse gasses, oil production and environmental pollution. However, the textile industry, while being one of the most polluting industries with vast amounts of greenhouse gas emissions, has not been covered extensively. Especially with regards to the
implementation of the Circular Economy in the textile industry, research is quite sparse (Franco, 2017). This research differentiates itself from other researches on circular textiles since it focusses on the management level of textile production and not necessarily on mechanical features.

Although sustainability in the textile industry is growing momentum, the transition to a more sustainable textile industry is going slowly, slower than other industries (Haug and Busch, 2016). This research will therefore hold a large scientific relevance, since this research will add new insights on sustainability and circularity in the textile industry with a focus on actual implementation of circularity through business collaborations. It also explores how governmental bodies and a civil society can influence the process of circularity implementation. Future research can build on these outcomes to provide even further empirical data to stimulate the adoption of circularity measures in the textile industry.

Societal Relevance
The Dutch government aims for a fully working circular economy in 2050, so changes in the current textile industry are inevitable. It therefore also holds a large societal relevance. There is lack of adequate policy and implementation on the recycling of textiles (Interview Texperium, 2018). This means that large societal and economic changes must be implemented in order to transition to a circular industry. The current linear take-make-waste system will no longer be viable, which requires changes in consumption and logistics for every citizen. The current practise of textile production and processing is also harmful to both the environment as well as for the people working in the industry and surrounding areas. Pesticides, dyes and other polluting chemicals are used in the production and the disposal of these substances often do not meet regulatory standards, thereby also harming nearby communities (Alay et al., 2016). A circular textile industry will eliminate or decrease waste streams thereby creating a safer work- and living environment for the people around.

1.2 The Textile Industry
This research will focus on the role of business collaborations in the textile industry. It is therefore necessary to take an outlook on the current state and practise of the textile industry and how the textile industry can improve on their environmental performance.

The textile industry consists of many different sub-industries, for example the fashion industry. However, the textile industry is more than just fashion. Textiles are used in many other products, such as car seating, carpet and furniture. For this research we will look at the textile industry in the Netherlands as a whole. Partners from Texperium exist in all different sub-industries and on different levels on the supply chain. The outlook on the textile industry will be on a worldwide level since the design, production and consumption of textiles, together with their environmental impact, happens globally.

The planetary boundaries, formulated by the Stockholm Resilience Centre, are often seen as the key factors of ‘sustainability’ and the carrying capacity of the earth (Steffen et al., 2015). Those boundaries are not to be overridden in order to maintain a healthy and sustainable world. A Report by the Pulse of the Fashion Industry researched the current state of sustainability in the fashion industry. As described earlier in this introduction, the fashion industry is part of the textile industry as a whole. Five of the planetary boundaries are present in the fashion industry, where the fashion industry poses an increased threat (Pulse of the Fashion Industry Report, 2017). Those consist of the
following: Land use, Chemical usage, Waste Creation, Water consumption and Energy emissions.

- **Land use:**
  According to the Pulse of the Fashion Industry Report (2017), land use will be a major threat to a safe operating textile industry. It is projected that due to population growth, an increased amount of land will have to be used for agricultural purposes, while at the same time the demand for clothing and textiles will rise too. The area of forested land that has been cultivated for use, amongst which is cotton production, has already exceeded the safe operating space by 17% (Pulse of the Fashion Industry Report, 2017). Population- and economic growth also increases waste streams, which causes additional land use for dumping grounds.

- **Chemicals usage:**
  Although only 3% of the total agricultural land is used for cotton production, it does hold a large share of the total pesticides and herbicides used, 16% and 7% respectively (Pulse of the Fashion Industry Report, 2017). This holds a negative impact on the biodiversity and ecosystem in the area. On top of that, vast amounts of fertilizer is used for the production of cotton. This leads to the depletion of groundwater and soil quality (Alay et al., 2016; Ellen MacArthur Foundation, 2017). The processing of textiles results in the use of large amount of dyes, bleach and chemicals (Hiremath et al., 2012).

- **Waste creation:**
  One of the biggest opportunities for the textile industry lies in the utilization of waste streams. Recycling has not been done extensively since the technology for recycling all types of materials on a large scale has not been present yet (Pulse of the Fashion Industry Report, 2017). Economic viability also plays a large role in this. The clothing apparel industry is mainly focussed on short-term profitability, while making use of recycled materials is oftentimes not profitable, but has potential to be profitable in the long-term. It is estimated that USD 100 billion worth of materials is lost from the system every year, which would be suitable for recycling (Ellen MacArthur Foundation, 2017). As mentioned, vast amounts of chemicals are used in order to create textiles. These chemicals are oftentimes not correctly disposed of, which results in pollution of water and soil in the surrounding environment (Hiremath et al., 2012; Hasanbeigi and Price, 2015).

- **Water consumption:**
  While the actual planetary boundary has not yet been exceeded, the textile industry uses a vast amount of water. For the production of a single pair of jeans, approximately 8000 litres of fresh water is used (Alay et al., 2016; Ellen MacArthur Foundation, 2017). In the current state, 79 billion cubic meters of water is used annually throughout the entire fashion industry and it is expected that by 2030 the annual water-usage will increase with 50% (Pulse of the Fashion Industry Report, 2017). The production often takes place in countries where water-stress is already present. According to research by Schlosser et al. (2014) fresh water is becoming increasingly scarce. It is expected that by 2050 about half a billion people are likely to be subject to water-stress. Vast amount of fresh water use also impacts the groundwater levels, groundwater depletion will hinder agricultural activities and in maintaining healthy environments (Schlosser et al., 2014; Hasanbeigi and Price, 2015).
Energy emissions:
The planetary boundary for energy emissions has already been exceeded, and it is expected that CO₂ emissions from the textile industry will increase by more than 60% to roughly 2.8 billion tons per year by 2030 (Pulse of the Fashion Industry Report, 2017). Just like with the water consumption, the production countries are vulnerable to the consequences of climate changes such as sea-level rising, heavy rainfall or extreme droughts (Schlosser et al., 2014).

The Pulse of the Fashion Industry Report (2017) mostly focuses on the environmental impact derived from cotton production and processing. Although cotton is the most common natural fibre for textiles, the synthetic fibre polyester is also a frequently used material. Polyester is derived from crude oil, which thereby also brings a large environmental impact (Sandin and Peters, 2018; Slater, 2007). When polyester degrades, it degrades into microplastics, which damages ecosystems and can potentially harm human health (Slater, 2007).

An issue regarding the planetary boundaries is the fact that the social factor is left untouched, while this is considered part of the Sustainability paradigm (Ben-Eli, 2018). The social aspect is a big issue in the textile industry. Since consumers are looking for the lowest price, clothing production has shifted from western countries to low-wage countries in e.g. Asia. Here, working conditions are poor and factory workers do not have legal representation, resulting in exploitation, intimidation and even violence (Unicef, 2015). Many workers do not receive living wages and are forced to work long days. In some cases, extra work hours are not paid. The majority of factory workers are female (roughly 80%), and do not have adequate maternity protection. Often, pregnant women are ‘voluntarily’ resigned, while in reality they are fired (Unicef, 2015). Oftentimes the current conditions in the textile production are referred to as modern slavery. A 2014 report by SOMO (Centre for Research on Multinational Corporations) and the ICN (India Committee of the Netherlands) about working conditions for female workers in south India, highlighted the abuses to, often young, female workers throughout the entire fashion supply chain. Many children are lured into working in mills and factories under false promises, such as well-paid jobs, food, schooling and good accommodations, while in reality the conditions are far from adequate (SOMO and ICN Report, 2014).

1.3 Transparency
One of the biggest factors that makes transparency in the textile industry so difficult is unauthorized subcontracting (Christopher, Lowson, Peck, 2004). Many factories outsource production of clothing to other nearby factories, where authorization lacks. This way, it is impossible for companies to know where their product is made and what the working conditions exactly are. Initiatives on improving the transparency are seen as a hopeful and promising way to better the current practise. One of the most well-known standards is the Better Cotton Initiative (BCI), which strives towards a better cotton production on environmental and social level. By using less pesticides and banning child labour, they try to make the cotton production less harmful (BetterCotton.org, n.d.).

However, as seen in a documentary by Zembla named ‘Het prijskaartje van katoen’ (2017), the BCI has received serious controversy and criticism. Organic cotton production has decreased with more than 50% over the last few years, while the cotton with BCI label has risen (Zembla, 2017). In the documentary it became clear that organic cotton farmers switched to BCI cotton, in order to legally use pesticides and harvest twice a year instead of once, thereby increasing their income. However,
by using the land more intensively, soil and groundwater quality decreases by a higher extend.

Ensuring the use of BCI cotton has also proven to be difficult. The documentary has shown light on the transparency issue in the textile industry. In factories and warehouses, BCI labelled cotton is mixed with regular non-labelled cotton, which thereby disables transparency on whether a garment is fully made out of BCI cotton. Many of these events are caused by corrupt factory and weaving mill owners.

1.4 Wicked Problem
The environmental and social problems in the textile industry can be described as examples of a wicked problem. Wicked problems were first described in an article by Rittel and Webber in 1973. They tried to address the issue on wicked problems and what exactly makes them so wicked. According to Rittel and Webber, a wicked problem does not have a definitive formulation since the problem is so large and a simple solution is not easily formed (Rittel and Webber, 1973). Rittel and Webber provide an example on the wickedness of poverty, which is relevant for the wicked problem on the current textile industry. It starts with the right definition of poverty, which turns out to be quite situational. Therefore it is hard to determine in what field, changes must be made. Another factor in wicked problem solving is that there is not a right or wrong solution, but rather good or bad solutions, or as Rittel and Webber state; more likely “better or worse” (Rittel and Webber, 1973, p. 163). What makes the textile industry such a wicked problem is the fact that there are many stakeholders involved that each have their own incentives and goals. For example, if companies try to solve the issue on low wages by increasing the price of a garment, consumption will likely decrease, which will results in a lower demand and need for employees. Every decision made, influences the whole industry in some way, good or bad, and that is what makes a solution to the wicked problem so difficult.

1.5 Textile recycling
By recycling and reusing materials, a shift towards more circularity in the textile industry is made. As previously mentioned in the introduction, only 20% of textiles gets recycled, of which 1% of textiles gets recycled into new high-end textiles used in e.g. clothing (Ellen MacArthur Foundation, 2017). Therefore, innovations regarding high quality textile recycling provides ecologic and economic opportunities. The Ellen MacArthur Foundation has set up four areas of action for textile recycling to optimize the use of recycled material.

- **Aligning clothing design and recycling processes;**
  Design of current clothing does not take the possibility of recycling into consideration. According to the Ellen MacArthur Foundation, there is a disconnect between the design and recycling process. For optimal use of the resources it is important that there is a clear outlook on the specification of raw materials and the selection of dyes, solvents, finishing processes, garment construction, accessories, and labelling methods for disposal (Koszewska, 2018). When those things are not taken into consideration, most of the garments end up in landfills or are incinerated. However, simple recycling is also not the answer. Most of the textiles that do get recycled, are being downcycled to lesser quality and end up as cleaning cloths and isolation material. The biggest environmental benefits can be reached when garment are up-
cycled, something that Texperium is pursuing (Koszewska, 2018; Interview Texperium, 2018). Upcycling strives to maintain the quality of materials, ensuring a longer lifespan.

- **Pursuing technological innovation to improve the economics and quality of recycling;**
  There is need for collaboration between the design of a garment and the ability to recycle (Fischer and Pascucci, 2017). Transparency about what materials are used for an optimal recycling revenue. Mixed materials make it harder for proper recycling, since they often are a mix of biodegradable and non-biodegradable materials which require different treatments for recycling. It is, after recycling, also impossible to control the correct composition of the recycled material (Fischer and Pascucci, 2017).

- **Stimulating demand for recycled materials;**
  The Ellen MacArthur Foundation (2017) states that the quality of mechanically sourced fibres are of a lesser quality than the original fibre, while chemical recycling can reach the same quality of the original. However, chemical recycling of textiles require vast amounts of chemicals, water and other substances, while mechanical recycling only require machinery (Interview Texperium, 2018). A higher demand for recycled materials will give an incentive for extra innovation on recycling technologies, which can improve the quality of mechanical recycling. Extra innovation will also likely decrease the costs for recycling, therefore decreasing the price per item and thus stimulate the consumption of recycled textiles (Hasanbegi and Price, 2015).

- **Implementing clothing collection at scale.**
  Due to the lack of large clothing-to-clothing recycling centres, textile recycling only takes place on a small scale. For the textile recycling to flourish, there is a need for large recycling centres that can operate on a large scale and provide good quality recycled textiles as a resource for new textile production (Ellen MacArthur Foundation, 2017). This can only be achieved by a growth in innovation, finance and demand.

All in all it can be concluded that the textile industry is not a frontrunner in the shift towards sustainability. The Pulse of the Fashion Industry Report constructed a Pulse-score which scores the sustainability of a certain industry. Based on the current state of the fashion industry and their approach to sustainability, they receive a 32% (out of 100%) Pulse-score, which is a low score (Pulse of the Fashion Industry Report, 2017). It therefore can be stated that there are many opportunities for the textile industry to become more sustainable.
2. Theoretical Framework

This research has a focus on the role of business collaborations in a circular textile industry. Therefore we take a detailed outlook on which processes take place in businesses and how implementation of sustainability or circularity can be applied. Thereafter, we take a short outlook on the current policies regarding sustainability and circularity in the Dutch textile industry. Although Policy is not the main scope of this research, it is oftentimes considered to be an important factor in circularity and business management.

2.1 Supply Chain

In order to create a more sustainable textile industry, changes in the supply chain must be made. For this research, it is therefore important to take a detailed outlook on the supply chain in the textile industry. The supply chain of a product covers every step along the production line, from the extraction of raw resources to eventually the final product being sold. A typical supply chain broadly consists of at least the following five stages: component/raw material suppliers, manufacturers, wholesalers/distributors, retailers and customers (Chin, Tat, Sulaiman, 2015). These five stages are connected through flows of products, information and money. Managing a supply chain network is complex and difficult since many different parties are present in a supply chain and they all work within different sub-systems and operate on different levels. An overview of the supply chain in the textile industry is given by Gereffi and Memedovic (2003):

![The global apparel value chain. Gereffi, G., Memedovic, O. (2003).](image)

The figure makes distinction between five different networks: Raw materials, Component networks, Production Networks, Export Networks and Marketing Networks. In every network, choices are made that influence the environmental performance of the textile product. The most crucial part, and the most relevant for this research, starts with the raw materials (Gereffi and Memedovic, 2003). The material usage is of upmost importance in the environmental performance of textiles. Certain materials such as cotton, wool and leather hold a large environmental footprint due to water, chemical and land use (Koszewska, 2018; Ellen MacArthur Foundation, 2017). Since material usage
has the biggest influence on the environmental impact of the textiles, it is most relevant to implement sustainable measures here. Texperium tries to normalize and stimulate the usage of recycled materials for textiles, which holds a smaller environmental footprint.

Although the material network holds the biggest environmental impact, the other networks have relevance too. The Component network naturally follows the Raw Material network, since the raw materials have to be processed into fabrics. In this network, the chemicals and dyes are used for the treatment of the textiles. They hold a large impact on water, soil and air quality of the surrounding areas (Gereffi and Memedovic, 2003).

The production network is where all of the textiles are made into useable products. Environmental issues are not very prominent here since the textiles are already created. Most of the sustainability issues regard the social aspect, since many textiles are produced in countries with low wages, poor work environments and exploitation (Chin et al., 2015; Gereffi and Memedovic, 2003). Environmental sustainability is present in the form of material efficiency, using as little textiles as possible for the creation of a full-fledged product. Nowadays, a lot of material is lost in the production network since factory workers are not focussed on material efficiency, but rather on large scale production (Chin et al., 2015).

The export and marketing networks are mostly economic and management based. Export of textiles regard transportation from factories to warehouses and stores. This regards greenhouse gas emissions since transport is mostly done with large container ships (Ahmed, Akter, Ma, 2018). The marketing network is an important network since the core business values are formed there. If a business chooses to adopt a more sustainable approach, changes in the other networks are formed, such as the adoption of recycled materials in the material network (Chin et al., 2015; Ahmed et al., 2018).

### 2.2 Circular Economy

This research highlights the shift towards a circular economy and the role of business collaborations within the textile industry. The circular economy (further referred to as CE) is a concept that has gained momentum in the last decade, when it became obvious that the current linear approach will no longer be viable and will eventually lead so all sorts of problems, be it ecologically, socially or politically (Koszewska, 2018). What makes CE different from other sustainable economic systems is that it addresses economic growth, while at the same time taking into consideration the shortage of natural resources and energy (Witjes and Lozano, 2016). This is done through a closed-loop approach where resources are used as efficiently as possible and as long as possible, this is called ‘value retention’. This resource efficiency can only be achieved by stimulating technical, social, and organisational innovations throughout the entire value chain. Within the CE, there are different stages of product and resource functions, called the R’s. According to Vermeulen, Witjes and Reike (2014), those R’s consist of: Resist (the usage of materials, Reduce (the usage of materials), Reuse, Repair, Refurbish, Remanufacture, Re-purpose, Recycle and Recover. Within literature there is difference in which R’s are actually prominent, some only take three (Reduce, reuse, recycle), while some take six or nine (Vermeulen et al., 2014). The most well-known figure about the circular economy is the butterfly diagram from the Ellen MacArthur Foundation, presented below.
Figure 2: Circular Economy System Diagram, Ellen MacArthur Foundation (2017).

Figure 2 shows all the different R’s in the economy. These will be explained in reference to the textile industry. The butterfly figure divides the circular economy into two different cycles. The technical cycle is the cycle that has the greatest relevance for this research and has the greatest influence in a circular textile industry. Although the diagram provides many stages, some of the relevant R’s are not mentioned. They are mentioned by Vermeulen et al. (2014). By combining those two lists we formulate the following R’s:

- **Resist:** Resisting the usage of material. The Ellen MacArthur Foundation has mentioned that in the last decade there has been a change in behaviour with regards to clothing (2017). We own more items, while at the same time wear them less till disposal. This statement is in compliance with a research by Koszewka (2018).

- **Reduce:** Reduce the amount of material. According to the Pulse of the Fashion Industry Report, due to population growth and economic prosperity, the rise of textiles is increasing (Pulse of the Fashion Industry, 2017). For the textile industry to become circular, it is therefore important to reduce the amount of textiles used for a product. This can be done through resource efficiency and eco-design, which both optimizes the use of resources.

- **Reuse:** Reuse the textile for the same function. In order to minimize the use of materials, reusing the textiles is profitable. Examples of this is second hand shops. The product is cascading, not in function, but in time, with the option for the highest value. A shirt remains a shirt, but rather switches owner.
- **Repair**: Repair textiles for continuation of usage. When the quality of a product is decreasing, repairing seems a viable option. This ensures that the product remains the same purpose.

- **Refurbish**: Refurbishment restores a product with the addition of new materials. It restores or upgrades the original product by replacing parts of the product that has been damaged or broken or where the quality has decreased. The difference between repair and refurbish is that in refurbishment, the focus is not only on the part that is broken but on upgrading the product as a whole.

- **Remanufacture**: Remanufacturing a product means rebuilding it with addition of replacements so that it exactly equal to an originally new product.

- **Re-purpose**: Giving the discarded textile a new function, mostly cascaded into a lower function. An example is using old shirts as cleaning cloths.

- **Recycle**: Recycling of textiles is manipulating the textile so that it becomes fibres again. This is done through chemical and mechanical recycling. The recycling of textiles is where Texperium is focussing on. Old discarded textiles are processed in different machines that manipulate the textiles so that the original fibres become exposed. These fibres are then formed into a new yarn.

- **Recover**: The latest, and most undesirable, step in the whole butterfly. Recover is the step when all the other R’s are not possible anymore due to quality loss. By burning the material, you can recover some of its value for other purposes such as energy production.

Reike, Witjes and Vermeulen (2017) provided a model on circularity which combined the supply chain and the product development stages of a product. In this model they provided insight in the intertwining of those two chains and clarified which R’s play a role. The Realisation part of a product design is where the Supply Chain is present. Here we have; component production, end product manufacturing, retailing, consumer, collection. When looking at circularity, here is where the real gain can be made. In the design process, the actual possibilities of the supply chain have to be considered.

The discussion about the different R’s can be seen as an example that is relevant for the whole CE theory. In an interview with Witjes (2018), he highlighted the fact that there is a lack of definition in CE. A research by Kirchherr, Reike and Hekkert (2017) collected 114 different definitions of CE. All of which contained the same idea, but described differently and with slight different aspects added. The researchers even presumed that the lack of clear definition and the current great variety may result in a collapse of the concept altogether. This is not solely the case with the term ‘circular economy’. Many terms in the environmental sciences are faced with unclear and different definitions. The same trend can be seen with the word ‘sustainable development’. A quote by Engelman (2013) highlights this: “we live today in an age of ‘sustainababble’, a cacophonous profusion of uses of the world ‘sustainable [development]’ to mean anything from environmentally better to cool”. (p.3) Sustainababble can also be harmful for the credibility of environmental issues. When there is a public discussion on the exact meaning of ‘sustainability’, confusion among the public is created. Politicians can question the factuality and seriousness of environmental issues, such as climate change, and people will take certain environmental claims less serious (Engelman, 2013). For this research, it is therefore crucial to appoint a clear definition regarding the Circular Economy. The definition will be discussed in chapter 3 ‘operationalisation of theoretical concepts’ below.
Challenges for circularity in the textile industry mostly revolve around the production and consumption of textiles. With the population growth, fast fashion and a rising economic growth, the demand for clothing has risen. The make-take-waste approach has to change in order to go circular so that means waste minimization is seen as one of the most important steps (Koszewska, 2018). According to Koszewska, the main focus should be on product design and development, waste collection, and sorting and effective recycling (2018). Texperium focusses on all three of those challenges; product design, waste collection and effective recycling, thereby strengthening the relevance of a knowledge and innovation centre such as Texperium.

As mentioned above, in the textile industry there is a mismatch between the design and disposal possibilities of a product (Ellen MacArthur Foundation, 2017). Clothing items are designed without taking possible efficient recycling into consideration, which leads to more difficult and less efficient recycling. In the CE, those issues will most likely be solved by the stimulation of resource efficiency and most likely through eco-design and co-design (Witjes and Lozano, 2016). The aim of Eco-design is to create a design with the highest resource efficiency while at the same time consider the afterlife of the product. The co-designing process of a product is important for circularity. As stated by Witjes (Interview, 2018), in the co-design state, the producer and client come up with their requirements for the product and then create the actual product. Clients that demands a product where circularity is top priority, will translate in a circular product (if possible). When the demand for such products increase, the market will transition to this new approach.

2.3 The Dutch Textile Industry

As mentioned in the introduction, this research will focus on the textile industry in the Netherlands, which is the main workfield of Texperium. Therefore, it is important to give an overview of the current state of the textile industry in this area. The textile industry was once one of the biggest and most valuable industries in the Netherlands, especially within the area of Twente (Modint, 2019). However, due to globalisation and outsourcing, the production shifted towards low-wage countries. First, the production was outsourced to countries within the European Union, whereas later the production shifted to Asia. Nowadays, the Dutch textile industry only generates roughly 2% of the industrial added value of the Netherlands, while in 1950 this was approximately 20% (MVO Nederland, 2013). Branch organization Modint is one of the key organization in the Dutch textile industry that brings together businesses, institutes and organizations. They stand for ‘sustainability, innovation and expertise with a vision on the textile industry in the Netherlands, as well as abroad’ (Modint, n.d.). Modint sees innovation, and especially interdisciplinary collaborations as key factors for the transition towards a more sustainable and circular textile industry. According to MVO Nederland, the Dutch textile industry, even though has decreased, still generates roughly 22 billion euros annually (MVO Nederland, 2013). Most of the businesses in the Dutch textile industry are small to medium enterprises, while there are only a few large players, such as Ten Cate which is located in Almelo.

2.4 Policy changes in the Textile Industry

This chapter will feature some of the (policy) changes in the last decade regarding the environmental and social performance of the textile industry.

The Rana Plaza collapse in 2013 is known as one of the biggest disasters in the fashion industry, killing more than 1200 people and injuring over 2000 (Sinkovics et al., 2016). Since then, there has
been an increase in awareness around the mishaps in the industry. Due to the outrage on the collapse, many fashion brands decided to join an accord that ensures better work conditions. This pact is called the Bangladesh Fire and Safety Accord. The accord supported inspections on building safety in order to prevent collapses like the one in Rana Plaza. However, the improvement of employee rights have been underwhelming. Employees are oftentimes still underpaid, ununionized and exploited (Hemphill and White, 2018; Jacoby, 2018).

The Dutch government has set up their transition agenda for a circular economy. The goal is that the Dutch economy will fully function according to the standards of CE by 2050, with a goal of 50% in 2030 (Rijksoverheid, 2016). They also provide subsidies for projects regarding innovations and sustainability. Texperium has experience with these subsidies and regards it as an important source of funding in the business collaboration and innovation realm (Texperium, 2018).

The Dutch government has set up different projects regarding circularity for many different industries. For the textile industry, this has resulted in the formation of the Dutch Circular Textile Valley. This project aims at increasing the implementation of recycled textiles in 2030. They have started multiple projects that aim on reaching the following goals:

- Improving high-quality textile recycling and creating products with recycled textiles.
- Creating examples of circularity and manufacturing in clothing and textiles.
- Creating new, more sustainable, materials such as plant-based leather and dye’s derived from algae.
- The creation of a plan of action together with the textile market on improving circularity, resulting in the Roadmap Circular Textiles. (Rijksoverheid, 2019)

The Roadmap Circular Textiles gives a schematic oversight of what the circular textile shift will entail. The R’s used in this roadmap are the same ones that are formulated by the Ellen MacArthur Foundation and Vermeulen et al. (2014). On top of this roadmap, the government formulated five steps that need to be taken in order create circularity. One of which is the improvement on recycling techniques.

The ministry of Foreign Affairs has also set up a department regarding textiles and trade, which deals with the environmental, economic and social aspect of the textile industry (Interview Texperium, 2018).

Figure 3: Roadmap Circulair Textiel, Transitie-agenda Consumptiegoederen. Rijksoverheid (2016).
Although these Roadmaps and goals can be relevant for businesses to start implementing sustainability features in their management, there are currently not any hard measures that force business to implement circular or sustainable textiles into their current practise.

2.5 Governance in the Textile Industry

Within the textile industry, clothing production is one of the biggest and most prominent players. With an increased wealth, the demand for clothing rises, while the prices are declining. Nowadays, consumers own more and more pieces of clothing, while at the same time the wear per item has decreased (Koszewska, 2018; Ellen MacArthur Foundation, 2017). Clothing brands anticipate on this by providing new collections every few weeks, with extra discounts on many clothing items. This process is called fast fashion. For major fashion companies, participating in sustainable collaborations are not seen as a necessity, since consumers generally do not pay attention to the sustainability of their product. Texperium sees this as one of the biggest burdens for a transition towards a circular industry (Interview Texperium, 2018). It is unclear who bares the core responsibility on bringing changes in the textile industry. A solution might be in the form of governance.

Governance is the interaction between the state, market and civil society and is stated to be of importance in changing economic and political systems (Stoker, 1998). In governance, the government is not necessarily the body that makes up laws or that acts as the ‘leader’. A research by Stoker (1998) describes governance as ‘the development of governing styles in which boundaries between and within public and private sectors have become blurred’ (Stoker, 1998). Stoker furthermore gives multiple propositions of governance, which include the market taking over the role as a leader when governments fail to act as one (Stoker, 1998).

State:
As mentioned in the paragraph above, the biggest players in the fashion industry practise the fast fashion approach, with high production volumes in combination with little wear-per-item. The Dutch government tries to combat the environmental impact of the textile industry through the act of soft governance, a way of governance that implements non-binding rules and measures that try to motivate businesses to adopt certain (environmental) improvements (Steurer, 2013; Maggetti, 2015). They do this by providing programs such as the “Roadmap Circulair Textiel” which was mentioned in the subchapter above. However, the Dutch government fails to provide the measures necessary for a more sustainable, and perhaps even circular, textile industry. The rules and measures are of such lacklustre level, that businesses do not feel pressured to improve their environmental performance.

However, this does not mean that the government totally ignores the environmental impact of textile production. There is a growth in governmental pressure on behalf of waste management (Interview Texperium, 2018). Texperium mentions that the government has risen the price of waste disposal for companies and consumers. Therefore, companies are searching for other ways to deal with their waste, one of which is recycling. Texperium also works with more local governmental bodies in several projects, such as ‘Going Eco Going Dutch’, mostly in the form of subsidies. These subsidies are often granted on project revolving innovations and resource efficiency.
MARKET:

Although most businesses in the textile industry are not active on sustainability, some businesses implement strict measures out of their own norms and values. Businesses that implement recycled materials in their products are seen as frontrunners on sustainability and circularity in the textile industry. This can be seen in scheme of the Early Adopters Theory. This theory proposes that new technologies and innovations are first adopted by a select amount of businesses. The theory, formed by Rogers (1995) distinguished the following groups: innovators, early adopters, early majority, late majority and laggards (Rogers, 1995). Current innovators, such as Texperium, form new innovations regarding textile recycling, which are adopted by businesses that are active on sustainability issues and improving their environmental performance. Eventually, these innovations might spread to more and more businesses until eventually it becomes mainstream. Although Texperium often work with small businesses, there are some larger businesses in the textile industry that can be seen as frontrunners on sustainability and circularity. Stella McCartney is a high-end fashion brand that proclaims sustainability to be one of their core business values. They produce clothing lines that are made out of recycled materials, or are produced in order to be fully recyclable. Although sustainability is a growing subject in the fashion industry, Stella McCartney began their sustainability projects much earlier (Kaikobad, Bhuiyan, Zobaida, Daizy, 2015).

Civil Society:
As mentioned above, societal pressure for ‘greener’ clothing is not very present. This however does not mean that there is not an active group, also known as civil society, that tries to address the issues through active advocating of the current practise. Such a group is the NGO “Schone Kleren Campagne”, which is known for being upfront and clear about the malpractice of the working environment in the fashion industry and the environmental impact it has on our world. Focussing events like the collapse of Rana Plaza play a significant role in their activism. Their approach consists mostly of naming-and-shaming fashion brands or companies regarding their unethical fashion. But not only NGO’s speak out on the cruelties in the fashion industry. Sometimes civilians themselves create uproar, an example is the (temporary) boycott of Zara after a customer found a label in their clothing which stated: “I made this item you are going to buy, and I didn’t get paid for it” (BBC, 2017). This caught the attention of many consumers and they stated a boycott from Zara. Unfortunately these boycotts are oftentimes forgotten about quickly and fast fashion quickly remains the main source of purchased clothing.

An overview of governance in the textile industry is shown below:
In Figure 4, you can see what each sphere is doing in order to create a more sustainable textile industry. However, all of these actions are intertwined with each other. The reason for businesses to collaborate is the growing pressure from government bodies to reduce waste streams and pollute less. By increasing the cost for waste incineration, companies seek other ways of waste disposal. Texperium benefits from this, since they collect discarded textiles which can be recycled (Interview, 2018). Governmental bodies also stimulate the market by appointing subsidies for new innovations, however strict measures, also regarded as hard governance (Steurer, 2013; Maggetti, 2015), are lacking on the use of recycled materials. This is remarkable, since the government wants to work towards 50% circularity in 2030 and 100% circularity in 2050.

This is where governance takes place, as a small portion of business take over the role as leader and implement recycled content in their production without governmental pressure. By stimulating other companies to improve their environmental performance, mostly through collaborations, they strive to spread the sustainability throughout the entire industry. These companies take over the role of the government, that lacks active involvement in the recycling of textiles. The Civil Society, especially active NGO’s, act as watchdogs that can publicly name and shame a business when their products are socially and/or environmentally damaging. The Civil Society takes over a form of governing that the state lacks, since there is a lack of strict rules and regulations that prohibit certain practices in the market. As mentioned previously, the textile industry lacks transparency. Clothing that is derived from factories or countries with dubious reputations, for example because of child labour, are still allowed to be imported since regulations are missing. The Civil Society therefore acts as advocate for these abuses and calls out businesses that work unethically.

### 2.6 Triple Helix

Another paradigm form, in resemblance to Governance, is the Triple Helix. In a triple helix, academia, industry and government form three helices that interact, overlap, and are in constant transition, accelerating innovation as well as creating new organizations and institutions, such as incubators and venture capitalists (Etzkowitz and Leydesdorff, 1995). The Triple Helix propagates a shift from an
industry-government driven Industrial Society, to a triadic relationship consisting of university-industry-government called the Knowledge Society (Standford, n.d.). The relationships between actors consist of five different aspects; technology transfer, collaboration and conflict moderation, collaborative leadership, substitution and networking (Etzkowitz and Leydesdorff, 1995; Ranga and Etzkowitz, 2013). All of these processes take place in the so-called ‘Knowledge, Innovation and Consensus Spaces’. What makes this approach different than Governance is the addition of academia to the interacting paradigm, but dismissing the Civil Society.

Based upon the Triple Helix paradigm, the concept of Triple Helix Systems of Innovation (Ranga and Etzkowitz, 2013) was formed. This concept is a more elaborate framework that combines the key features of the Triple Helix interactions together into an ‘innovation system’ format. The framework makes three important distinctions; between R&D and non-R&D innovators, between ‘single-sphere’ and ‘multi-sphere’ and last between individuals and institutions (Ranga and Etzkowitz, 2013). In relation to Texperium, they can be seen as R&D innovators that work as a multi-sphere institution. The Triple Helix Systems of Innovation highlights the development of innovations and the power of collaborations. Texperium oftentimes uses the Triple Helix Systems approach as a standard in their projects. Many projects consist of a variety of companies, foundations and institutes where the Triple Helix approach is preferred. A simplified overview of the Triple Helix Systems approach is given below (figure 5).

**Figure 5: Triple Helix Systems, Etzkowitz and Leydesdorff (1995).**

An example of a Triple Helix project is the BIO2HighTex project, in collaboration with: De Berkel B.V. – Gebr. Van der Geest B.V. – Kayser Bedrijfskleding – A.C. Ter Kuile B.V. – Stichting Wageningen Research, Instituut Wageningen Food & Biobased Research – Ten Cate Thiolon B.V. – ROC van Twente – Stichting OICAM and Gemeente Almelo. The BIO2HighTex project focusses on eliminating the use of fossil resources and reintegrating natural fibres into the current industries. These businesses and institutions all partake within the Triple Helix System with each their own business approach.

**2.7 Business Collaboration**

This subchapter will provide an in-depth analyses of business collaborations, what collaboration exactly entails, why companies seek collaborations and lastly what purpose collaboration has.
According to literature (Cao, Vonderembse, Zhang, Ragu-Nathan, 2009), collaboration can be described as:

“An inter-organisational relationship type in which the participating parties agree to invest resources, mutually achieve goals, share information, resources, rewards as well as jointly make decisions and solve problems.” (p. 161).

Although this definition sums up all of the possible attributes, there are many different forms of collaboration, each consisting one or more of the attributes. One of those forms of collaboration is the Triple Helix, which has been described in context of Texperium in the previous subchapter. Another well-known form of collaboration is Business Network Collaboration (Majava, Isoherranen, Kess, 2013). A network is defined as ‘an abstract of a structure in which there are a number of nodes that are connected via specific threads’ (Håkansson and Ford, 2002). In a business network collaboration, these nodes can be seen as a business, and the threads as the relationship between the businesses. These threads can be simple or complicated and can take place on different levels and in various ways (Håkansson, 1997). Companies may have different types of relationships with each other simultaneously. In a research by Majava et al. (2013), an example was given of Apple and Samsung. Both businesses cooperate in component supply, but are direct competitors in the electronics market.

One of the main limitations of business network collaboration is the absence of institutions such as universities or governmental bodies, which were present in the Triple Helix approach (Majava et al., 2013). Another form of collaboration, business ecosystem, does include institutions in their network. A business ecosystem is described as “an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world” (Moore, 1996). Collaborating businesses combine their capabilities and skills around a new innovation: they cooperate and compete to support new products, satisfy customer needs, and finally build succeeding innovations (Majava et al., 2013).

Research on the incentives for companies to actively collaborate have been well documented. Overall, the main insights are that businesses often pursue collaboration for different reasons (Yarahmadi, Higgins, 2012; Goetz, 2010). One of the most prominent reasons are: Resource Efficiency, Cost Reduction, Improvement of competitive position and Risk Management.

- Resource Efficiency: Due to the sharing of knowledge and skills, new innovations are developed. Most of these innovations are based on the notion of resource efficiency. Resource efficiency strives to maintain a products’ quality and functionality, while at the same time reduce the amount of material necessary. Resource efficiency has the ability to enhance sustainability while at the same time reduce the costs of new materials (Cao et al., 2009).
- Cost Reduction: As mentioned above, resource efficiency will lead to lower costs of new materials. But also the costs of innovating are shared with all the companies. Innovations require research, time and materials, all of which costs money. By sharing the resources, knowledge and time, costs regarding creating new innovations are decreased per company (Kumar, Banerjee, 2012).
- Improvement of competitive position: Research by Albino, Dancelico and Pontrandolfo (2009) and Barney (1991) highlight that business collaboration can be beneficial for all companies involved since it improves the competitive position. Collaborations and partnership can be used as vehicles to obtain knowledge that forges new capabilities and that achieve performance improvements (Albino
et al., 2009). New innovations can lead to more resource efficiency and therefore reduce costs and more profit.
- Risk Management: Collaboration often focusses on the development of new innovations, as seen by Texperium. However the development of innovation bring along certain risks, such as failure of innovating. By sharing costs, resources and knowledge, the step to innovating is less risky.
- Another important feature is regarding both the risk management and competitive position. Markets change rapidly, and when a company lacks the newest innovations and technologies, they will become less relevant and oftentimes disappear. Business collaborations thereby will become increasingly essential to both the survival and sustainable growth of a company (Merrifield, 2007).

2.8 Green Business Collaboration
The incentives given above are all focused on improving competitive position and reducing costs. However, environmental incentives are often added from outside pressures. Stakeholder pressure is seen as one of the biggest reasons for businesses to adopt a more sustainable practise (Yarahmadi and Higgins, 2012). Adopting a more sustainable practise is therefore seen as a strategic move, since stakeholders are more and more demanding certain standards. Not complying with certain standards can be harmful for companies, even more so since societal pressure from consumers come in play as well. But also governmental meddling stimulates collaboration. The Paris agreement demands lower emissions and waste and this can only be achieved by lowering the environmental impact of production. Sharing of resources, innovation and knowledge is therefore necessary (Yarahmadi and Higgins, 2012).

Collaboration is not necessarily done for environmental reasons but, as described above, for more efficient and strategic motivations. In literature, environmental collaborations are described in many different terms, each with certain differences. The most used term for environmental collaboration is Green Supply Chain Management. Green Supply Chain Management adopts an environmental incentive throughout the whole entire supply chain; purchasing, manufacturing, marketing, logistics, and information systems (Green, Zelbst, Meacham, Bhadauria, 2012; Ahmed et al., 2018). According to a research by Chin et al. (2015), Green Supply Chain Management is seen as an evolution from standard Supply Chain Management. It was formed because of increased awareness of green practises and, as previously stated, businesses felt triggered to adopt environmentally and ethically responsible measures into their supply chain. Green Supply Chain Management aims to reduce or eliminate the usage of hazardous chemicals, greenhouse gas emissions and waste streams. Thereby, Green Supply Chain Management influences the total environmental impact of any business involved in the supply chain of a product (Chin et al., 2015).

Another term that is often used is Green Supply Chain Collaboration. It emphasizes the collaboration element into the supply chain, which results in; coordination of product development; the exchange of data about demand forecasts and delivery schedules; and sharing cost and other strategic information (Cao et al., 2009; Yarahmadi and Higgins, 2012).

Some businesses do not focus solely on implementing green measures into their supply chain, but adapt a more holistic change into their business. This results in Sustainability-oriented innovation (SOI) (Adams, Jeanrenaud, Bessant, Denyer, Overy, 2016). SOI implies changes to the philosophy and values of a company, as well as to its products, processes or practices. All this to create and realize social and environmental value in addition to economic returns. This way, sustainability is not
something that is product only, but also flows through the company as well. In an interview with Witjes (Interview, 2018), this statement about SOI in relation to CE was confirmed. Witjes states that in order to successfully transition to a CE, circularity needs to become the main priority for businesses. Not just for a few products to build on a greener image, but throughout the entire company.

Within the business collaboration research, there are two relevant theoretical concepts, provided by Yarahmadi and Higgins (2012). Those concepts are the Institutional Theory and the Resource-based Theory. The Institutional Theory proposes that, as previously mentioned, cooperation amongst firms oftentimes arise as a result of compliance with regulations and obtaining legitimacy or credibility from stakeholders (Yarahmadi and Higgins, 2012). The so-called Civil Society, amongst which are NGO’s, interest groups, and society as a whole, impose considerable pressures on firms to rationalise their business and strategic practices and outputs. Companies will have to comply to the societal pressure for the sake of legitimacy. According to Yarahmadi and Higgins (2012) a firm or company may pursue business collaboration, or cooperation with Civil Society groups, to increase its legitimacy as a socially responsible company. The Resource-Based Theory focusses more on knowledge and skills within a company. The theory states that firms can gain a competitive advantage if they possess resources and skills that are valuable, non-substitutable, rare and not imitable by their competitors. These resources consist of “all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness” (Barney, 1991, p.101). Those resources can be divided into two different sorts; property-based resources and knowledge-based resources. Property-based resources are resources such as psychical assets, financial capital and human resources. On the other hand there are knowledge-based resources such as knowledge and skills. Knowledge-based resources are hardly imitable due to knowledge and information barriers. Drawing on the Resource-based Theory, partnerships can be of great influence. The sharing of knowledge, risks, costs, innovations and property-based resources can lead to new business models and innovations (Yarahmadi and Higgins, 2012).

2.9 Business Collaboration in CE

Now that we have described the incentives for business collaboration, it is also relevant to describe the importance of collaboration with regards to the circular economy. This research focusses on the role of business collaboration towards a circular textile industry. According to literature by Witjes and Lozano (2016), collaborations play a key role in the transition to CE practises. In their research, they conclude that “The transition to a functioning CE regime requires a systemic multi-level change, including technological innovation, new business models, and stakeholder collaboration.” (p. 42). As mentioned above, it is believed that a successful collaboration might in fact stimulate technological innovation since knowledge and resources are shared. This innovation is necessary in the textile industry in order to improve the quality of mechanical recycling. Better quality material will result in a better quality product which will possibly increase the use of recycled material.

However, by simply looking at business collaborations, we do not get an answer to the question how that plays a role in the shift towards a circular economy. For that, we have to take an outlook on the theories on CE implementation. What is necessary for a successful transition and specifically what is
needed in the textile industry. Literature provided by Lieder and Rashid (2016) gave insight in the current state of CE implementation and how to succeed this. They provided the following scheme:

![Diagram of CE implementation strategy applying top-down and bottom-up approach]

Figure 6: Proposed CE implementation strategy applying top-down and bottom-up approach. Lieder, M., Rashid, A. (2016).

Figure 6 provides a two-sided approach to achieve successful CE adoption. On the one hand we have a top-down/national effort approach which deals with social awareness and governmental legislation and policies, mostly changes of policies regarding waste (Lieder and Rashid, 2016). On the other hand we have the bottom-up approach which deals with the economic pillar. That is where the role of business collaborations mostly falls into place. Lieder and Rashid (2016) state that a shift towards CE calls for integrative approaches of business models, product design and supply chain and product lifecycle management. A way for businesses to stimulate CE is to create collaborative business models. This can help create multiple lifecycles for a product, since the product assembly is coordinated. This is in compliance with the statements made by Witjes (2018) and the research by Reike et al. (2017). Collaboration and focus on circularity throughout the supply chain, in every design and production process, seems to be the best way to transition towards a CE.

According to Lieder and Rashid, a top-down and bottom-up approach is necessary to facilitate a CE transition (2016). Stakeholders among the whole production chain hold contradicting motivations for wanting or not wanting a CE transition. For businesses, it is currently unfavourable to pursue a transition since competitive pressure makes it harder for them to experiment or change their current practise. Businesses often have a short-term outlook on economic growth, so investing in a long-term, for now costly, transition is unfavourable. In a survey by MVO Nederland, businesses explained that mishaps in the industry still occur due to the low margins on clothing items (MVO Nederland, 2013). Fashion brands are discouraged to increase the price since the consumer demands the lowest price.

On the other side (top-down), societies and governmental bodies are advocating a collective consciousness about environmental issues (Lieder and Rashid, 2016). These groups witness the mishaps and environmental impact of textile production and demand environmental and social improvements. This results in a state that both motivations must become converted, since the ultimate goal is to create a CE that is both economically and environmentally sustainable. Figure 1 also highlights the influence of governance, since both the state, market and civil society provide input towards the collective nexus; the circular economy. As stated earlier, the government
and society do not pressure the market drastically, but regulations do stimulate new innovations and cleaner production.

When combining all of the gathered scientific theories, we come up with the following framework:

![Figure 7: Framework showcasing the influence of business collaborations on CE](image)

This framework gives an overview of the interactions and influences of the multiple theories mentioned. The different incentives businesses have for collaborations creates the collaboration with a knowledge and innovation centre, such as Texperium. The resource-based theory (Yarahmadi and Higgins, 2012) on business collaboration translates into the competitive position incentive, whereas the pyramid scheme from Lieder and Rashid (2016) adds the governmental and societal pressure. From the collaboration onwards, we have the combination of business models, knowledge sharing and supply chain management. Here, the resource-based theory (Yarahmadi and Higgins, 2012) translates into the knowledge sharing, whereas the collaborative business models and product design arises from the pyramid scheme (Lieder and Rashid, 2016).
The business collaboration ideally results in an improved environmental performance, with product design focussed on implementation of recycled materials. This offers a contribution to a circular textile industry.
3. Operationalisation of theoretical concepts

For this research it is important to clearly give definitions of the terms that are frequently used. Those include: Sustainability, Circular Economy, Resource Efficiency, Cradle to Cradle and Recycling. Then, the bottom-up approach from Lieder and Rashid (2016) will be defined more thoroughly.

The premise of this research is to examine the appearance of sustainability and circularity in the textile industry. It is therefore necessary to pinpoint exactly what those terms entail.

**Sustainability:**
In this research, the term Sustainability has been used extensively. Sustainability is known for having multiple definitions, each focusing on a different aspect of the sustainability paradigm. A definition provided by the United Nations describes sustainability as: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations General Assembly, 1987). Three pillars are present that fall within the development; economic development, social development and environmental protection. However, for this research, the social development is difficult to examine. Sustainability therefore will focus on the environmental performance regarding, also called environmental sustainability. The main focus will be on the use of virgin material, chemical use, water use and land use (Ben-Eli, 2018).

**Circular Economy:**
The Dutch government has set a goal that the entire economy must function according to the principles of the circular economy in 2050 (Rijksoverheid, 2016). Although the CE is a popular topic and many businesses claim to work according to the idea of circularity, a clear standalone definition of the circular economy is lacking (Interview Witjes, 2018). What is considered to be circular is different per industry, per product and even per company. In an interview with Sjors Witjes (2018) it became clear that circular economy has become a term that is often used without proper knowledge on the actual meaning and implementation. Witjes states that the circular economy is really only about resource efficiency, and what actually is efficient differs per industry. An example is given for the textile industry where one producer works with a 100% recyclable jacket. The jacket is recycled back to fibre when the quality of the jacket is still relatively good. This way it can be recycled and made into a new jacket without losing quality. This form of circularity of material is however not applicable to every industry and material. That makes formulation of circularity difficult. That is why the main focus will be on resource efficiency.

**Resource Efficiency:**
Sjors Witjes claimed resource efficiency to be the most important factor in CE. A solid definition therefore is important. Material resource efficiency is seen as the process of decreasing the amount of material resources needed to produce one unit of a product (Taranic, Behrens, Topi, 2016). Simply stated “doing more with less” (EEA, 2015). Additionally also reducing the environmental impact of products and services along their entire life cycle (UNEP, 2010), since oftentimes less resources results in lower environmental impact. The most important feature of resource efficiency is value retention (Interview Witjes, 2018). In order to reuse or recycle a material, a certain level of value retention must be occurring, since recycling a product that has low value is not useful. Material recycling falls under resource efficiency since it processes discarded material for new purposes which
means that no virgin materials are needed. In the co-design stage of collaboration, resource efficiency is expected to be prominent.

**Cradle to Cradle:**
In this economy form, the principles of cradle to cradle are very prominent. The basic idea of cradle to cradle is that there is a closed loop from material usage. The output of material throughout the production cycle is used as new resources for other productions. There are two types of cycles distinguishable within the Cradle to Cradle concept; biological and technical. In the biological cycle, the output of material is either consumed or composed to that it still fulfils a purpose. The technical cycle sees the phenomenon of reuse and upcycling of material flows. There is a continuous loop of material flows without losing the quality and without non-used by-products (Franco, 2017). The biggest burden for Cradle to Cradle in the textile industry is the blend of different materials for textile production (Fischer and Pascucci, 2017). According to the principles of Cradle to Cradle, the chemical composition of materials must be controlled in order to ensure material health and the level of toxicity when entering the biological and technological cycles. A blend of materials makes it hard to control these features (Fischer and Pascucci, 2017).

**Recycling:**
As mentioned in the introduction, there are different ways of textile recycling; mechanically and chemically. Texperium has an innovation plant where they do mechanical recycling. With mechanical recycling, old textiles are shredded and gridded so that the fibres become loose. The fibres are then treated into the formation of new yarn which are suitable for the production of new clothing and other textile products. The difference between Cradle to Cradle and recycling is that in recycling there is not necessarily a purpose for the by-products. An example provided by the Cradle to Cradle centre; with the recycling of paper, also comes paper sludge that cannot be used or safely put into our biological system. Incineration is therefore the most used alternative, which does not fit into the cradle to cradle paradigm.

**Bottom-up:**
The framework (figure 1) provided by Lieder and Rashid (2016) gave a distinction between a top-down and bottom-up approach. For this research, we will have an overall outlook on the top-down approach. For the bottom-up approach we will set up a more thorough analysis because the bottom-up is of higher relevance, since this covers the business collaboration feature in a circular economy. The areas covered within the bottom-up approach are:
- Collaborative business models
- Information and communication technology (ICT)
- Product design
- Supply chain

**Collaborative business models:**
Each company has their own business model. A business model can be seen as a strategy on how the company creates value and what their goal is (Witjes and Lozano, 2016). In collaborative business models, the strategies are combined into creating a new interlinked business model where strategies are adjusted to one another.
ICT:
Information and communication technologies play an important role in the supply chain management and business collaboration. According to Soosay, Hyland and Ferrer (2008) the supply chain environment is “characterised by globalisation, increased customer responsiveness, channel integration and advances in information and communication technologies (ICT)” (p.160).

PRODUCT DESIGN:
The product design is essential for a successful circular product. When a product is designed or formed, the disposal or possible recycling has to be taken into account. This creates more possibility for industries to use more recycled materials (EllenMacArthur Foundation, 2017; Witjes and Lozano, 2016). According to Witjes (2018), product design is the most important stage when transitioning to a more circular product. Companies collaborate in order to create a new product, which has to meet certain criteria, one of which can be circularity. A research by Reike et al. (2017) clarified the stages in product design. The most important stages are; Policy, Idea Generation, Strict Designing, Realisation, Evaluation and Reconsideration.

SUPPLY CHAIN:
The supply chain entails every step in the production of a product. A supply chain consists mostly of the following steps: component/raw material suppliers, manufacturers, wholesalers/distributors, retailers and customers (Chin et al., 2015). Environmental improvements are implemented in the supply chain, e.g. in the use of raw materials.
4. Methodology

This chapter will describe the foundation of this research regarding the reality and knowledge. First we will describe the Ontology of this research. What is considered reality and how is it constructed. In the Epistemology paragraph we will discuss the way in which knowledge is formed. In the Data Collection paragraph, the specific methods of data collection will be explained and how this data will be analysed.

Figure eight shows an overview of research philosophy, with the steps of Ontology, Epistemology and Methods present. For every scientific research, it is important to explain the ontology and epistemology since they are considered to be the foundation of a research and in what light a research can be seen. Based upon the ontology and epistemology, the correct form of data collection is derived.

4.1 Ontology
The ontology of a research deals with the nature of reality and what reality is (Lincoln and Guba, 1985). Is reality something that exists, or is it formed by social construction (Hudson and Ozanne, 1988)? This research consists of a case-study that tries to outlay the influence of business collaboration, therefore we assume that business collaborations and their impact are something we can observe. However, since business collaboration are man-made constructs, we do not assume that there is one singular reality that follows the exact same path forever. This research tries to outlay the business collaboration from a single firm, Texperium respectively, and tries to describe reality as closely as possible. This analyses is not necessarily representative of business collaborations in every industry, but the truth regarding the influence of Texperium in business collaborations. This form of critical realism fits within a postpositivist paradigm (Guba and Lincoln, 1994). The postpositivist paradigm assumes a form of reality to exist, but it to be imperfectly apprehendable due to flawed human intellectual mechanisms and the intractable nature of phenomena (Guba and Lincoln, 1994).

4.2 Epistemology
The epistemology of a research deals with knowledge and ‘how do we know what we claim to know”. This research is a case-study that tries to create insight on business collaborations with Texperium. This is done on the basis of scientific frameworks and hypotheses on general business collaborations. These framework and theories are granted to be true and the qualitative data of this research will be analysed on basis of these frameworks and theories. However, interpretation of data is open to subjectivism on behalf of the researchers, since they are aware of scientific theories that might influence the collection of data. Due to this approach, the epistemology of this research can be seen in the light of modified objectivism (Guba and Lincoln, 1994). Modified objectivism asks the
question whether or not we can grasp reality. The assumption is made that it is possible to approximate (but never fully know) reality (Guba and Lincoln, 1994). The goal is to measure whether or not the findings of this research fit into the pre-existing frameworks of business collaboration, and perhaps if this research can contribute to further understanding of business collaboration.

4.3 Data processing

CIRCULARITY

In the beginning of this research it became quite clear that the circular economy is a hot topic, which unfortunately, comes with its’ disadvantages. In an interview with Sjors Witjes (2018), expert on the circular economy field, it was stated that there is a lack of definition on the term Circular Economy and that it differs for every industry and product. The goal of the Netherlands, for working towards a fully circular economy in 2050 was debunked by Witjes, he states that currently, the Netherlands is frontrunner on the recycling of glass, paper and plastic. However those percentages are not close to the 100%. It is simply not possible yet to have a fully working circular economy. This however does not mean that every strive towards a circular approach is worthless. Witjes mentions that there is need for a mindset change, where people who really understand what circularity means are the ones leading projects. The current state is that people call themselves ‘experts’ on circularity, but lack basic knowledge in the complexity of the issue. What they call circular is not necessarily correct, which leads to false advertisement of a product and a not-so circular economy. We need the right people at the right place at the right moment.

This knowledge provided by Witjes has been used for the research on circularity in the textile industry. Partners from Texperium have been interviewed which focus on the role of circularity in their current practise. Witjes mentioned in an example from Aliander, that it is very important that ‘circularity’ needs to be the main priority in business in order to create good results. Therefore the focus of the interviews is on the role of circularity in their current practise.

Data collection

This research specifically focusses on business collaborations and their possible effect on a CE. In order to succeed this research and provide new insights on collaborations within the textile industry, certain considerations have been made on behalf of which aspects to focus on, which form of data to use and what to analyse. These choices will be discussed in this chapter.

As mentioned in chapter two, this research focusses mostly on business management. This means that in order to answer the questions of this research, there will not be done extensive research and analyses on governmental and societal patterns, documents or measures. However, since Lieder and Rashid (2016) proposed that governmental and societal pressure are key factors on reaching successful CE, we do take an outlook on how the governmental and societal pressure is perceived by businesses and if they are of any significance in their management. In chapter two, multiple governmental documents have been discussed in light of the current state of circularity in the Dutch textile industry. These documents provided some background information on how the Dutch government tries to stimulate circularity in the textile industry. For the purpose of this research, there has not been done a detailed analyses on these documents and the direct effects it has had on the Dutch textile industry but more on how these documents are perceived by businesses.
In order to provide data for this research, the main focus was on executing interviews and analysing reports on various projects of Texperium. In order to gather enough data and respondents, emails have been sent to as many businesses that have collaborated with Texperium as possible, since more gathered data means more falsifiability. It was chosen to interview only one employee per business since most businesses were small enterprises and the owner of the business was the contact person. Texperium supported the data gathering by contacting businesses as well. If businesses did not respond to the first email, a second request was put out in order to increase the participation rate. In total, nine interviews have been executed, of which seven with businesses that have directly collaborated with Texperium. These interviews were held in between November 2018 – March 2019 and a list of all the interviewed businesses can be found in Appendix 1. The total of seven individual businesses is on the lower side, however it was found to be difficult to come into contact with businesses that were willing to cooperate with this research and since this research is a case-study focusing on the influence of collaborating with Texperium, there was a limited amount of businesses. That said, the interviewed businesses all belong to different aspects of the supply chain, such as designers, weaving mills and business owners. All together, these interviews create a complete outlook on the influence of collaboration throughout the entire textile supply chain. In addition to these interviews, various progress reports on two large projects were analysed. These projects are Going Eco Going Dutch and BIO2HighTex respectively, which will be discussed in the beginning of chapter five.

Interviews were done in a semi-structured way, since this provided the interviewer the opportunity to ask more questions on certain answers given by the interviewee. The interview guide used for the interviews can be found in Appendix 2. The interview questions used for this research were formulated on the basis of scientific literature, theories and frameworks found in chapter two and three, regarding collaboration and their role in CE. The first questions are focussed on the perceived top-down governmental and societal pressure, since they are fundamental for successful CE (Lieder and Rashid, 2016). Thereafter the question shift onto the collaboration with Texperium, how the collaboration has changed their management and what function Texperium had in their project.

Data collection process

The original approach of this research was to solely interview partners of Texperium and use these results as main source of information. It was argued that the amount of interviews would ideally be around 20. However, due to a low participatory rate, this was eventually changed into interviews and a focus on two larger projects of Texperium in order to generate more data. Reports on these projects and interviews with businesses that participated within these projects have also been used as primary data.

Reasons for the low participatory rate in interviews has not been found. It can be argued that businesses are quite reluctant to share information publicly on their business models and the outcome of their project. New innovations or possible new product development can be considered to be of high value for a business, by openly sharing them they could be harming their own business. Especially since all of the interviewed businesses are considered to be small to medium enterprises, sharing business values and models can be tricky. It can be expected that larger firms are more willing to share their business values and models since they are obliged to publicly share annual reports to their stakeholders. The businesses that were available for interviews were very open about their experiences with Texperium, the role of circularity and their relations to the Dutch
government. The results of these interviews, and thus the questions of this research, will be discussed below.

Since this research is a case study on the influence of collaborations with Texperium on a circular Dutch textile industry, the data is falsifiable. There is a limited pool of actors, and the ones that were available for interviews were interviewed. It gives insight on the motivations of these companies on why they pursue collaboration with Texperium, what value Texperium holds for those businesses and what influence these collaborations had on the circularity of the business.

Data analyses

After collecting as many interviews with individual businesses as possible, the interviews were coded through Atlas.ti. Coding through Atlas.ti has provided a more thorough analyses of the gathered data and is considered to be of higher quality than non-computerised coding. Codes were formulated through the scientific theories given in chapters two and three. Most of these codes are focussed on the pyramid scheme by Lieder and Rashid (2016) since their scheme provided an overall outlook on what is necessary for successful CE and what aspects within business collaborations are crucial and fundamental. An example of this coding is given below:

“A: En uw project met Texperium, was u in dat project onderdeel van een co-design waarin u uw eisen en wensen kon combineren met wat Texperium kon bieden?

E: Ja, ja. Dat ontstond, dat was heel leuk. Maar dat ging eigenlijk een soort vanzelf in het project. Het was, zeker dat project, een mind changer. En niemand wist eigenlijk waar ie aan begon en ik ken het, ik zit ongelooflijk lang in de textiel, ik ken geen situatie waarin zoveel openheid was als in Going Eco Going Dutch. In het algemeen binnen de textielindustrie heeft ieder level zijn kaarten tegen de borst. Dat was nu niet, daardoor ontstaat die co-creatie. Dus niet zo dat het eigenlijk, misschien was er wel een vaag idee, maar dat was nog nooit gerealiseerd. Door de opzet van het project ontstond de co creatie. Een direct gevolg.”

This fragment shows an example of the coding. This fragment focusses on the co-design stage, which is stated to be one of the most important factors in collaborations within CE (Witjes, 2018). The highlighted parts represent the core of the answer given by one of the interviewees. By coding every interview in this way, an overview is created on how every business experienced co-design with Texperium and how it has effected the project and possibly resulted in permanent changes in their management. The same style of coding is done with fragments about e.g. perceived governmental and societal pressure, collaboration incentives and circularity within their business.

Through coding, analysing the role of collaborations with Texperium in circularity was possible. All businesses provided their answers on the semi-structured interviews and with the help of coding, an oversight on the influences of collaboration with Texperium was formed. The coding thereby was not necessarily executed in order to give quantitative data, but to create more clarity. This approach translates into the results of this research being very detailed and elaborate, which enables for a more in-depth outlook on the motivations of business to collaborate, how they experienced the collaboration with Texperium and what changes have been made since the collaboration. With all the answers present, certain similarities and differences were easily determined.

On top of the interviews, multiple reports on the projects Going Eco Going Dutch and BIO2HighTex were used as viable data. They have been provided by Texperium, although some of these reports
contain confidential data. These reports have been analysed using the same key factors of collaboration and circularity, most importantly: knowledge exchange, co-design and innovation.

**GOING ECO GOING DUTCH**

One of the most recent and biggest projects of Texperium was Going Eco Going Dutch. This project revolved around three different objectives regarding the addition of locally sourced natural fibres, in this case hemp and partially recycled denim. Their first objective was to create sustainable textiles, with good quality and to research their environmental impact. The second objective was on eco-design, what principles of design for recycling must be used and for what purposes these materials can be used. The third and last objective was on marketing and branding. Is there a competitive advantage on implementation of recycled and sustainable textiles? Also, how to brand recycling, locality and sustainability in a desirable way (Texperium, Projectplan Going Eco Going Dutch, n.d.)?

The project is considered to be of cross-disciplinary descend, where Texperium, Saxion and Stexfibers represented the knowledge and innovation centres. The manufacturing industry was represented by De Reuver and Van den Acker, whereas regional partners, such as ArtEZ, Gertie Teunissen of Moyzo, Els Bugter of Tous Les Chéris and Annemieke Koster of Enschede Textielstad represented the creative industries (Texperium, Projectplan Going Eco Going Dutch, n.d.).

Going Eco Going Dutch was preceded by a project named Closing the Loop, which focussed on the possibility of creating high quality textiles with hemp and recycled materials such as cotton and wool (Texperium, Projectplan Closing the Loop, n.d.). Going Eco Going Dutch built on this knowledge and added the cross-disciplinary approach and the idea of creating sustainable textiles on a local level with local partners. The project took place over a time period of two years, in which multiple blends of materials were produced in order to create a blend that has high enough quality for marketable product development.

**BIO2HIGHTEX**

The other big project analysed for this research is BIO2HighTex. This project focusses on the implementation of a natural fibre in the production of many different products, and is currently in progress (Texperium, Voortgangsrapportage BIO2HighTex, n.d.). The main objective is to reduce the amount of fossil fuels in several industries and to create sustainable high-tech solutions. The production of locally sourced natural fibre will contribute to economic prosperity in the province of Eastern Gelderland. This project is not solely focussed on sustainable textile production, but also on creating biobased products such as paint (Texperium, Voortgangsrapportage BIO2HighTex, n.d.).

Earlier on in this research, the BIO2HighTex project was used as an example of a Triple Helix approach. In this project, businesses, educational institutes and governmental bodies all work together and offer their knowledge, technologies and finances to complete the project. In this project, the businesses consist of De Berkel B.V. – Gebr. Van der Geest B.V. – Kayser Bedrijfskleding – A.C. Ter Kuile B.V. and Ten Cate Thiolon B.V.. Institutions such as Stichting Wageningen Research, Instituut Wageningen Food & Biobased Research, ROC Twente and governmental bodies Gemeente Almelo and funding from the European Union and OP Oost, the European Region Development Fund (Texperium, Voortgangsrapportage BIO2HighTex, n.d.).

Analysing the project reports was done by highlighting the parts where patterns were found that corresponded with important factors regarding collaborations in CE. An example is given below:
“De bedrijven formuleerden samen de volgende minimale eisen:
- Wasbaar
- Verfbaar en/of bedrukbaar (bij voorkeur met biologische kleurstoffen en pigmenten)
- werken aan verbetering/reductie kreuk x prettig aan de huid, ademend”

This quote shows a clear example of co-design, where businesses demanded certain specifications that the product must entail. This example was used to strengthen the claim that Texperium uses c-design in their projects and that businesses can combine their demands with the possibilities that Texperium can offer.

The analyses of project reports was done after collecting and processing the interviews. This has influenced the analyses of the reports in a way since certain outcomes of the interviews were already formed. Many findings of the report analyses were considered to be of confirmative nature, however they provided additional data as well that was not found in the interviews.
5. Results

This chapter will examine the outcomes of the interviews and report analyses. The sub questions, formulated in the introduction of this research, will be answered individually.

Texperium is an open knowledge- and innovation centre located in Haaksbergen, the Netherlands. It was founded in 2010 as a non-profit foundation with the goal of creating awareness around textile recycling and improving textile recycling in the Dutch textile industry. Texperium specializes in the technological area of mechanical recycling, which consists of the following attributes; sorting, shredding, and spinning of post-consumer textile materials.

The main activity of Texperium consists of collaborations with businesses along the entire textile supply chain; designers, weaving- and spinning mills, suppliers, and fashion brands. Oftentimes, businesses contact Texperium with certain ideas or proposals for a collaborative project. Most projects derive from companies with strong ideals on sustainability and eco-friendly materials. An example of this is the project BIO2HIGHTEX, which is a collaborative project with multiple businesses, foundations and knowledge institutes.

Collaborations with Texperium generally consist of the following factors: Companies mostly get into contact with Texperium since they have an overflow or an abundant amount of waste materials. Since these waste materials do hold value, they want to retain that by recycling and possibly using these materials again. Texperium will first request general meetings on what the company wants, what Texperium wants and what Texperium can deliver with regards to the treatment of the waste flow. Innovating is necessary and encouraged since innovation is key in transforming an industry (Merrifield, 2007). After the innovating process, hopefully a successful product is created. These are manufactured elsewhere, but with the innovation implemented, since Texperium only has a limited test factory. The goal of Texperium is that the innovation and knowledge is spread throughout the supply chain and becomes a standard for the companies involved (Interview Texperium, 2018).
5.1 In what way do businesses perceive top-down governmental and societal pressure regarding circularity?

In chapter two it was made clear that this research mostly focusses on the role of business collaborations in a circular textile industry without focussing on governmental documents and analysing exactly how they are trying to reach the goal of a fully functioning circular economy in 2050. However, the pyramid scheme of Lieder and Rashid (2016) shows that top-down governmental and societal pressure are key factors in successful CE. For this first sub question, we therefore take an outlook on how businesses perceive this top-down pressure and how they possibly stimulate circularity in their business management.

It was found that businesses perceive top-down governmental pressure regarding circularity in the following ways:

- Implementing (soft) measures
- Increasing costs of waste disposal
- Subsidies for innovation projects
- European tenders for addition of sustainable features

According to our interviewees, societal pressure is hardly present. This founding will be discussed more thoroughly below as well.

Implementing (soft) measures
Most of the interviewed businesses explained that they experience no- or hardly any pressure from the government to improve on their sustainability performance. This is because they already work beyond government measures, so any additional measures added by the government do not affect their current practise. This was mentioned by Charlotte Corstanje, studio-advisor for designer Conny Groenewegen, Annemieke Koster, owner of Enschede Textielstad, Els Bugter, owner of baby clothing brand Tous les Chéris, Gertie Teunissen, owner of Moyzo and Gisele van der Star, Head of Sales for designer Omar Munie. The low standard set by the government, and even possible slight improvements on measures, do not effect these businesses since they already apply high standards. Sustainability and circularity are part of their core business approach. For example, designer Conny Groenewegen uses high amounts of discarded materials for her designs, so improved measures on the use of recycled content or ‘sustainable’ materials are not relevant for her.

Increasing costs of waste disposal
The governmental measures are mostly focussed on the reduction of waste streams. By increasing the price of waste produced, the government gives incentives for businesses to look at other options for their waste streams. They seek opportunities to turn their waste streams into valuable rather than worthless materials. In the interview with Giselle, she mentions a project with Texperium and NS, a large Dutch public transportation company. NS chose to renew the blue seating materials used in their ‘sprinters’. This material consists of leather, which holds a large environmental footprint but is also seen as a valuable material. The costs of burning these materials has risen since the Dutch government implemented a price increase. For NS, it therefore became interesting to seek other options regarding their waste streams and to possibly reuse these materials for other purposes. With the help of Texperium, those materials are now used for other functions, such as bags and keychains.

The example given by Giselle van der Star, regarding the reuse of seating materials from NS, is a clear
result of those measures taken by the Dutch government. A large business like NS has a large waste stream, which will result in high costs for waste treatment. Turning those waste streams into valuable products can also be beneficial for the sustainability performance of other larger businesses. The success of this collaboration can serve as an example and inspiration of how to minimize waste streams and perhaps even reduce costs, which is an interesting opportunity for larger businesses.

**Subsidies for innovation projects**

In their projects, Texperium often uses subsidies from local governmental bodies. Since there is hardly any profitability on these projects, these are necessary for continuation of new innovation projects. According to Lieder and Rashid (2016) and Franco (2017) profitability is a pre-requisite for a successful implementation of the circular economy (Lieder and Rashid, 2016; Franco, 2017).

The projects Going Eco Going Dutch and BIO2HighTex are granted with subsidies. Both of these projects collaborate with local governmental bodies that provide financial support. Mostly this is done to stimulate regional economic development, while sustainable development is also an apparent incentive. The importance of subsidies was emphasized by Els Bugter, who explained that subsidies are of utmost importance in innovation projects, since these type of projects often take a long time to develop. If businesses solely have to put in their own time and money, they back out. However not every business was positive about subsidies regarding new innovation projects.

Annemieke Koster said that for her own business, she has never taken any subsidies in her projects. She believes that the whole trajectory for subsidies slows her down since there is a lot of paperwork involved in receiving subsidies. For her, there is enough profitability to not make use of subsidies.

**European tenders for addition of sustainable features**

One way in which the Dutch government tries to stimulate the sustainability in the textile industry is by offering projects and contracts to companies that implement certain sustainable factors (Interview Texperium, 2018). Companies score points by choosing e.g. organic cotton or recycled materials. More points mean more chances of getting the project. This system was mentioned by Peter Kayser, owner of Kayser Bedrijfskleding, who stated that for them, this was seen as a big influence of the government to transition the current industry into a more sustainable version.

However, in the interview with Charlotte Corstanje, this practise of assigning points was disapproved of. She stated that adopting sustainable materials purely for getting a project is not a stable way of doing business. She questions whether the adoption of sustainable materials is thereby genuine or merely for economic benefits. When asked if it does matter if it is genuine or not, she said that it is not a stable way of doing business: ‘one year you might get the project, but other years perhaps not, that is not a stable way of doing business’ (Appendix). A statement by Witjes supports this. He mentions that businesses need to adopt sustainability and circularity as their top priority, or core business value, in order to really create results. Geert Westerhof, team manager Textiles and Fashion of ROC Twente, also mentioned the point-system and how that does not necessarily lead to significant changes. He states that a business must not merely do a project just because they can attract subsidies with it. Subsidies should be an extra, but not a basis for a project. By merely implementing sustainability when it can gain economic benefits, it does not become a core business value and will most likely not create significant results.

The real issue here is that the government does not punish bad behaviour, but only stimulates good behaviour. This way, large companies can still practice their unsustainable way of businesses, since the government does not interfere. A reason for this is that the Dutch government expresses an
open market approach and is afraid that if they implement strict measures, large companies will move away to other countries.

Consumers

In light of the scheme provided by Lieder and Rashid (2016), which proposed a combined influence of governmental and social pressure, we also take a look at the perceived influence of consumers in the textile industry.

Many businesses address the issue of consumers’ values and their conflicting behaviour. According to Annemieke Koster, consumers consider sustainability to be important. However, those values to not necessarily impact their consumption pattern. For many people, textile production is a ‘ver van het bed’ show and the increased price of more sustainable clothing items demotivates people from actual purchase. A statement by MVO Nederland confirms this statement by Annemieke Koster. They state that the Dutch consumer behaves ambiguously, since they do value sustainability to be an important factor in their norms and values, but are not willing to pay a higher price for sustainable clothing items (MVO Nederland, 2013).

This ambiguity makes the sustainable textiles industry a difficult market when looking at profitability. Although not necessarily mentioned in the interview, Giselle van der Star of Omar Munie does confirm this statement. Omar Munie produces two different lines of bags, one made out of high-quality virgin materials, and a line made out of recycled materials. The virgin material line is there to keep Omar Munie a profitable brand. From this information, we can conduct that the consumer desires high quality virgin products over recycled products, and it not yet willing to shift their consumption patterns from virgin to circular products.

Sustainability has also been seen as an added bonus, but not a necessity. According to both Gertie Teunissen of Moyzo and Els Boger of Tous les Chéris, the main focus of consumers are on the quality and look of a product. The fact that their products are sustainably produced is not seen as an incentive. Especially in baby clothing, of which Els Bugter is specialised in, there are many other incentives that play the upper hand, such as functionality, washability and design.

Charlotte Corstanje explains that consumers think within the current framework of the textile industry, and that certain sustainability demands do not contribute to a more sustainable textile industry. This current unsustainable framework is something that will be discussed in more detail later on in this research.

Concluding

It seems that companies that have sustainability or circularity as a staple in their business, do not feel pressured by the Dutch government to improve on their sustainability performance. Companies that work in the more commercial side of the textile industry, that work on a larger scale e.g., do notice pressure or stimuli from the Dutch government. The point-system that increases the change of obtaining a project if a company choses more ‘sustainable’ materials, stimulate companies that previously did not pay attention to sustainability in textiles whatsoever. However, it is stated that this form of business is not stable or reliable.

The CE figure by Lieder and Rashid (2016) showed that for a successful CE, there must be active top-down pressure from society and the government regarding waste treatment in the form of strict
policies and legislation. In the interviews we have seen that the pressure regarding waste treatment is present and that large businesses more often seek other smaller and specialized businesses in order to create new options for their waste streams. However, smaller designers do not experience any form of pressure, and they feel as if the government is not pro-active enough on behalf of sustainability in the textile industry.

In chapter three, it was mentioned that the Dutch government expresses a form of soft-governance where they try to stimulate sustainability and circularity through various programs and subsidies. This form of governance can be welcoming for businesses that are looking to implement their first sustainability measures. However, for most businesses that already implement many sustainability measures, the soft-governance approach is seen as lacklustre and demand a more hard-governance approach were actual results are achieved.
5.2 What drives a business to pursue collaboration within a sustainable textile industry?

As mentioned in the theoretical framework of this research, the incentives for business collaborations have been researched extensively. In the Literature Review, there has already been a chapter on the incentives of companies to pursue collaboration. It was stated that the most frequent incentives are those of; Risk Management, Cost Reduction, Resource Efficiency and Improvement of competitive position (Yarahmadi and Higgins, 2012; Goetz, 2010). Also pressure from governments and societies are part of those incentives. However, these incentives are all conceived through literature studies and those researches where not focussed on collaborations in the textile industry but in industries in general. Since this is a case-study in a niche market for sustainable and circular textiles, the incentives for these businesses to collaborate might differ from the average incentives.

The incentives for collaboration with Texperium are:

- Proper business management
- Economic improvements
- Local partner focussing on sustainability

Proper business management

Many of the businesses expressed the necessity of collaboration for proper business management. In the interview, Charlotte Corstanje stated that collaborations are very important, perhaps even most important, for their business. She mentions the importance of interdisciplinarity in the textile industry and how designers must explore new ways of doing business. Not just looking at designing products, but take an outlook on what consequences these designs might have in other regions of the supply chain. On top of that, she mentioned their incentive to work with Texperium. As mentioned in the first sub question, designer Conny Groenewegen works outside of the set framework in the textile industry and they are looking for partners that work outside of that framework as well. She sees Texperium as a company that tries to break through these boundaries by experimenting with new ways of dealing with textiles and finding a way to make use of discarded materials that still have value. For Conny Groenewegen, the experimental basis of Texperium is very important, but they also mention that they do have a goal of creating an actual product. Not just solely experiment for the purpose of experimenting, but working towards something innovative and new that exists outside of the usual framework. Only then, a sustainable textile industry can exist.

Annemieke Koster also mentioned collaboration to be a key element in her business management. Annemieke Koster is owner of Enschede Textielstad, a sustainable weaving mill, and is always looking for businesses in the region of Twente that focus on textile production and sustainability. In the interview, she mentions that collaboration is very important in her business. She believes that if you try something new, you can never do it alone. You need partners in order to create something new and special. She also likes to keep in touch with her clients in order to create products that her clients desire. She stated that Texperium is not of upmost importance for her company but she does keep an eye out for possible new innovations and techniques that might be interesting for her own business.
Giselle van der Star of Omar Munie explained that a majority of their business cannot exist without collaborating with other businesses, since one of their bags are made out of waste derived from other businesses. Their own high-end line of bags do not generate enough waste for their non-profit recycled bag line, so they need the input of other waste streams. Their collaboration with Texperium is needed based on creating possibilities of using these waste streams in a proper way that they can be used for new bags.

**Economic improvements**

For Peter Kayser, collaborations are mostly done in order to create insight on possible changes and activities in the supply chain. With a pro-active attitude, Kayser Bedrijfskleding tries to actively participate in these changes, with the goal of attracting possible new clients. Collaboration with Texperium can lead to Kayser Bedrijfskleding being a frontrunner on sustainable and circular business clothing. Therefore this collaboration holds an economic incentive which is in compliance with the incentives given in the theoretical framework. Peter Kayser also mentioned a project with Texperium on implementing flax (vlas) as a material for clothing production. Flax is a plant that is grown in the Netherlands, which makes it a local product and it uses far less water than cotton. Flax is, according to Peter Kayser, very well suited for business apparel, but is currently not used as a standard material. By adopting these new materials and innovations, Kayser Bedrijfskleding set themselves apart from other businesses which can results in Kayser Bedrijfskleding becoming a frontrunner on innovative and sustainable clothing management.

**Local partner focussing on sustainability**

For a few companies, the collaboration with Texperium was formed due to it being a local business that had relevance for their business ideals. The project Going Eco Going Dutch was formed with local partners in the region of Twente, which was done deliberately. One of the main goals of the project was to bring local partners together in creating sustainable products (Texperium, Projectplan Going Eco Going Dutch, n.d.). In BIO2HighTex, this incentive is also the case, where the focus was on creating a strong regional industry focussing on bio-based materials with locally sourced materials.

One of the partners of Going Eco Going Dutch was Els Bugter of Tous les Chéris. She highlighted the importance that the project was based on regional textile production. Before this project, she mostly worked with textiles produced in Slovenia, but due to the success of the project, she now also produces her textiles in the Netherlands. Annemieke Koster, of Textielstad Enschede, explained that, if possible, she likes working with businesses and partner within the same region. This way, a network of partners within the same region is formed that collaborate with each other. For Gertie Teunissen, this was also a major incentive. For the production of her fabrics, she likes to work with local partners in order to keep the environmental footprint low. A local partner that has knowledge about sustainable materials and that can offer recycled materials therefore is a good match.

For regional development, especially in a region with a history in textile production, these collaborations form a strong standard on behalf of sustainability. Texperium often works with Saxion Hoogeschool and Deltion, all of which are schools and organizations within the region. In an interview with Geert Westerhof, Teammanager Fashion and Textiles of ROC Twente, he explained what roles educational institutions have in collaborations. They support the projects with knowledge, skills and students who will participate within these projects. ROC Twente focusses on sustainability throughout their fashion and textiles programs, which familiarizes the theme with the students.
Sustainability will then not be an afterthought but a basis of doing business in the fashion and textile industry.

Concluding

In the beginning of this research, many incentives were given for business collaborations. Multiple of those incentives were given in the interviews, such as; profitability, competitive position, knowledge sharing. However, there were also incentives that were unique, probably due to the niche market of sustainable textiles. Conny Groenewegen works with Texperium because of their ability to recycle and reuse textiles, but also because they share the same values on the framework of the textile industry and how they want to change the current. The incentive given by Giselle van der Star of Omar Munie, which focussed on using other businesses’ waste for their own products, was a clear example of a special incentive that ties well with the goal of the government on reaching a fully working circular industry in 2050.
5.3 What is the relevance of a knowledge and innovation centre, such as Texperium, in business collaborations?

The most important factors of CE in the textile industry that Texperium contributes to, are the following:

- Co-design
- Improvement of quality recycled materials
- Increased use of recycled materials
- Transparency in the supply chain
- Possible profitability
- Triple Helix

Co-design

One of the most important factors that can contribute to a circular textile industry is the co-design of a product. According to Witjes (interview, 2018), a co-design stage is the key element in turning the current textile industry into a circular version, which was confirmed by Lieder and Rashid (2016), with their pyramid scheme on CE. This importance of co-design has been adapted into the interview, which resulted in the following outcome. Most businesses confirm that there was definitely a stage where they combined both of their business models and worked together to create a product that all businesses felt content with. The wishes and demands of the business was easily combined with the goals and possibilities that Texperium has. This was mostly focussed on the possibility of being able to work well with the presented material. For example the collaboration with Omar Munie, who dealt with the waste streams of NS. The provided materials are difficult to use, however Texperium was able to deliver the desired process and resource.

Going Eco Going Dutch had co-design as one of the main aspects of their project. Their objective was to create sustainable textiles that were suitable for many different textile products. Examples are baby clothing, haute couture, confection and interior purposes. This multifunctionality of a material is only reachable when all partners state what their wishes and demands are for the material and which features it must contain. In the co-design stage, the following measures for the textiles were formulated:

- Good washability
- Paintable and/or printable (preferably with natural dyes and pigments)
- A reduction of wrinkles in the textiles
- Breathable

Also during the project, the demand for the following attributes were formulated:

- The ability to develop jersey, which necessitates a thin thread.
- To further develop and evaluate the anti-bacterial and anti-UV character of hemp fibre.
- Implementation of elastane to increase the dimension stability, which means increasing the resistance against moisture and other external influences.

(Texperium. Projectplan Going Eco Going Dutch, p. 4, n.d.)
Another prominent factor in Going Eco Going Dutch was the development of products that were designed for proper recycling, this is called design for recycling (Interview Texperium, 2018). As mentioned in the introduction by the Ellen MacArthur Foundation, in most textile products, the afterlife of a product is not taken into account (2017). With design for recycling, the entire lifecycle of a product is taken into account, whilst also ensure good wearability during the consumption of the item. This enables extension of the life-cycle of a garment up to four times in which materials are re-utilized (Teunissen, Grevinga, Brugeman, 2018). Design for recycling has a lot of similarities with what Lieder and Rashid were discussing in their CE scheme (2016). In their bottom-up approach they highlighted the importance of ICT (Information and Communication Technology). They stated that for proper recycling and remanufacturing, a ‘product passport’ could be assembled that should detail what components and materials are used and how they can be disassembled and recycled at the end of a lifecycle (2016). According to Teunissen et al. (2018), Going Eco Going Dutch provided the possibility of co-creation that enables optimal recycling and upcycling, which is crucial in the transition to a circular textile industry.

For Gertie Teunissen of Moyzo, the co-design stage was considered a difficult process. Their project revolved around the addition of a natural fibre that hold a smaller environmental footprint than other natural materials. However, correct implementation of this fibre was difficult to execute. According to Gertie, there was not really space for co-design, but rather a full focus on creating a fabric consisting of this natural fibre and that is suitable for creating a good product. However, she stated that Texperium did provide a lot of knowledge about design and recyclability. She eventually created a clothing collection that was fully circular and a collection that was fully recyclable.

The experiences regarding co-design seem to differ per business. Within the same project, Els Bugter of Tous les Chéris was very positive about the co-design in their project. She stated that co-design was not necessarily the main focus of this project, but rather formed naturally, since all of the partners involved in this project were very open about their businesses and how they worked. This made co-creating a very natural and important factor in the project.

Within BIO2HighTex, co-design has also been a prominent factor. Within the collaborations with Texperium, the main focus was on creating a blend consisting of flax and polyester that would create a strong enough material for production. One of the partners, Gebr. Van der Geest B.V. stated their desire to also implement post-consumer denim into this blend, which was then tested by Texperium as well. In a later stadium, Texperium also experimented with Ten Cate B.V. on implementing post-consumer fibres for slope covering. With each collaboration, Texperium and the concerned party discuss what features the produced textiles must contain. For each business, these can vary since different industries require different features (Texperium, Voortgangsrapportage BIO2HighTex, n.d.).

Within BIO2HighTex, Texperium worked together with ACTK, De Berkel B.V. and Kayser Bedrijfskleding on producing textiles suitable for chef’s clothing and other functions within the catering industry. Activities within this collaboration consisted of technology development for the sealing and assembly of the textiles. Afterwards, samples were tested on quality and functionality (Texperium, Voortgangsrapportage BIO2HighTex, n.d.).
Improvement of quality recycled materials

Many businesses emphasized the importance of quality in their product and how recycled materials currently cannot measure up to the desired quality. This has been confirmed by the Ellen MacArthur Foundation, who, as previously mentioned, stated that the current technology cannot obtain the same quality with recycled materials as it has with virgin materials and sees the improvement of recycling techniques as one of the most important factors in stimulating a circular textile industry (2017).

Texperium has quality improvement of recycled post-consumer textiles as their main focus point, which can be seen in every project and collaboration. As mentioned before, the projects Going Eco Going Dutch and BIO2Hightex both revolved around the implementation of a new virgin material in combination with a blend of recycled materials. The goal was to create textiles with locally produced natural materials and recycled materials. In order to come up with the highest quality textile, Texperium has to experiment with different blends of virgin and recycled material, whilst also ensuring that the produced textile is indeed more sustainable than conventional textiles.

In BIO2HighTex the main focus was on finding the right balance between flax and polyester that resulted in a good quality, while at the same time ensuring the percentage of flax to be as high as possible. In the beginning, the plan was to create textiles consisting of 33% hemp, viscose and polyester. However, since there are not hardly any quality standards on hemp fibres, this idea was scrapped. Then flax was chosen as replacement of the natural fibre. In the beginning, samples were made consisting 70% flax and 30% polyester, however it was found that the machines are currently not able to produce textiles of high enough quality with these materials. This example goes to show that the projects often take a long time, in order to develop a blend of materials that are more sustainable and are of the same or higher quality as regular textiles.

Peter Kayser, of Kayser Bedrijfskleding, explained that they are looking for quality in a product. When a product is fully circular, or made out of recycled material, but has a low quality, it does not have the preference. They rather implement other sustainability measures in their clothing production, such as organic cotton or cradle-to-cradle techniques. The same incentive was given by Gisele van der Star, Head of Sales of Omar Munie. She explained that they have two different collections of bags. One consists of high quality, virgin materials such as leather, while the other is a non-profit line consisting of recycled materials. When asked why this division is made, she explained that currently the level of quality for high-end bags cannot be reached with recycled materials and that, in order to be a profitable company they have to offer these virgin bags.

Giselle van der Star also mentioned in her project with NS, that large companies do want to improve on their sustainability performance and minimize their waste streams, but they do not want to put in a lot of effort to reach that. Other businesses therefore have to make it easier for them to implement changes in their waste streams. By providing the innovations Texperium has created, the improvements become easier to execute and thereby improving the sustainability of a company.

Increased use of recycled materials

Since quality has been mentioned to be very important to many businesses, the quality of recycled material must be optimized in order to stimulate the implementation of recycled materials.
Gertie Teunissen expressed that since her collaboration with Texperium, circularity became a more important feature in her business. She stated an interest in creating a private recollection of her clothing for recycling, and reusing these materials for new clothing production. However she stated that her customers oftentimes wear the product until there is such a low value that recycling is not possible or desirable. This brings us back to the statement made by Witjes on Resource Efficiency and in particular Value Retention. For proper recycling and to enable good quality circular products, the value of the material must be taken into account. By wearing the product to its full potential, the material value gets lost which hinders recycling.

Both Annemieke Koster and Charlotte Corstanje state that circularity does not yet necessarily equal sustainability. If a product can be produced that is 100% circular, but that is not as sustainable as a product with (a blend of) virgin materials, they will choose the latter. Sustainability is the most prominent factor and driver in these companies, and when a circular product is less sustainable, with regards to water, energy and chemical use e.g., it is not desired. This raises the question whether striving towards a fully functioning CE is desirable even if it might not be as sustainable as combining recycled and new virgin materials? New and improved innovations have the possibility of making recycled products more sustainable in every way than virgin products.

Transparency in the supply chain

In the interviews, it was also asked how much contact they have with other businesses in the supply chain. Most businesses answered that they have contact with almost every player in the supply chain, since they mostly work within the Netherlands and thereby have direct connections. There is oftentimes no presence of outsources practises with subcontractors in other continents. This makes the collaboration and communication very clear and transparent. New technologies and innovations thereby have a greater chance of being adopted or executed. This creates a further spread of innovations and most likely an increase in the use of recycled materials, even in businesses that do not have a direct connection with Texperium. Having Texperium in your network enhances the sustainability of the whole supply chain on a larger scale. Many of the interviewed companies state that they have implemented, or are planning on implementing, the knowledge and innovations permanently which are then used in future collaborations as well. This results in the spread of innovations, knowledge and eventually enhances the environmental performance of the textile industry.

The creation of transparency was an important incentive in the project of Going Eco Going Dutch. The goal of Going Eco Going Dutch was to create textiles made from locally produced materials, but also to create more transparency in the entire supply chain, since the materials were produced and manufactured in the Netherlands. Oftentimes, textiles are produced outside of Europe, where transparency lacks, due to the physical distance as well as corruption. By producing and manufacturing textiles in countries with strict laws and regulations, more transparency in the supply chain is created.

Transparency is not only desired for social reasons. Many designers address the issue that it has become more difficult to have close contact with textile producers in order to discuss quality of the material, how it feels and what specifications are desired. Going Eco Going Dutch aimed on creating more transparency for both social and communicational improvements.
Possible profitability

The influence of Texperium does not only result in an improved environmental performance, but can also stimulate the profitability of a business. In the beginning of these results, the point system regarding project assignment was introduced and discussed. For Kayser Bedrijfskleding, using more sustainable alternatives, some of which Texperium offers, can result in obtaining of a project and thus in more profitability. Another factor deals with market performance. Businesses that have collaborated with Texperium often state that they do share their knowledge and innovations with other partners in other projects. This makes them attractive to work with, since these new innovations are oftentimes new and an improvement on the old situation regarding e.g. the quality of recycled materials. These innovations and skills set them apart from other businesses that work in the same realm and therefore can stimulate possible business collaborations. This incentive has been mentioned in the theoretical framework of this research, where Merrifield (2007) mentioned this as a key factor in incentives for collaboration. They even went as far as to state that businesses that do not participate in business collaborations will eventually become irrelevant due to a lack of implementing innovations.

The project Going Eco Going Dutch also held economic incentives. It is argued that the visual identity of the textiles, in this case hemp, can be seen as a form of sustainability, namely aesthetic sustainability (Harper, 2017). Brand owners have a clear story on where the materials were sourced and manufactured, which is argued to be of importance in design and branding strategies (Chapman, 2009). Chapman even goes as far as to argue that sustainability is more of a behavioural issue rather than economic or technological. He proposes the idea of emotionally durable design, which focuses on creating a bond between designers, consumers and their products, realizing a longer life-cycle and a decrease in consumption (Chapman, 2015).

When reflecting on the theoretical framework provided earlier, the resource based theory introduced by Yarahmadi and Higgins is of great value in collaborations with Texperium. This theory proposes that firms can gain a competitive advantage if they possess resources and skills that are valuable, non-substitutable, rare and not imitable by their competitors. Technological improvements and obtained knowledge can improve the competitive position of a company. Texperium is a knowledge and innovation centre, so collaborations with Texperium generally consist of vast information exchanges. Businesses can use these new skills and knowledge for future collaborations.

Triple Helix

In various projects, Texperium has worked with different types of businesses and organizations. Those consist of businesses along the entire textile supply chain, but also educational organizations. In the theoretical framework, the concept of Triple Helix was introduced and discussed. Many of the interviewed businesses have experience with this concept since the project often involved multiple parties. The interactions and collaborations between businesses, institutions and governmental bodies result in the exchange of skills and resources. Gertie Teunissen of Moyzo, explained that she learned a lot from the students that worked together with her in the Going Eco Going Dutch project.
Concluding

In conclusion, it can be stated that Texperium holds a large relevance for the improvement of sustainability and circularity in a company. Texperium is a knowledge and innovation centre that is focussed on improving the quality and possibilities of recycled materials, therefore stimulating the use of recycled materials for companies that are looking for quality. For the transition to a circular textile industry, it is of upmost importance that the quality of recycled materials will improve and that companies are stimulated to make use of these materials.
5.4 What is currently the biggest obstacle for creating a circular textile industry, and what is needed to combat this?

As this research has clarified, the current linear take-make-waste approach in the textile industry brings multiple different threats to the environment and society. The difficulty of changing the current state lies in the textile industry remaining a profitable industry, as named an important factor by Lieder and Rashid (2016), while at the same time changing the current approach into a more circular version. It is interesting to see what challenges businesses face and what businesses see as big opportunities that can change this current approach into a more environmentally and socially friendlier version. The changes differ per supply chain actor, since all of the companies work in a different part of the supply chain.

The main recommendations are:

- Changing the pace of textile production
- Interdisciplinary approach
- Create a profitable market surrounding recycled textiles
- Knowledge spreading

Changing the pace of textile production

Annemieke Koster pleads for a total holistic change of the current practice. The take-make-waste linear approach is not sustainable and by implementing more sustainable measures in an unsustainable approach, you will never reach proper results. The whole industry needs to be changed. Something that is also addressed by Charlotte Corstanje. Charlotte mentioned that they do not support so-called ‘green fashion’ since that only provides a slight improvement, but still works within a non-sustainable industry. Fashion brands and retailers that implement more sustainable measures, still work according to the current system with the same focus on sales, price and efficiency. She calls for an industry change where there is a shift in framework. The current industry is not sustainable so a new approach to look at textiles in a new and different way is required.

Interdisciplinary approach

Interdisciplinarity is seen as an important factor in changing the current industry. A designer must not only look at their own framework, but break consisting boundaries. Charlotte Corstanje states the following:

“It is important that different industries come together. Not just a designer that stays in their familiar framework, but one that opens up boundaries with different industries such as product developers or even waste disposal centres.”

By working interdisciplinary, existing frameworks are broken which enables new forms of doing business, such as a focus on creating circular products. The current textile industry is focussed on high production and sales. New forms of business has the possibility of changing the current rhythm. Charlotte Corstanje also mentions the importance of time, time to develop and what time it costs for a product to be made and to break down. Many businesses do not take the time it needs to look at
alternatives, a new system or new innovations. Things have to go fast, time is money and money is power.

Create a profitable market surrounding recycled textiles

Another shared topic is the idea that many businesses believe that recycled materials are more expensive to make and buy, which hinders the use of it. Gisele van der Star states that in her project with NS, NS stated that their partners were concerned that implementing circular measures costs a lot of money. However, as Giselle stated, they can also save a lot of money by reducing the amount of virgin materials needed for production. This way, implementing your own waste as a new resource can be seen as an investment rather than an expensive way of treating your waste.

Geert Westerhof also mentions the importance of price. For many businesses, the consideration of implementing sustainability measures, is solely focussed on the profitability. If a product is more expensive when using recycled materials, many businesses will use cheaper materials, since a more expensive product will oftentimes result in a lower revenue. This is in compliance with a statement by Els Bugter. The current textile industry, and especially the fashion industry, is focussed on large volumes with low prices, and thus small revenue per item. In order for fashion brands to turn profit, they must produce and sell large volumes. According to Els Bugter, the biggest opportunities lie in tackling this process of fast fashion. Fast fashion characterizes itself with poor quality virgin materials, which as a result stimulates the purchase of more cheap clothing. The government can act as a leader and prohibit or fine businesses that offer poor quality materials.

Knowledge spreading

The government should be more active on spreading knowledge to consumers on the environmental impact of textile consumption. According to Geert Westerhof, many people do not have the proper knowledge on how unsustainable clothing is, how they can implement sustainability in their consumer behaviour and where they can find sustainable products. By teaching students the importance of sustainability in the textile industry, Geert tries to bring awareness to the students, who then spread this knowledge in the field. Sustainability will then not be an afterthought, but something that lies on the basis of proper textile business.

Peter Kayser, owner of Kayser bedrijfskleding makes a statement on the lack of collection locations for business apparel specifically. Regular textile collectors are not suitable for business apparel since many of them contain logo’s. The discarded clothing is treated as waste since proper collecting is not present. Oftentimes smaller companies are influenced by this shortage of business apparel collectors. Large quantities can be recycled by e.g. Frankenhuys in Haaksbergen, but for small businesses with a limited amount of clothing, the options are very limited. In order to fix this issue, there needs to be a change in logistics when it comes to clothing collection.

Concluding

Some of these ideas are grounded by theories or have a clear practical way of implementation, but the holistic changes of the textile industry require more thorough definition, since we already deal with sustainababble (Engelman, 2013). It is remarkable to see that there is no clear consensus on which party (state. market, (civil) society) holds the biggest responsibility regarding the transition towards a circular textile industry. Some businesses explain that the market holds the responsibility since they hold the tools to create more transparency in the supply chain but do not fully execute
these tools. For the consumer, it therefore is difficult to determine which e.g. fashion brand is ‘sustainable’ and what that exactly entails. Some businesses however state that the consumer is very powerful and if they demand certain sustainability measures, the market would simply have to follow. The reality is that most consumer purely focus on the price of the product and not on material use, sustainability or perhaps even circularity.
6. Conclusion

The goal of this research was to appoint how business collaborations can contribute to a circular Dutch textile industry, especially collaborations with a knowledge and innovation centre, in this case Stichting Texperium. The main question of this research was: How can business collaborations, particularly those with innovation centres, contribute to a circular textile economy? In the theoretical framework, an outlay on business collaboration in circular economy was created. The pyramid scheme by Lieder and Rashid was used as a foundation on what is needed for a successful circular economy which proposed a combined top-down and bottom-up approach. Therefore, this research discussed the top-down approach briefly as well.

Top-down pressure

In the CE scheme, it became clear that there were two large players in a top-down approach that had relevance for a successful circular economy; government and society. In the scientific background, it was mentioned that the Dutch government was not active on creating the foundation for a circular textile industry and was not pressuring businesses enough on behalf of their sustainability performance. Their main focus was minimizing waste streams and stimulating sustainability by giving subsidies, but not discouraging businesses by giving fines or strict sustainability measures. This statement was backed up by the qualitative data. Most of the interviewed businesses expressed their disappointment in the presence of the Dutch government. They did not perceive any pressure on improving their sustainability performance, so they did it voluntarily. This however means that, according to the scheme by Lieder and Rashid (2016), a fully working circular economy is not yet achievable. The Dutch government has many opportunities to improve the circularity and sustainability in the Dutch textile industry, by spreading knowledge to consumers and by increasing the pressure on businesses to improve their environmental performance.

The bottom-up approach was explained to be of most importance for this research, since this is the area in which Texperium partakes. It was found that collaborations with Texperium contribute to a circular Dutch textile industry in the following ways:

Co-design and collaborative business models

Scientific research and an interview with a Circular Economy expert pointed out the importance of co-design in business collaborations. It even has been stated to be one of the most important aspects in a transition to circularity in any industry. It was found that in past and present projects, Texperium has been very active on co-designing and co-creating products. In Going Eco Going Dutch, the co-design translated to the formation of textiles that would work both for confection, haute couture, baby clothing and interior purposes. The collaborating businesses all had their say in what measures these textiles had to consist of, and what purposes it must be able to execute. This communication and transparency is very important to stimulate the implementation of more sustainable and circular textiles, since quality of textiles is of upmost importance for many of the businesses.

However, the scale of circular textiles implementation is rather small. For many businesses, especially fast-fashion clothing businesses, money is the most important driver. Choosing recycled textiles for their product might increase the price per item, which then results in fewer sales and less profit. Consumers tend to care about sustainability in some way, but actual behavioural changes are yet to be seen. Many businesses therefore play it safe and offer virgin materials at a low price, with
its corresponding environmental impact as a consequence. Small businesses, which were the main portion of collaborators with Texperium, can more easily choose circular or sustainable approaches since they conform to the niche market of sustainable textiles. There are consumers that consider sustainability to be important and are actually willing to pay more for recycled and more sustainable textiles. It is a hopeful sign that more and more textile and fashion brands are open to offer more sustainable options, such as Kayser Bedrijfskleding.

SUPPLY CHAIN

The pyramid scheme also pointed out the importance of a clear supply chain. Transparency and control in a supply chain is of importance in order to guarantee that products are made in accordance to the standards demanded by a business. The partners of Texperium often have a great outlook on the supply chain since they are mostly small and local businesses. They produce their clothing in the Netherlands or somewhere in Europe, with transparent production cycles. The projects Going Eco Going Dutch and BIO2HighTex added on this by developing textiles made from local materials. By working with local business that produces, processes and manufactures the textiles, the whole supply chain consist within the region of Twente. This results in a supply chain that is both socially and environmentally preferred in contrast to the worldwide supply chain with large scale exploitation, environmental issues and lack of transparency.

The only issue was found on the scale of production. Since Texperium only has a test factory, production on a larger scale is outsourced. For some businesses that was seen as a disadvantage since they like to stay in contact with all the actors in the supply chain.

KNOWLEDGE SPREADING

Another important feature of business collaborations is the exchange and spreading of knowledge and skills. For the transition to a circular textile industry, it is important that new technologies and knowledge regarding design for recycling and the environmental impact of materials is spread with businesses throughout the entire textile industry. It was stated by many businesses that they implemented their gained knowledge in future projects and that they more actively make use of recycled content in their products. For example; Although Omar Munie already had a sustainable/circular bag production, the collaboration with Texperium enabled Omar Munie to work with NS and recycle their seating materials for use. New technological advances were created that made recycling of these materials possible. According to the Ellen MacArthur Foundation, innovations are one of the most important drivers for increased textile recycling. By spreading new technologies, the amount of recycled textiles can be increased.

The fact that Texperium and their partners score well on behalf of the factors provided by Lieder and Rashid (2016), makes it so that the bottom-up collaboration portion is well present. Texperium is a business that is well capable of providing the knowledge and resources necessary for businesses and a successful collaboration. It can only be expected that in the future, with help of partners and businesses, the technological innovations for textile recycling will improve. Thereby furthermore stimulation the adoption of recycled textiles for many more businesses.

A clear vision on what can further improve the implementation of circularity in the textile industry is yet to be formed. The interviewees all came up with different aspects of the textile industry that needs to change in order to facilitate a circular transition. However the most prominent aspects were
on the notion of price and time. Businesses must adopt a long-term vision that is not solely based on money and profitability on the short-term but also to take into account the changes and challenges on the long-term.

All in all, it can be concluded that Texperium holds a large relevance and importance in the bottom-up approach for a successful circular economy. By providing businesses with new technologies, knowledge and skills, Texperium spreads the ideals and possibilities for a circular textile industry. However, the adoption of circular/sustainable measures mostly exist in small to medium enterprises, while the biggest improvements can be obtained with major brands adopting circular measures. One way in which that can be achieved is by increasing the role of the Dutch government in pressuring large businesses to improve on their environmental performance, a top-down approach as described by Lieder and Rashid (2016). Unfortunately, the role of the Dutch government is currently not efficient enough for a successful circular economy since strict measures are not present. They have formed ambitious plans and programs to stimulate recycling and resource efficiency, but fail to successfully execute these plans. If the Dutch government wants to stimulate the transition towards a circular economy, it must come up with stricter laws, since the textile recycling innovations are showing signs of feasibility.
7. Discussion

As with every research, certain choices were made that lead to the outcome of this research. Those choices are discussed in this chapter, where possible alternatives are brought up for future research regarding CE in the textile industry.

In order to successfully execute this research, certain assumptions had to be made. The research question assumes that business collaboration can stimulate the transition to a circular economy and it tries to provide insight in how it exactly does this, especially in the textile industry. Besides that this research also assumes that a circular economy is per definition better than the current linear economy, however in reality this depends on many different factors such as energy use, water use and chemical usage. For the sake of not overcomplicating this research it is assumed that a circular economy is desirable and beneficial for the environment and society.

Participants

As previously discussed, this research did not manage to generate enough data, a.k.a. interviews, in order to create falsifiable data. Only seven participants were willing to share their incentives and experiences with the collaboration with Texperium while a multitude of that were contacted for possible data gathering. A reason for this is not clear, but it can be argued that businesses are not open to share their business models, or do not have the desire to explain their decisions regarding sustainability and circularity. Due to this low participation, the outcome of this research is regarded as not being fully reliable and representative for a broader context of business collaborations and their influence on a circular economy. However, the outcome of this research is useful for Texperium, since it maps the incentives and experiences of their partners. Texperium can use these outcomes to strengthen their position and can elaborate on why they are an important player in the Dutch textile industry, especially as a party that can improve the environmental performance of many potential businesses.

The partners of Texperium were all very active on behalf of sustainability and circularity respectively. This gives a biased view of the influence of Texperium on sustainability and circularity in the Dutch textile industry, since many businesses were already performing well and companies that show no interest in sustainability and/or circularity do not participate in this kind of business/green collaboration. The businesses that were open for interviews were mostly positive about Texperium and the knowledge and resources provided. It may well be possible that many businesses do not experience the collaborations that positively and find Texperium and their influence to be underwhelming. However, they might not be willing to express this over an interview. Since the companies that did participate, already expressed involvement in sustainability practises, the actual influence of Texperium is hard to determine. Future research may perhaps focus on businesses that are new to sustainability and circularity measures. By analysing the new and old situation, the effects of collaboration can more easily be determined.

Another improvement can be applied on the scale of this research. All of the businesses and educational institutes were located in the Netherlands, while the textile industry partakes on a global level, with many larger businesses outsourcing their production to low-wage countries. Focussing on the Dutch textile industry therefore can be seen as a niche market, missing the bigger picture of the global textile industry. For a broader answer on the general influence of business collaborations in the textile industry, more data needs to be gathered and analysed. Preferably bigger companies that
work on a global level are to be analysed, since the largest improvements can be gained by improving the environmental performance of key players in the textile industry.

**METHODOLOGY AND RESEARCH PHILOSOPHY**

This research has been approached as a qualitative case-study research, meaning the data would be consisting of in-depth interviews. However, for a proper outlook on the influence of Texperium on the environmental performance of a business, quantitative data should also be taken into consideration. Businesses can claim that they implement certain new innovations or are pro-active on sustainability, however answers like these are not fully reliable. Socially desirable answering of the questions has to be taken into consideration. This means that a business can state they are very sustainable, but in reality this might not be the case. Quantitative data can act as a measurement for these claims.

The focus in this research was on business management and not on the role of governmental policies and consumers in the shift towards a CE. It was chosen not to analyse governmental documents or interview consumers regarding their view on sustainability in the textile industry, but rather to highlight how governmental and societal pressure is perceived by businesses. New research can focus on governmental and societal pressure since they are regarded to be important in successful CE.

The data collection has been done through voluntary interviews. The interview questions were derived from the theoretical background provided in this research. This means that questions might be biased an hinting towards certain patterns that are created in the theoretical framework, while in reality perhaps other theories take the overhand. The interviews were semi-structured which resulted in some freedom in questioning. Some businesses were more open than others, which can result in some important knowledge not being mentioned.

The pyramid scheme, provided by Lieder and Rashid (2016), was used as a foundation in this research. Although the pyramid scheme is considered to be of high quality and scientifically profound, it has inspired certain questions used in the interviews, and in the analyses of the data. As a results, most answer has led to answering the questions in regard to the factors provided in the scheme. However, there are many more theories and schemes regarding circular economy, that can possibly lead to different questions and answers. Thereby leading to a different outcome.

The role of the researcher has been of influence on the collection and analyses of the data, since the researcher is not totally unbiased. As argued in the Methodology chapter of this research, the research has a post-positivist view, which translates to a form of critical realism. The truth is not something that can fully be grasped, but we can get close. Other research philosophies can also be used for this research, one that focusses on realism that uses quantitative data instead of qualitative.
8. Recommendations

The set of recommendations will fall in all three of the pillars of the Triple Helix and Governance; namely governmental, institutional, societal and economic recommendations.

**GOVERNMENTAL**

This research has highlighted the current situation of textile recycling. It was made clear that the Dutch government lacks dedication and adequate measures to stimulate the textile recycling industry. The Dutch government only wants to stimulate businesses to adopt sustainability measures by providing subsidies or projects with sustainable factors. They are afraid that harsh measures will negatively impact the industries, so they come up with initiatives and programs that do not show enough results. This is called soft governance (Steurer, 2013; Maggetti, 2015). A form of governance which involves non-binding rules and measures that tries to create, in this case environmental, improvements. A more efficient way would be to set up strict measures regarding textile recycling and fining businesses that do not adopt these measures fast enough, this is called hard governance (Steurer, 2013; Maggetti, 2015). By leaving the sustainability and circularity transition up to the market, the government pulls their hands away from the issue. However the market transitions slow and is largely focussed on short-term profits, therefore the environmental impact of textile recycling will likely not change over the following years.

**ECONOMIC**

For the market to adopt recycled materials, there needs to be an increased quality and a decreased price of recycled content. According to many of the interviewed businesses, there currently is no viable revenue model on offering recycled textiles. The quality of mechanical recycling is still inferior to chemical recycling and virgin materials, and using virgin materials is also often cheaper. Innovations on behalf of mechanical recycling are therefore recommended and necessary in order to stimulate the usage of recycled textiles. Local governmental bodies already stimulate regional innovations by assign subsidies. In order to stimulate the innovations of textile recycling even more, it is recommended that major fashion brands and larger governmental bodies also assign subsidies and financial support to innovation centres, so that these centres can upscale the innovation processes. Financial support is one of the most important factors on improving mechanical recycling innovations.

Better textile collectors, primarily those for business apparel can contribute to an increase in textile recycling, since most of these items are landfilled. However, an increased textile recycling is dependent on supply and demand. If a self-sustaining and profitable supply and demand is not present, more textile collectors are not necessary. The most important factors are quality and price of recycled textiles.

**SOCIETAL AND INSTITUTIONAL**

One of the factors that hinders the implementation of recycled textiles, is the knowledge gap of consumers. Most consumers do not take sustainability into consideration when buying clothes and other textiles. According to Geert Westerhof, this knowledge gap can be decreased by governmental projects that focus on addressing the environmental issues of textile consumption. Another way of
spreading knowledge about sustainability in the textile industry is through education. Geert Westerhof works at ROC Twente, where sustainability is one of the core factors in their fashion and textiles education. By making sustainability a standard in textile studies, it will more likely be perceived standard in the actual textile industry when the students will work. Not every university adopts this vision of sustainability, however it is recommended in order to make sustainability a core element in textile businesses.

Some businesses stated their disappointment in the production scale of the developed textiles. Since Texperium has a test factory and not a fully equipped production factory, the actual production of textiles is outsourced to a larger factory. For small businesses it would have been easier if Texperium could fully produce the product, since the outsourcing also means a more complicated and larger supply chain.
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DOCUMENTARIES
Appendix 1 Interview guide:

What is the main activity of your company and how does sustainability fit into your company?

Do you have contact with the whole supply chain of the textile industry?

Does your company experience outside pressure (from consumers or governmental bodies) to improve on your environmental performance?

What incentives does your company have for collaborations with other companies? And why collaborations with a knowledge and innovation center in particular?

What was the project with Texperium about? Where you part of a co-design stage for the creation of a new product (if relevant)?

Did you form collaborative business models for the collaboration? And if so, was it challenging to combine your demands/goals and that of Texperium?

What permanent changes in practice have been made since collaboration with Texperium?

Do you exchange the knowledge and innovations with existing partners and new collaborations?

The Dutch government has set a goal that the Netherlands will have a fully functioning Circular Economy in 2050. What role does circularity play in your company and did the collaboration with Texperium stimulate circularity in your company?

Do you think business collaborations stimulate the transition towards a circular textile industry? If so, please explain in what way.

What changes in the current textile industry are needed to stimulate the transition towards a circular textile industry?
Appendix 2 Partners of Texperium:
The interviewed businesses for this research all worked together with Texperium. Some of these on the large projects Going Eco Going Dutch and BIO2HighTex, while others worked on smaller more individual projects.

Omar Munie; contact person; Giselle van der Star
Conny Groenewegen; contact person; Charlotte Corstanje
Enschede Textielstad; contact person; Annemieke Koster (Going Eco Going Dutch)
Moyzo; contact person; Gertie Teunissen (Going Eco Going Dutch)
Tous les chéris; contact person; Els Bugter (Going Eco Going Dutch)
ROC Twente; contact person; Geert Westerhof (BIO2HighTex)
Kayser Bedrijfskleding; contact person; Peter Kayser (BIO2HighTex)

INTRODUCTION OF THE BUSINESSES.

Omar Munie:
Omar Munie is a Somalian/Dutch designer located in The Hague. There, he runs his label Omar Munie, which focusses on high quality bags. Among his customers are: Oprah Winfrey, Hillary Clinton and Maxima. Omar Munie works together with Texperium on the recycling of materials collected by NS (Nederlandse Spoorwegen).

Conny Groenewegen:
Conny Groenewegen is a Dutch designer from Amsterdam. She specializes in knitwear and works according to a different mindset than regular designers or fashion brands, similar to Sustainability-oriented innovation (Adams et al., 2016). She has a strong opinion on ‘fashion’s volatility and high turn-around speed’, and works together with Texperium on her project The Fashion Machine. This project focusses on the upcycling of discarded fleece, which is a material that is seen as the least valuable out of all the materials for textile production.

Enschede Textielstad:
Enschede Textielstad is a weaving mill located in Enschede. It is considered to be the only sustainable weaving facility in the Netherlands. The business is run by Annemieke Koster and she worked together with Texperium in the Going Eco Going Dutch project.

Moyzo
Moyzo is a private label owned by Gertie Teunissen. Her label offers clothing for women that are made with organic and natural materials. All of her clothing is made according to fair trade standards. Production happens on a local level, so that transparency is ensured (Moyzo.eu). Gertie worked together with Texperium in the Going Eco Going Dutch project.

Tous les Chéris
Tous les Chéris is a private label owned by Els Bugter, which specializes in baby clothing. Her business is located in Arnhem. Els Bugter worked with Texperium on the Going Eco Going Dutch Project.

ROC Twente
ROC Twente is a scholarly institute. They provide secondary vocational education to students,
amongst which education regarding fashion and textiles. They work together with Texperium on BIO2HighTex and provide students for other smaller projects as well.

Kayser Bedrijfskleding
Kayser Bedrijfskleding is a business located in Enschede. Their business supplies clothing for businesses and institutions since 1928. Examples of their customers are: Industrial clothing for the construction sector, logistics, hospitals and wellness centres. Kayser Bedrijfskleding partners with Texperium in the BIO2HighTex project.