GROWN IN THE NETHERLANDS, MADE IN ROTTERDAM

TEXTILES OF THE FUTURE

A qualitative study of the Dutch textile and clothing industry of new materials

Iris Lommerse, June 2019, Erasmus University Rotterdam.

Master thesis

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Submitted: 10/06/2019

Acknowledgements

"If it can't be reduced, reused, repaired, rebuilt,
refurbished, resold, recycled, or composted, then it should be restricted,
redesigned or removed from production" – Pete Seeger

When buying textiles and clothing, an individual has the choice of different fabrics, producers and products. Businesses have the ability to choose what stakeholders to work with, where their producers are located and on what scale they wish to produce. I acknowledge that there is a gap between these forces: where consumers want to make the right decisions but point at the producers for offering the right products; businesses on the other hand, point at consumers who demand high value products at the lowest price possible. This has created a global textile and clothing industry that poses environmental and social challenges. It always confuses me, how one's desire for a perfect product is set above the needs of employees, the environment and our society. When buying a dress for that specific event is more important than to stop and think about where that dress came from, who made it, what fabric it is made of and if it is recyclable at all. I am not saying that I have always made perfect circular buying decisions, I am just pointing at the problem of the industry, which is designed to make consumers believe that more, newer and better, is the status quo.

With this thesis I seek to focus on the businesses that want to transform the industry and overcome this gap; who are these frontrunners and pioneers? This academic research contributes to the knowledge within these topics and the development of a more circular and sustainable textile and clothing industry in the Netherlands and further beyond. Without the help of the people around me, I could never have accomplished this work, and therefore I would like to thank a few people in particular.

First and foremost, I would like to thank my supervisor, Dr. E. Loots. She has been supportive, and has kept me challenged, sharp and inspired throughout the entire process. With her enthusiasm and passion for the subject as well as for her job, she has contributed to my knowledge in this field. Furthermore, she has believed in me and my research, enough to encourage me to apply for academic journals and conferences in the field of sustainable business innovation and management. I am proud to say that with her help I am one of the speakers of the 'New business model conference' in Berlin, July 2019.

Secondly, I want to grant my special thanks to Dr. M. Lavanga and her enthusiasm and support for the topic of sustainable fashion. She has been an inspiration and has shown me that academic

research is a way to contribute to the field of sustainable fashion. Besides, she has been responsible for introducing me to Blue City Lab, which has given me the opportunity to connect with the frontrunners and pioneers in the field of circular economy.

Thirdly, I would like to thank the project team of Tomato Textile. Without the project team that has welcomed me from day one, this thesis would not have been where it is today. My utmost gratitude for the enthusiasm that was shared amongst the team, as well as the setbacks which has made me feel part of the process and more integrated into the subject.

Fourthly, I appreciate all interviewees who have taken the time to share information and introduce me to their networks. The interviewees have all been the kindest to be willing to make time and contribute to this research, as for most entrepreneurs in this field, time is scarce.

Fifthly many thanks to my friends and family for being patient and supportive throughout its development. The journey of writing this thesis, gathering the data and staying up to speed with the process has been rather challenging and their help in the process have been invaluable.

Sixthly, I am very grateful for my parents, who have given me the opportunity to follow two academic studies and develop myself professionally. In particular my dad, who has been my proof-reader for six years and is always ready for a thorough discussion, coffee break or motivational talk. And my mother, who has always looked out for me, making sure I was well rested, positive and energetic enough to work.

Iris Lommerse,
Rotterdam, June 2019.

Abstract

Because of the social and environmental challenges that the global fast fashion industry is facing today, solutions proper to slow fashion practices are gaining importance. Values such as circularity, local production and the use of more environmental-friendly materials are reshaping diverse domestic industries. The present research involves a case study of a local production network that roots in the maker movement and experiments with diverse forms of circular business models. The case in this thesis is a start-up operating in the textile and clothing (T&C) industry in Rotterdam (the Netherlands), that explores the opportunities of producing textile made of the tomato waste in the Dutch horticulture sector. Participant observation of the project is combined with in-depth interviews with frontrunners in the field. Together, this leads to deep insight in the heterogeneity of circular business models that are used and can be used by the entrepreneurs and designers who develop new materials for the slow fashion industry on a local scale. A proposal for a circular a collaboration framework for circular innovations, *The Tomato Collaboration Model,* is made, justified, and discussed.

Keywords: circular business models, slow fashion, maker movement, new material, local production.

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Overview of Abbreviations

BCL	Blue City Lab
BM	Business model
CBM	Circular business model
CBMI	Circular business model innovation
C2C	Cradle to cradle
NBM	New business model
SDG	Sustainable development goals
SME	Small and medium-sized enterprises
T&C	Textile and clothing
TCM	Tomato Collaboration Model

Overview of Figures, Images and Tables.

Chapter 1: Introduction

The impact of global warming is present and pressing; the latest IPCC (Intergovernmental Panel on Climate Change) on the impact of global warming warned for the effect of a likely rise to 1.5℃ above pre-industrial levels by 2030. The possible effects include increases in temperature, rise in sea level, extremely hot areas and drought in certain regions (IPCC, 2018). A month after the release of this report, in October 2018, the United Nations Climate talks in Poland took place, where the aim was to develop a climate agreement as the threatening prospects of the effects of global warming are coming increasingly close (Harvey, 2018). The IPCC report of 2018, as well as the UN climate talks, both acknowledge the role of technology as a possible solution to tackle the pressing climate issues the world is facing today. Innovative and creative solutions are needed in order to reduce, tackle or even prevent the outcomes of the catastrophic prospects.

An urgent need for a new paradigm is discussed in a variety of prominent third-party reports (McKinsey and Company, 2018; EMF, 2013a, 2013b, 2015, 2017, 2018) as well as in the academic literature (Steffen et al., 2015; Geissdoerfer et al., 2018) and influential works (Jonker, 2018) like the Doughnut economy (Raworth, 2017). The main argument is that we are reaching the limits of our own growth economy (Rockström et al., 2009) and that a more holistic, circular approach to economics is needed to keep society from reaching its limits (Kraaienhagen et al., 2016; Murray et al., 2015; Raworth, 2017. Furthermore, the publication of the United Nations' Sustainable Development Goals has fed the public debate on the need for a system change (United Nations, 2015). The conversation on a new type of economy has been gazing around policy models, corporations and government institutions; the facts are clear, the system needs to change. For example, the central Chinese government (Yuan et al., 2006) has earlier accepted the circular economy as a new development as a strategy to build "a prosperous society in a comprehensive way by 2020" (p.4). The European Commission (2018) considers the circular economy as an opportunity, to develop a continent that respects the world's boundaries to resources, honouring the sustainable development goals, creates jobs and a competitive advantage for the union. The EC report (2018) stresses the importance of monitoring key trends and patterns the union's Circular Economy (CE) to be able to understand different elements that make a circular economy possible.

The textile and clothing industry (T&C) is facing severe challenges regarding the transformation to a new economy (EMF, 2017; McKinsey and BOF, 2018). To illustrate: between 2000 and 2015 the worldwide clothing production almost doubled to approximately 100 billion units produced in 2015 (EMF, 2017), and it accounts for a growth of 4-5% per year (Global fashion agenda, 2019). Growth has mainly been increasing in the context of the 'fast fashion' phenomenon,

typified by mass-production, offshoring to developing countries, 'take-make-dispose'[1] and the 'race to the bottom'[2] that creates many societal and environmental challenges. A characteristic example of the environmental consequences of the severe water usage that is needed for textile production is the 'completely' dried Aral Sea Basin in Kazakhstan, where the cotton production used for the global fashion industry has exhausted the area (Hoskins, 2014). Questions about and criticism on these practices have entrenched the 'slow fashion' movement that values sustainability, social responsibility and transparency (Clark, 2008) and focusses on long-lasting products, traditional production techniques or innovative design techniques (Fletcher, 2010). In the academic world concerns on the developments in the fashion industry are voiced as well, which is embodied in the *Manifesto of concerned researchers.* The manifesto was published at the beginning of 2019 and calls for textile and clothing researchers to unite and advocate for a paradigm change that excludes the business models that are focused on growth (Fletcher, 2019).[3]

Within the niche markets and local production networks of the slow fashion movement, entrepreneurs of the so-called 'maker movement' have been fostering innovations on a local scale. As an umbrella term, it refers to people who collaborate with the usage of technology to produce tangible products (Anderson, 2012), with open innovation and knowledge-sharing as its core characteristics (Browder et al., 2019). The term captures a variety of makers, such as firms, hobbyists, artists, students, educators as well as small businesses and experimenting entrepreneurs (Browder et al., 2017). As a movement, it has started to create opportunities for producers/entrepreneurs to introduce their innovations into a 'making and sharing economy' (Browder et al., 2019). Within this context, novel and innovative design ideas for reshaping the T&C industry and its practices are popping up as part of "our generational design challenge" (Raworth, 2017, p.246). Within this challenge, fashion designers and other pioneers have increasingly been warranted the roles of problem-solving actors (Hussain, 2018; Van der Velden, 2016). Especially small, experimental practices that could eventually scale up when successful have been ascribed to a crucial role (Beinhocker, 2012). The maker movement has sparked the interest of policymakers, as it could catalyse an entrepreneurial environment (Holman, 2015) and act as a precursor of the next industrial revolution (Browder et al., 2019). Additionally, the trend of local production and near-shoring[4] (McKinsey and BOF, 2018) provides the fashion industry

[1] Refers to a linear way of doing business in which firms acquire profit by producing low quality products that ends up on landfill.
[2] Race to the bottom refers to a linear way of doing business where businesses aim at producing as much and fast as possible at the lowest price.
[3] The complete manifesto can be viewed from the Union's website: http://www.concernedresearchers.org/
[4] Near-shoring refers to transferring (parts of) a business supply chain to a near-by country, which is instead of a production country that is more distant (off-shoring).

with challenges, as previously outsourced industries are slowly integrating into local economies (see for example Brydges, 2018).

At the micro-level, several firms have indicated to have intentions for the integration of circular production and eco-design initiatives in their business practices (Ghisellini et al., 2016). For innovative solutions to be successfully integrated into the economy and society, new business models emerge. Such innovation of business models is crucial to achieving a circular economy (Boons and Lüdeke-Freund, 2013; EMF 2015; EMF and McKinsey 2012; Geissdoerfer, 2019; Jonker, 2017) as they provide guidance that helps firms to analyse, communicate and plan within the increasing complexity of the new economy. Within this new economy changes in values are at hand, where the 'race to the bottom' and 'take-make-dispose' propositions are replaced with a more holistic, circular view focussed on sustainability and long-lasting products. The means by which these values are created, call for experimentation and innovation in business models (Antikainen and Valkokari, 2016; Bocken et al., 2016; Boons et al., 2013) and case studies are urgently needed to test the strategies of circular economy thinking on a micro-level (Bocken et al., 2016).

In this thesis, business models for the development of new materials in the T&C industry are studied. More specifically, the niche market of producers of new materials for the industry active outside the traditional business models of the current fashion industry will be accounted for. The scope in this present research will be the production process of a new material that can possibly be used by fashion designers when designing for a circular economy will be taken into the scope in this research: it is about the journey from cradle to cradle,[5] where waste is seen as a resource. The case study is located in Rotterdam, which is claiming to be "the European centre of the bio-based and circular economy" (City of Rotterdam, 2015). Here pioneers are working on an innovative project that aims at producing a yarn made out of tomato stems: the Tomato Textile project. In the project, the waste of one of the largest export products of the Netherlands, tomatoes, will be used as a resource to develop a textile product. Unique in this project is that stakeholders from various parts of the supply chain are included in its development: from horticulture over fashion designers and scientists, to marketeers and business leaders. Following Browder et al. (2019), an ethnographic study of the entrepreneurs operating in the makers' movement that is used to develop and advance theoretical and empirical entrepreneurship research. The ethnographic approach will be combined with a qualitative analysis of the business practices and values of similar projects, firms, and entrepreneurs, working with innovative business models and producing new materials from residual waste, or other alternative resources. The Netherlands export of tomatoes holds one of the highest dollar values, accounting for a share of 22.2% of the total exported tomatoes in 2017 worldwide

[5] In this principle, businesses produce materials that can maintain in a closed loop. After usage of a product, it does not become waste, but is used as a resource for a new product.

(Workman, 2018). If the Dutch can be the biggest tomato exporter, why can't we be an ambassador of the textile made out of residual waste?

1.1 Research Objective

This research aims to contribute to the empirical gap in the literature on circular business models in the textile and clothing industry, with a local production approach. The Netherlands figures as an interesting case. While a strong tradition in the fashion industry is lacking and the domestic industry is limited in size, it is increasingly populated by small companies that engage with alternative and sustainable fashion design and production, for example in denim (Lavanga, 2019).

Inevitably, launching new projects and products in the T&C industry creates challenges, opportunities, and shortcomings in the current system. Therefore, the following research question will guide this research:

> *How do innovative projects that merge design and research to develop new materials operate?*

Additionally, this research aims at exploring the circular business models that are proposed in academic literature, prominent third-party documents, and in the local niche clothing industry in the Netherlands. Because of the identified gap between theory and practice (Antikainen and Bocken, 2019) and the existing call for case studies in the academic literature (Boons and Lüdeke-freund, 2013), a case study will be combined with qualitative research components to answer the following research question:

> *What are appropriate business models to be used by producers of new materials operating on a local scale?*

Chapter 2: Literature Review

The following chapter develops a framework and builds a conceptual framework for the topic of this study: innovative new materials produced, developed and implemented on a local scale, based on the values of a circular economy. This context and framework allow for a clear starting point for the development of theoretical research, which is one of the aims of this study by its grounded, qualitative approach (Babbie, 2011; Bryman, 2012; Creswell, 2009).

First and foremost, it is important to note that is it essential to build further on previous research and knowledge in the field. A combination of peer-reviewed journals as well as non-peer-reviewed documents (such as consultancy reports and policy reports) are used because a lot of work on the subject of the circular economy is done in such non-academic papers (Kirchherr, 2017).

The literature review is structured as follows. In section 2.1 the global fashion industry will be discussed and leads to a problem statement that brings us to section 2.2 where the concept of the circular economy is set out. To explore how the concept of circular economy can be adopted into businesses, an overview of currently existing circular economy business models is provided in section 2.3. In section 2.4 the design context in which new materials are developed, namely the maker movement is explained. Fifthly, in section 2.5, the role of the process of innovation is being discussed. *Figure 1* illustrates the structure of the literature review:

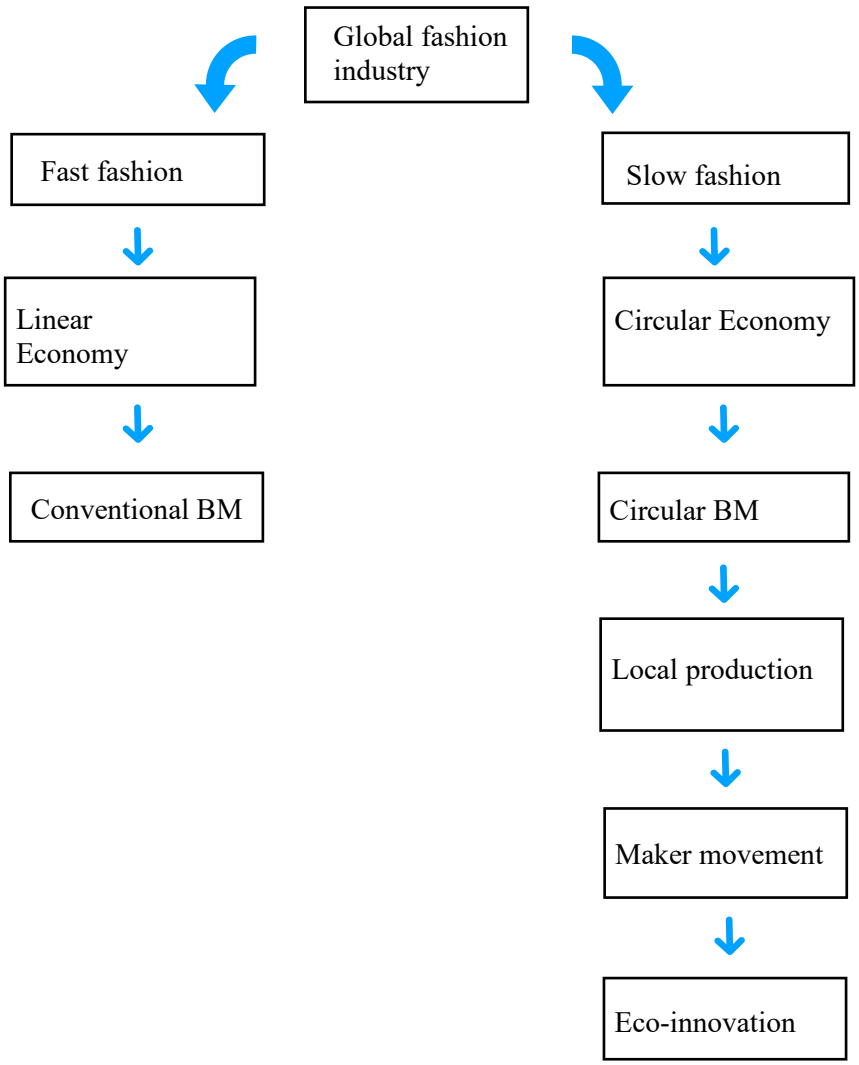


Figure 1: Structure of the literature review

2.1 The Globalised Fashion Industry

The fashion industry of today faces challenges such as the negative impact that production, transportation, and distribution have on the environment as well as on society. Before discussing these challenges, it is important to introduce the features and current state of the industry, which will be provided in 2.1.1. The issues of the current production of garment will be presented in section 2.1.2. The analysis of this thesis will focus on the Dutch textile and clothing (T&C) industry, which proves to be an interesting case with an expected annual turnover of €5,614 million in 2019, and an expected growth rate (CAGR 2019-2023) of 6.0% (Statista, 2019).

2.1.1 The State of the Industry

The textile and clothing industry is an integral part of everyday life and forms an important sector in the global economy (EMF, 2017). This industry consists of the production of fibres (such as cotton, wool, silk, nylon and polyester), knitting and weaving of the garment, and the finishing activities (such as dying, bleaching, printing, etc.) in producing a textile product. Within this value chain, the

retail sector forms the last station of the product, in which it is sold to consumers (European Commission, n.d.). Fashion apparel consumption related to the fashion industry can be defined as follows:

> *"*All companies or individuals involved in the creation, production, promotion, and sale of items that (a) have novel and specific aesthetic and functional properties, (b) trigger psychological reactions related to desire and need, and (c) are adopted by a group of people for a limited amount of time (d) and decorate or cover the body including textiles, clothing and accessories." (Ruppert-Stroescu et al., 2015, p. 168).

The fashion component makes the aesthetic of clothing and the value that is added to apparel crucial. The highly subjective nature of taste preferences in the fashion industry creates a structural uncertainty for the suppliers, defined as the 'nobody knows' principle (Caves, 2000). This uncertainty has given the industry incentives to produce 'push products', where a maximum number of products is pushed into the market to increase the likelihood of success (Jin and Cedrola, 2018; McKinsey and BOF, 2018). Another aspect of the industry is asymmetric information and supplier-induced demand, where the producers and consumers do not have access to the same information (Towse, 2010). In the fashion industry, this has reduced the transparency of the products and its supply chain for consumers. Additionally, the internet-boom and the rise of e-commerce have speeded up the pace the industry is expected to produce at (Fletcher, 2010). Because consumer preferences change rapidly and nobody knows what the next trend will be, well-established brands are often left with unsold items and uncertainties. Fast Fashion is a business model reliant on the principle of addictive consumption. Within an addictive model, consumption increases over time with exposure to the goods, creating a desire to acquire more of it (Stigler and Becker, 1977). In the fashion businesses success is connected to the ability to find the sweet spot at which consumers are made to feel better about themselves by buying your clothes, at the amount that it remains addictive enough to make the consumer come back to buy more (Bush in Haak, 2018).

According to their annual report on the state of the industry of 2018, McKinsey and BOF (2018), predict changes in the fashion industry in 2019:

> *"*For fashion players, 2019 will be a year of awakening. The ones who will succeed will have to come to terms with the fact that in the new paradigm that is taking shape around them, some of the old rules simply don't work" (McKinsey and BOF, 2018, p. 10).

At a global level, societal and environmental issues and e-commerce are becoming increasingly intertwined with the industry. This leads to a situation in which consumers are demanding more transparency, narrative and connection to a brand, and platforms and niche market can grow (EMF, 2017). This trend in consumer preferences is partly the reason for the "explosion of the small"

(McKinsey and BOF, 2018, p. 74), where consumers are increasingly susceptible for smaller brands that use purpose and values at the heart of their strategy.

2.1.2 Issues in the Production of Garment

The textile and clothing industry is characterised by a complex supply chain (Franco, 2017). Within the production and life cycles of the T&C industry, environmental and social challenges arise at all stages of the supply and values chains. At the initial stage of production, materials that are mostly used to produce textiles are extracted out of on non-renewable resources such as polyester (98 million tonnes in total per year) and water-consuming materials as cotton (using around 93 billion cubic meters of water annually) (EMF, 2017). This production process heavily pollutes the environment and accounts for negative societal impacts. The cotton industry uses a wide range of chemical pesticides: taking into account that 40% of the textile industry uses cotton, the impact is great. The widely used pesticides are harming the surrounding crops as well as the workers (Waart and Oosterhof, 2011).

The production cycle of the garment is mostly located in lower income countries, where the pressure of the industry regularly results in social problems as child labour, low wage policies and workers forced to work with chemicals and materials which are well known to have disastrous effects for their health (Lueg, 2013). The delocalisation of the production to the Far East decreased the size of the European clothing industry (Brito et al., 2007). During the consumer use phase, the product is handled, washed and repaired, which accounts for high usage of energy and water with the washing of the clothing (Global fashion agenda, 2017). Furthermore, the high number of under-utilised items in this phase (Maldini et al., 2017; EMF, 2017) causes problems to the environment, as fast fashions have changed that relationship consumers have with garment, treating them nearly disposable (Global fashion agenda, 2017). According to their recent report, Global fashion agenda (2017) recognises most problems in the end of the life cycle, due to a lack of innovation and economically viable solutions for up-cycling and recycling. To illustrate: items that are not sold, are destroyed; a major retailer as H&M burns up to 12 tonnes annually (Celie, 2017). The donation of (non)used textiles for good causes mostly enter the second-hand textile industry and are transported to third world countries. This leads to the demolishment of domestic clothing industry in these countries (Brooks, 2015).

On a social level, there is an increasing awareness of the ethical side of the fashion industry, caused by sweatshop scandals associated with brand names as Nike and Levi-Strauss (Brito et al., 2007) and the disastrous collapse of the Rana Plaza factory in Bangladesh (Lee et al., 2011). At the same time, the demand for the clothing industry is continuously growing (EMF, 2017; Fletcher, 2008; McKinsey and BOF, 2018), which makes innovative action on the supply side necessary (Grin et al., 2010). The *Pulse of the fashion industry* report forecasts great a economic potential for

the industry when its societal and environmental problems are tackled, estimated at €160 billion-per-year (Global fashion agenda, 2017, p.19).

Established fashion brands are feeling the pressure to meet the new age standards (Brydges et al., 2018), and are using corporate social responsibility strategies (CSR) by awarding for example sustainable initiatives (ABN AMRO, H&M) or integrating sustainable innovation solutions into their collection (H&M). But still, 40% of all companies in the industry haven't seriously considered sustainability practices and 60% of the companies that do address these practices are mostly smaller companies or start-ups (Global fashion agenda, 2019).

In sum, the disposability and short-life cycles are features of the fast fashion industry, where items are designed to be short-lived, involving low-cost production cycles and materials (Fletcher, 2008). In contrast, slow fashion can be described as a paradigm where sustainable fashion solutions include altered strategies of design, consumption and production (Fletcher, 2010). Clark (2008) clarified this paradigm, as in one which puts a focus on alternating the relations between consumers and suppliers which is trust-based, operating on a local scale. According to Clark (2008), the slow fashion business knows three characteristics, displayed in *figure 2:*

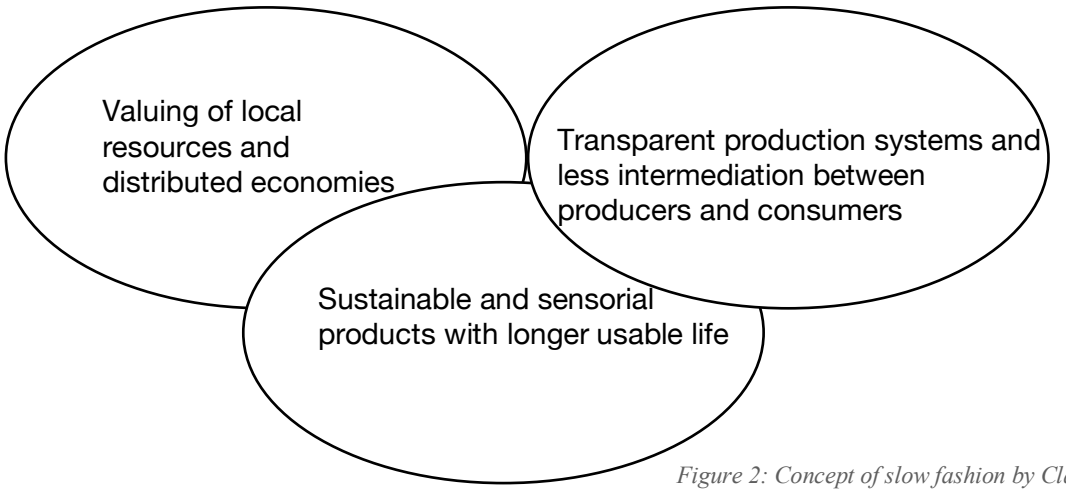


Figure 2: Concept of slow fashion by Clark (2008)

2.1.3 The Dutch Slow Fashion Market

In a recent study by Maldini et al. (2017), it was found that 'The Dutch clothing mountain' is still piling up. Partly because the average price of an item is around €16, while the average Dutch consumer buys around 46 new clothing items annually. Besides, the industry that is based on addictive consumption and the 'nobody knows' concept results in the overproduction of garment that remains unsold. Of the 250 tonnes of textile that is used by households and businesses, annually 155 ton is burned (op den den Brouw, 2017)

External factors such as the political environment, social and legal changes influence the development of industries, economy and society. In the Netherlands, the Dutch government has been engaging in stimulating a more sustainable textile and clothing industry. In 2013, the Dutch

Ministry of Infrastructure and Environment commissioned a study on consumer behaviour in the T&C industry and how this can be directed towards a more circular behaviour (Drijver and Broer, 2014). In 2016, branch organisations, unions, NGO's and the government signed a covenant 'sustainable clothing' to reduce the environmental and social damage and increase the transparency and tools for the creation of a more sustainable supply chain (SER,2016). In the report 'implementation programme circular economy 2019-2023', in which the Dutch governments' vision on a circular domestic economy is set out, an explicit role is given to the new materials industry within textiles. In this period support is granted to the 'circular make and craftsmanship industry'. The prospects and aims of the implementation programme are embodied in the iconic project 'Dutch circular textile valley', which focusses on realising a significant supply of circular textile in the Netherlands by 2030. This project stimulated innovative projects focussed on new materials, recycling and craftsmanship. Simultaneously, a policy programme is being created to work on specific goals for the Dutch T&C industry and to foster research on the possibilities to slow down the disastrous consequences of the fast fashion industry, in which business model innovation is also considered (Rijksoverheid, 2019). Additionally, a Dutch law to tackle child labour, where businesses are expected to actively engage in preventing this type of labour in their services and products, was voted in favour by the Dutch Senate (Ortjes, 2019).

2.2 The Circular Economy

The present section provides a brief explanation of the context in which the concept of circular economy has gained ground. This is followed by a definition of the concept and the concept in new business models. New business models and circular practices in the fashion industry today will be discussed in particular.

2.2.1 Context

The publication of the 'Limits to Growth report' in 1972, is considered to be one of the pioneering works in addressing the exponential economic and population growth and the effects of non-renewable resources on the environment. The Brudtlands's report in 1987 has made sustainability a recurring component of policy reports worldwide (Brito et al., 2008; Kraaijenhagen et al., 2016; Murray et al., 2017). The most widely used definition of sustainability has been introduced in 1987 by the United Nations (1987, p.5) as aiming to meet "the needs of the present generation without compromising the ability of future generations to meet their own needs". In 2015 the SDG's provided society, businesses and governments guidance to economic growth with environmental and social awareness (United Nations, 2015).

Sustainability will potentially create and develop new sources of value for the current system. Jonker (2018) follows Perez (2002) and describes a society that is currently in the 'change of era'. This means society is growing into a new era, which calls for radical sustainability and a

new economy. In the academic literature, the circular economy is believed to benefit environmental, economic and social dimensions of the sustainability ideal and the circular economy models are seen as an operational tool that can support businesses to implement the sustainability concepts (Kirchherr et al., 2017; Linder and Williander, 2015; Murray et al., 2015).

The Netherlands is ambitious in terms of sustainability: the country is reaching out to the objectives of a circular economy to make a successful transition to the next phase and has set the goal to have a circular economy by 2050, aiming to be a worldwide frontrunner in the field (Rijksoverheid, 2016).

2.2.2 The Definition and Concept of the Circular Economy

The concept of a circular economy (CE) is considered to has been introduced in 1990 by David Pearce in his study on environmental economics (Angelis, 2018; Geissdoerfer et al., 2018; Franco, 2017). Much attention is brought to CE practices at is seen as a tool to meet the objectives of the sustainability goals. However, as Kirchherr et al. (2017) point out after a thorough literature review on the concept of CE in academic research and policy reports, CE definitions are to some extent subjective and there is not one definition present that captures all elements of it. Furthermore, there is a difference in what practitioners and academics find to be characterizing the CE. According to Kirchherr et al. *(*2017), the definition by Ellen MacArthur Foundation and McKinsey (2012, p.7) is used the most frequently in the literature:

> "[CE] an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with re-storation, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models." (EMF, 2012, p.7)

Kirchherr et al. (2017) add that in the currently used definition social equity and consumer perspective is lacking, which leads them to the following definition:

> *"*A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with redu- cing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Kirchherr et al., 2017, p. 226)

Linear vs. circular

The increasing usage of the term circular economy has rendered the concept 'linear economy' as its antonym. Linear economy refers to "converting natural resources into waste, via production"

(Murray et al., 2015, p. 371). Within a linear system, natural products are focussed on a one-way system, where products are seen as waste after its usage:

> " Waste, n:
>
> *1.* Useless expenditure or consumption, squandering (of money, goods, time, effort, etc.).
> *2.* Loss of something valuable that coccus because too much of it is being used, or because it is being used in a way that is not necessary or effective."
>
> (Kraaienhagen et al., 2016, p.7)

Within the circular approach, products remain in the 'loop' or 'cycle', where all products eventually will return into the economy by either repairing, manufacturing or recycling. The circular economy furthermore eliminates waste through efficient production and focus on long-life product cycles, which intensifies the usage of the product (Bocken et al., 2016). In a classic product life cycle, the use of the product after purchase is not the responsibility of producers. While in the circular economy products of the producers stay in the system which increases the accountability of producers (Erler and Rieger, 2016). Some authors expect that eventually circular will outperform the linear (Kraaienhagen et al., 2016) because it will foster cost savings and a reduction in the depletion of our natural resources (Linder and Williander, 2015).

Once a theoretical construct which the CE, nowadays Circular business models (CBM) are gaining ground in business practices and policy. In a transition toward a different economy, new business models are needed (Ghisellini et al.; Bocken et al., 2016) as they contribute to create value and increase the logic in trades patterns (Jonker, 2016).

2.2.2 The Circular Economy Model

Since the 1970s, principles of the CE have been developed in various schools of thought, which are identified in (academic) literature by amongst others Angelis (2018), EMF (2013), Franco (2017) and Geissdoerfer et al. (2018). There is not one author or model to which the CE concept can be traced back (EMF, 2013), but the following schools of thought illustrated in *table 1* have been of great influence.

Main school of thought	Author	Keywords
Industrial ecology	Erkman, 1997	Closed-loop processes, waste serves as an input, connecting operators in the system.
Regenerative design	Lyle, 1996	All systems can be orchestrated in a generative manner
Cradle to cradle	McDonough and Braungart, 2002	Product-life extension, long-life goods, reconditioning activities, waste prevention
Biomimicry	Benyus, 2002	Innovation inspired by nature
Looped and performance economy	Stahel, 2010	All materials in the process are nutrients, design for effectiveness, define molecular composition of materials and use period
Blue economy	Pauli, 2010	Increase resource efficiency, waste as by-product, use of local resources

Table 1: Main schools of thought in CE based on EMF (2013) & Kraaienhagen et al. (2016)

The CE is rooted in industrial ecology (e.g. Ghisellini et al. 2016), which was established as early as 1997 where the industry is seen as an ecosystem in itself. This is because the whole system relies on the resources provided by our biosphere. The fundamental idea in this view is that the current industrial system should be understood, in order to comply with the natural ecosystem functions. In regenerative design (Lyle, 1996) humankind should restore, renew and optimise the already existent eco-systems. This system is resilient to change, as change is the only constant we have on the planet. Within cradle to cradle the concept of waste is rethought garbage is just a 'resting place' as products will always remain on the earth and should be used as resources. Biomimicry has a holistic view, in which nature should be seen for example as a mentor, rather than inventing new solutions. In the looped and performance economy (Stahel, 2010), the reuse, repair and remanufacturing of goods is advocated, in which a loop has no beginning and no end to create jobs on a regional level and prevent waste. Within the Blue Economy (Pauli, 2010) products close to home should be used and valued to create solutions for a more sustainable economy. This view concentrates on small, local, clean technologies to create jobs and increase resource-efficiency.

In all schools of thought, the role of designers, entrepreneurs, and pioneers in times of change and innovation is vital and key.

2.3 Circular Business Models

The academic and practitioner literatures have given ample attention to the system-wide change the circular economy is expected to bring about. However, the business angle of the circular economy and a focus on businesses transitioning on a micro-level have lacked attention from academics and practitioners (Franco, 2017). The following section will first address the current conventional business models present in academic literature, followed by an introduction to business model innovations that have been discussed in CE literature. To be able to elaborate on businesses

operating at a micro-level, examples of business models in the textile and clothing industry that aim to produce based on the cradle to cradle principle are provided accordingly.

2.3.1 Business Models

Business models have gained attention and recognition in the field of management literature since the 1990's. When a new product is developed and put on the market, a new business model must be created. It should involve the way value is captured and the strategy defining the entry on the market. After all, the technology and products alone do not form a guaranteed ticket to success (Teece, 2010). As a tool, business models proved to be useful in giving potential funders and stakeholder a simplified but comprehensive business idea. Besides, it gives businesses guidance in deciding its strategy (Boons and Lüdeke-Freund, 2013; Geissdoerfer *et al.,* 2018; Osterwalder and Pigneur, 2005; Richardson, 2008). The growing number of tools and frameworks to be used by businesses proved to be necessary for firms to create a competitive advantage in times of rapid technological change and increasing competition (Richardson, 2008; Osterwalder et al., 2005).

The work of Richardson (2008), and Osterwalder et al. (2005) can be considered as the foundations in business model creation and business model innovation (Angelis, 2018). According to Richardson (2008) a business model is a simplified version of how a firm does its business. Deciding on a firm's competitive advantage by creating an effective strategy (Barney, 2002), is considered to be key in creating a business model framework for firms (Richardson, 2008). Richardson's model is divided into the value proposition (what the firm delivers, what the target consumers are and what the firm's competitive advantage is), value creation and delivery (how the firm will deliver its values) and value capture (its revenue model). Osterwalder et al. (2005) also created a framework equally based on values, existing of nine components. According to these authors, business models focus on how the value is created for consumers and a way to find a promising business concept for firms. The nine components of a business model are considered the 'building blocks' which can be adjusted and experimented with in such ways that managers/businesses can adjust these to their own needs.

Contrary to what is argued in the business model frameworks by Richardson (2008) and Osterwalder (2005), the Lean movement argues that for start-ups, such extensive business planning does not work. At the same time, Osterwalder (2005) and Ries (2012) also have similarities in their line of thought, as it is agreed that a business model is a 'blueprint' (Osterwalder, 2005, p. 4) at one moment in time and that the building blocks can be adjusted and experimented with as if they are Lego blocks. In 2010, Osterwalder and Pigneur published the handbook 'business model generation', which offers a flexible template consisting of the nine building blocks referred to as: the 'Business Model Canvas'. This tool should give business developers more flexibility, in today's

fluctuating and increasingly complex economy where innovation and experimentation are needed (Osterwalder and Pigneur, 2010)

Ries (2012) takes the experimentation further, as in the times of start-ups and entrepreneurs there is simply no time, and time can only be wasted through extensive planning. The lean start-up movement was developed in times where economies were dealing with the worldwide financial crisis of 2008. This resulted in increasing interest for entrepreneurship and start-ups by governments and businesses (Rusu and Roman, 2017). The start-ups are considered as businesses that are creating something new and is dealing with great uncertainties in its process. By experimenting and integrating consumers perspectives entrepreneurs should be able to 'pivot': change their strategy to fulfil their vision. In terms of this process a fair balance needs to be sought, as the 'just do it' mentality[6] creates chaos instead of success. Because of the prominent role of experimentation and the ability to pivot, the business model of start-ups is constantly altered and adjusted to increase their likelihood of success. The key principles of the lean method (Blank, 2011) are:

1) Testing hypotheses, which are summarised into a business model canvas (Osterwalder and Pigneur, 2011)
2) Customer development is used to test hypotheses. The minimum viable product is put on the market and based on consumers reviews products are send back with small adjustments (iterations) or more extensive ones (pivots)
3) Agile development in which the minimum viable products are created and adjusted after customers' input

An overview of the business models' main schools of thought can be found in *table 2*.

[6] This refers to a mentality in which all forms of management are rejected.

	Richardson (2008)	Osterwalder et al. (2005)	Ries (2012)
Definition BM	The basic idea is that a firm's business model describes the way it delivers its products and services to customers and the way it makes money (p. 135)	A business model is a conceptual tool that contains a set of elements and their relationships and allow for expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of costumers and of the architecture of the firm and it network of partners	Existing companies execute a business model, start-ups look for one (p.64)
Specific components	Value proposition Value creation and delivery system Value capture	Value proposition Target consumer Distribution channel Relationship Value Configuration Core competency Partner network Cost structure Revenue model	Testing hypotheses Customer development Agile development

Table 2: Business models main schools of thought (own elaboration)

In order to understand why conventional business models differ from circular business models at first hand, it should be noted that the objectives between the conventional and circular business models differ. Circular business models come forward from social and environmental concerns, instead of a desire to gain revenue by strategically putting a product on the market and gain competitive advantage. The different objectives in value creation and the delivery element is arguably one of the biggest differences between conventional business models and businesses in the CE (Geissdoerfer et al., 2018).

2.3.3 Circular Business Model Innovation

The mind shift that forward from the values of CE requires changes on a macro-level (cities, regions), meso-level (networks, eco-industrial parks) and micro-level (individuals' businesses, consumers) (Ghisellini et al., 2016). At the micro-level of the CE, businesses that aim to engage with circularity should follow three key principles according to EMF (2015):

1. Preserve and enhance natural capital.
2. Optimise resources yields, including maximization of the value of resources both in technical and biological cycles over time.
3. Foster System Effectiveness (which is focussed on excluding negative environmental externalities).

Innovation in business models is necessary in the light of the increasing complexity organisations face, with challenges such as sustainability and changing values in society (Linder and Williander, 2017; Geissdoerfer et al*,* 2018). To optimise the integration of these challenges and changes into society, the business models that are used at a micro-level need innovation, as the business focus is changing.

A thorough literature research on circular business models (not to be mixed up with sustainable business models), recently conducted by Angelis (2018), reveals that there is no consensus on the definition of the CBM. Furthermore, a real conceptualisation of the CBM is lacking in the literature, except in the study by Linder and Williander (2015):

> (CBM) "a business model in which the conceptual logic for value creation is based on utilizing economic value retained in products after use in the production of new offering. Thus, a circular business model implies a return flow to the producer from users, though there can be intermediaries between the two parties. The term circular business model, therefore, overlaps with the concept of closed-loop supply chains and always involve recycling, remanufacturing, reuse or one of their sibling activities (e.g. refurbishment, renovation, repair)" (Linder and Williander, 2015, p.2)

Businesses require guided tools to experiment with business models to find an appropriate way to market their new products (Antikainen and Bocken, 2018). Newly created business models could serve as one of the building blocks of the CE (Angelis, 2018; EMF, 2017). While some opt for a radical change in BM (Jonker, 2018; Raworth, 2017) other scholars claim that existing elements should be elaborated, such that important elements can be integrated: a focus on sustainable value and stakeholder and supply chain management (Geissfoerfer et al., 2018), sustainable innovations (Boon and Lüdeke-Freund (2013), and various strategies for closing down the loops (Bocken et al*.,* 2013). According to the proponents of new business models**,** openness to social and technological innovation is needed to counter the Western business practices which driven us to where we stand today in the first place (Hart, 1997; Raworth, 2017). In their research, Linder and Williander articulate the need for experimenting and testing of new business models, as we have seen before in Ries (2012) his theory of the lean start-up movement. By adding innovation and experimentation, circular businesses create customer development and can run cheap tests that give them the ability to test various hypotheses (Linder and Williander, 2017).

Within models that are meeting the objectives of the circular economy value propositions, producers face new relations with their consumers as well as with their product. Erler and Rieger (2016) acknowledge for example how a shift to the circular way of doing business expands the range of responsibility for the producer within the lifecycle of its produced products. Most authors that list business models focus on the extension of product-value by for example re-manufacturing,

preparing and recycling; in which the ownership of the product is not focussed on the consumer (Bocken et al., 2014; Kraaienhagen et al., 2016).

Tukker (2004) created a product-service system concerning sustainability. In this system, business chooses to focus on the service or product content of their businesses. Examples of this system are platforms, renting and leasing services. Other scholars focus on the efficiency of sustainable design and high-quality products (Bakker et al., 2014; Bocken et al., 2016; Kraaijenhagen et al., 2016; Stahel, 1994)

At the same time, we need to keep in mind that business models are not an end in itself (Boons and Lüdeke-Freund, 2013). Although they prove an important tool, it needs to be linked to approaches to sustainable innovation. The business plan is not fixed, as the industry is subject to internal and external factors that change rapidly (politics; innovation (product, process); trends; changing consumer demands). Therefore, it is argued that innovations are not possible to be planned from the outset but need experimentation in real-life to offer businesses concrete examples (niche level experiments) (Antikainen et al., 2017).

2.3.4 Cradle to cradle business principle in the Fashion Industry

The cradle to cradle principle lays at the core of the CE (Linder and Williander, 2017). Within this principle, closing the material cycle is the bottom line (Lüdeke-freund et al., 2018). Therefore, it is important to stress the different kinds of loops in the lifecycle of a product. The circular business models proposed by Bocken et al. (2016), Bakker et al. (2014) and Kraaijenhagen et al. (2016) prove to be the most extensive in addressing the various loops in the CE and how these can be implemented into business models on a micro-level. Within the cradle to cradle CBM types, the loops can be focussed on narrowed, slow and closed (Bocken et al., 2016). A loop can be either *narrowed* by designing long-life goods and focus on extending life-cycles, *slowed* by extending the lifecycle of a product by narrowing resource flows, repairing etc., or *closed* by creating a product that closes the loop between production and post-use (Bocken et al., 2016; Mc Donough and Braungart, 2002; Stahel, 1994). Based on Bocken et al. (2014, 2016) and Bakker et al. (2014), the following overview (*table 3)* has been established. For each business model strategy, a specific example of the adaptation of it in the T&C industry is provided.

Business model strategies	Type of loop	Definition	Example of cases in garment/fashion industry	Organisations applying strategy
Access and performance model	Slowing	Consumers can use the product to satisfy their needs, without needing to be the only owner.	Leasing Renting	Mud Jeans Lena library
Extending product value	Slowing	Exploitation of residual value of products, either by remanufacturing from consumer back to producer or from business to business	Clothing-return initiatives	Swedish stockings
Classic long-life model	Slowing	Products focused on long-product life and durability	High-end fashion brands	Atelier PHI
Encourage sufficiency	Slowing	Possibilities are provided to reduce end-user consumption by focussing on durability, reparability, service and a non-consumerist focus in sales and marketing	Premium and high-quality service brands	Patagonia
Extending resource value	Closing	Turn otherwise wasted materials into new forms of value	Recycling of waste products into new materials	Adidas
Industrial Symbiosis	Closing	Shift waste outputs from one industry or output into resource for another process or product line.	Resources from other industries used in the fashion and garment industry	Piñatex Orange Fiber

Table 3: Innovation in business models focussed on closed or slowed resource loops. Based on Bocken et al. (2014, 2016) and Bakker et al. (2014)

Access and performance model

In the access and performance model, the emphasis of the business model is focussed on providing access to a service or product, without consumers needing to physically purchase it. MUD Jeans in the Netherlands is a circular business that gives consumers the possibility to lease jeans (Moorhouse and Moorhouse, 2017). Consumers pay a monthly subscription and can return their jeans to the company after 12 months and exchange for a new one, the returned jeans are then upcycled (sold again as f.e. vintage jeans) or recycled (forming a resource for new jeans).

Extending product value

Within this slowing loop, products that no longer function are taken back by the manufacturer and composed into a new product or material. An example is the company Swedish Stockings, which gives consumers the possibility to send old or ripped stockings to one of their recycling centres. In return, consumers get a discount code that can be used to purchase a new stocking in their web-

shop. Eventually, the company aims at providing a closed loop system (Fisinger and Forsberg, 2019)

Classic long-life model

For other companies, the value proposition is to produce products that can be used for a lifetime, which increases the products' life cycle. In atelier PHI, the aim is to produce clothing on a local scale and focus on timeless designs. The clothing is tailor-made by refugees from Syria and Lebanon, by which the business also creates employment (Lommerse, 2018).

Encourage sufficiency

An example of the non-consumerist approach is the marketing campaign by outdoor-brand Patagonia, in which the brand stated "don't buy this jacket" during the famous black-Friday sales in which conventional stores offer high discounts to their consumers. This was a way to communicate with their consumers to consume thoughtfully and buy consciously (Cave, 2016).

Extending resource value

By extending the resource value, otherwise wasted materials are used again to keep them in the loop of its life-cycle. The sportswear brand Adidas uses the plastic waste from beaches, coastal communities and the ocean in their running shoe 'Futurecraft loop'. The zero-waste value proposition of the product is furthermore extended with their recycle policy in which consumers are motivated to return the sports shoe after use so the company can re-use it as a source for a new shoe (Breyer, 2019).

Industrial Symbiosis

An industrial symbiosis business model is focussed on process-oriented solutions, where the system is focussed on creating products taking waste outputs of another product line as a feedstock. Fruit-waste from pineapple (Piñatex uses the leaves of this fruit which is waste after harvest to produce a leather-like product) and orange (orange fiber is made from the peels of this fruit after juice production by which a silk-like product is created) are upcycled into textiles which are used by H&M in their conscious exclusive collection of summer 2019 (Farra, 2019). This business model stretches even further then just focussing on circular supplies and is focussed on the supplies as well as enforcing an innovative circular system where products remain in the loop of various industries.

2.3.5 Values

Business models are always based on value capturing (Antikainen and Bocken, 2019). Central in CBM is a combination of a business' social, ecological and economic values (Jonker, 2018). According to Murray et al. (2015), the social aspect of the circular economy is lacking attention and its role in the new economy needs recognition. The reduction of the usage of non-renewable resources benefits humankind. However, important questions, such as its influence on subjects as social equality, diversity and social opportunity remain. The focus on values in business is

articulated by Klamer (2017) in his value-based approach, according to this view business and individuals operate from a 'purpose'.

The different focus points of closing or slowing loops in a cradle to cradle business model depend on the values, mission and vision of the brand which are connected to its strategy and competitive advantage. As indicated before, the shift from a linear to a circular economy changes the value of products, where products in a circular economy should be valued and used for as long as possible (EMF, 2015; Bocken et al., 2016; Kraaijenhagen et al., 2016). The value of the product in a linear cycle, is added in the extraction, manufacturing, assembly and retail phase and through usage of the consumer that purchases the product. The post-use phase of products with short lifecycles, create a lower value of the product (Achterberg et al., 2016). Within the circular economy, the aim is to add value to the product by slowing, narrowing or closing the loops. Contrary to the linear economy, the pre-use, use and post-use phase should all focus on adding and retaining value (Achterberg et al. 2016). According to Nussholz (2017), all stages in the product cycle need value management from an early stage to foster innovation and experimentation with BM's and various loops. For businesses experimenting and innovating with (new) products on the market, it is important to decide on the purpose (Klamer, 2017) of a business. By choosing a *narrow, slowed* or *closed* loop (Bocken et al. 2016; Kraaienhagen et al., 2016) a decision is made on where the value is added to their products in the pre-use, use and post-use phase (Achterberg et al. 2016).

2.4 Local production

The changing values in organisations and businesses are challenging the way they are established and delivered through their business models requiring a revision of established production and supply chain networks (Lüdeke-freund et al., 2018). Businesses in the CE are dependent on a system (European Commission, 2018), where the cradle to cradle business practices intensifies the responsibility of the producer and the life-cycle of a product. It is important to acknowledge the interdependence in circular business, which is based on collaboration and the circulation of products and resources (Kraaijenhagen et al., 2016). Collaboration in the new paradigm of the circular economy is important for products to maintain its value (Achterberg et al., 2016) and for companies to share solutions and work together on open collaboration (Global fashion agenda, 2019). In the fashion industry, an increasing complexity of the system by upscaling and mass-production have created difficulties for businesses that operate in the slow fashion movement, as production networks closer to home need to be re-invented. Local production networks can be defined as "collaborative linkages between local firms and local factors of production", where a variety of local resources are used to compete locally and abroad (Simmie and Hart, 1999, pp. 445). It is

argued that by developing local production networks, clusters and network effects are developed (Feld, 2012) and innovation is stimulated (Simmie and Hart, 1999).

The fashion industry, which is an ideal example of a globalised sector, has been growing into a global production network with interconnections spreading national boundaries, including national and international nods (Coe et al., 2008, 272). In a recent research on local production networks in Canada, it was found that designers and fashion businesses do not necessarily need to be located inside the traditional fashion system and is in some cases part of a strategy to promote niche products with the "made in Canada" brand (Brydges, 2018). These designers hold the values home to the slow fashion movement, where time-less design and high-quality manufacturing are emphasized and local identity, unique consumer experiences and the signaling of their values towards consumers is part of their strategy. Within the slow fashion movement, a key characteristic is the valuing of local resources and distributed economies (Clark, 2008). Local production networks are necessary as new agglomeration economies. They are developed because the place still matters in a global economy, as it gives firms the ability to adapt to radical changes and innovation. Agglomerated economies give firms the ability to adapt and react flexible and effective (Feld, 2012; Simmie and Hart, 1999). This leads to an interdependency of the firms as they are embedded into the local economies.

A trend that is emerging simultaneously as supply chains and production networks are evolving is the maker movement. In this global phenomenon actors 1) cooperate which establishes 2) knowledge creation and sharing spaces while 3) using technological resources for the production (Browder et al., 2019). This movement has created opportunities for producers-entrepreneurs to introduce their innovations for the making and sharing economy. According to Browder et al. (2019), the maker movement should be more researched in relation to entrepreneurship, and specifically under which conditions entrepreneurship in the maker movement is established. Therefore, the following framework is created *(figure 3).*

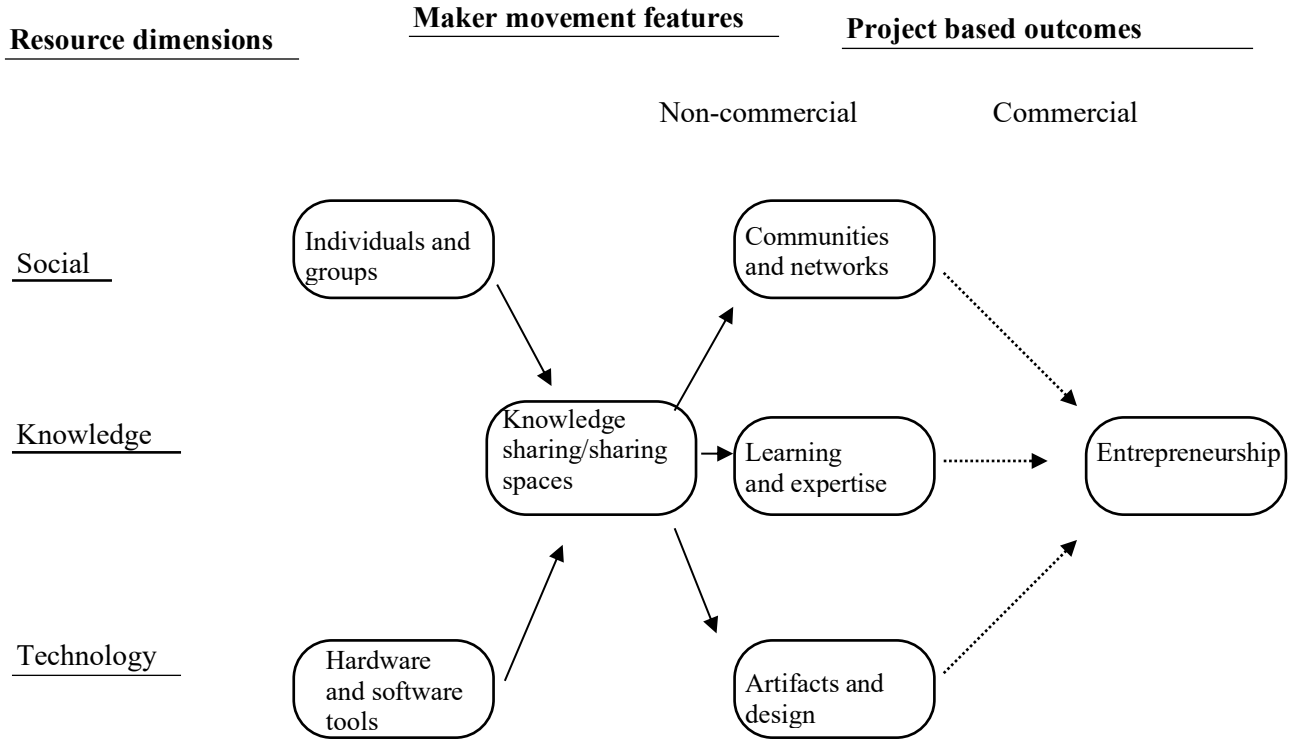


Figure 3: Conceptual model Maker Movement (Browder et al., 2019)

Entrepreneurship in this article is defined as: "the action of coordinating resources for commercial projects under uncertainty" (p. 2). In the model there are three resource dimensions: social, knowledge and technology that can be combined by entrepreneurs to create products. Makers act as entrepreneurs when available resources are employed to explore a combination of potential but previously underexplored projects (Casson and Wadeson, 2007). Currently, the movement fosters an open innovation network, that fosters knowledge sharing and an environment where collaboration is valued to foster new skills and create innovative designs. In this environment, digitalised solutions and the enabling of user -innovation (including customers, developers, amateurs and professionals) prevails which resembles with the CE principles such as "consumer as producer" and product-service systems models (Bakker et al., 2014; Tukker, 2004).

2.5 Innovation

It is argued that local production networks foster innovation (Brydges et al., 2018; Simmie and Hart, 1999). Niche experiments and initiatives that result from these innovation systems are important pioneers when the system is in a paradigm shift (Grin et al., 2010; Perez, 2002)

2.5.1 A paradigm shift

Following the maker movement, entrepreneurs are seeking new opportunities in times of uncertainty foster innovation. Perez (2002) and Grin et al. (2010) underpin the context in which innovation systems develop, where the underlying patterns in the economic, social and political systems influence the process of a shift to the next phase. The entrepreneur has a bridging role between the phases, searching for new combinations that give opportunities that give the ability for openings for whole new trajectories when the former paradigm is exhausted. A paradigm is seen by Perez (2002) as a techno-economic paradigm, defining the routines of the economy in a certain phase, providing a set of systems, solutions and industries offering modernisation and innovation. Within a "great surge of development" not only economic factors,[7] but also societal and cultural factors change a techno-economic paradigm shift can bring about.

2.5.2 Eco-innovation

Within the socio-economic paradigm shift and design is historically known to offer solutions to complex issues (Maher et al., 2018). Within the process of searching for solutions, research through design (Maher et al., 2018) or the front-end process of innovation (Bocken et al., 2014) is important. The front-end process of innovation refers to the early stages. With iterations, reflections and room for experimentation from the initial phase of the innovation, the minimising of potential economic setbacks is achieved (Bocken et al., 2014). Eco-innovation in this sense includes the "competitively priced products and technologies with better environmental performance than relevant alternatives" (Bocken et al., 2014, p. 43). The front-end process of eco-innovation is different than a normal innovation process, as specific inter-disciplinary knowledge on environmental issues is needed. Following Perez (2002), start-ups and new firms form a fruitful ground for eco-innovation to take place. The importance of eco-innovation and start-ups is also acknowledged by the EU:

> "First, many SMEs could benefit by introducing eco-innovative approaches into their operations. Second, SMEs and especially start-ups, can be ideal incubators for eco-innovation, and can bring to market new, less environmentally damaging products, services and processes". (European Commission, 2012).

The EU policies have had a fruitful effect in the start-up landscape for small and medium sized businesses in Europe, gaining growing recognition as a 'start-up hub' (Smale, 2018).

For start-ups focussing on innovative product designs aimed at addressing social and environmental challenges, integrating circular economy concerns from the start is important (Bocken et al., 2016; Nussholz, 2017). When the resources, value systems product and activities

[7] Perez is building on Schumpeter's notion of long waves of economic growth, where a wave is the result of market mechanisms in the economic sphere.

have already been devoted to a certain design, it is mostly difficult to change this at a later stage in the product development.

Chapter 3: Methodology

This section outlines the methodology that was used in this research. Section 3.1 will provide the research objectives, followed by the research design and operationalization in section 3.2. Section 3.3 presents the case study of this research, and section 3.4 provides an overview of the data collection.

3.1 Research objectives

This study has two major objectives. The first objective is providing in-depth analysis and rich understanding of the business processes by closely following one project specifically, which brings together a variety of stakeholders ranging from the horticulture industries to the fashion industry. The second objective of this research is identifying the challenges that pioneering entrepreneurs in the maker movement face, to identify internal and external factors that influence their business. The overall aim is to propose a coherent, practical and useful new business model that focuses on local production networks and circular economy values.

In this research, the concept of circular economy (CE), circular business models, the maker movement and eco-innovation related to the Dutch textile clothing industry is explored. CE business models are still in an innovation phase, which makes exploration of already existing models in the field a needed starting point as it can pave the way for practitioners in the field and improvement of current literature. As CE is still a novel phenomenon which is developing and innovating, exploratory case studies are best suited (Ghisellini et al., 2016), because as at this stage little is known about the strategic processes, new forms of network organising and the important players in the stakeholder networks (van Dijk et al., 2014). In this, research an inductive, field-based case methodology is used. Such an approach is vital to an unexplored area such as the circular business models, in general, and in the Dutch textile and clothing industry in particular.

3.2 Research design

Considering the innovative character of the subject of study, namely entrepreneurs in the maker movement, Browder et al. (2019) called for more ethnographic research in the field to advance theoretical and empirical entrepreneurship research. In this thesis, ethnographic research will be combined with a multiple-case study using qualitative analysis. The data collection technique of participant observation gives the researcher the ability to get an in-depth understanding of the phenomena (Lacono et al., 2009).

Because of time constraints, this ethnographic research will be in the form of a *micro-ethnography* (Wolcott, 1990), in which a specific aspect of the topic is focused on. For a relatively short period, February 2019 until May 2019, the researcher studied the topic of circular business modelling and challenges of the maker movements' entrepreneurs. The researcher took on the role of an overt full member in a closed setting, meaning that the role of the researcher was known to all actors involved (Bryman, 2012). Data collection of the ethnographic study was obtained through

participant observation. The researcher took on the role of the *complete participant*, which refers to a method of participant observation where an insider role is held (Gold, 1958). The role of *complete participant* gave the researcher the ability to collect data extensively by observing the participants in the team. Furthermore, by being a representative of the team more information could be obtained and shared during conferences, expert meetings and interviews.

In a case study, an individual unit is studied intensively, which stresses the development factors and focuses on relation environment (Eisenhardt, 1989; Flyvbjerg, 2011). As acknowledged by George and Bennett (2005), case studies have developed much knowledge in the empirical world of today. At the stage of theory-building, case studies are even more suitable as it follows for a deep understanding of causation, the historical context, the understanding of the sensitivity of the study object studies and allow for new hypotheses and questions to be studied. Context-specific knowledge, based on experience and concrete cases are at the base of social science, Flyvbjerg (2011) even claims that the social sciences have not achieved to develop predictive theories and universals. Case studies might not be generalisable from the start, but it can give value and contribute to scientific innovation. One of the objectives of this study is adding to academic theory, and it has been argued that the use of case studies is also relevant and claimed to be the best tool to produce theory (Watson, 1992).

3.3 The Case Study

The case study in this research is the Tomato Textile project, based in Rotterdam, where the possibilities for creating textile based on horticulture waste is explored. The case was selected as it provides a good example of business model innovation at an early stage, including multiple stakeholders that are focussed on circular economy practices. This allows addressing value creation, capture and delivery from an early stage and the challenges that come forward from this phase. Following the advice of Bocken et al. (2014), the front-end process of eco-innovation an important factor. By being involved from this phase, the researcher was able to identify internal and external challenges of the project from an early stage.

This case study is chosen because it combines a diverse group of stakeholders in the project, which gives the ability for a unique close-up analysis of the process of the research and development phase of the Tomato Textile project. Access to the setting was attained by the business leader at the Blue City Lab, and the key informant of the project was the coordinator of the project. Furthermore, the full project team had a meeting every six weeks and the researcher was present at the Blue City Lab one day a week where the volunteers, students and project leader were also present. Additionally, the researcher attended expert meetings, conferences and events as a member of the project team. Two events were organised by Blue City Lab. The business case of the Tomato

Textile project was discussed during the 'Blue business club' and the possibilities for Rotterdam as a circular textile hub were reviewed during an expert meeting. [8]

The project

The Tomato Textile project aims at providing a cross-over between the textile- and the horticulture industries where waste resulting from local tomato production is innovatively transferred into a product of high value: a textile. Greenport West-Holland approached Blue City Lab with this idea to promote a circular business also for the horticulture sector, with the purpose to stimulate its producers to reduce plastic usage and acknowledge waste as a raw material for a t-shirt. The project aims at developing a business case for an entrepreneur to launch this product (a tomato t-shirt) as a start-up.

The team

The Blue City Lab provides the space for project members to work on the project in the lab. As the inter-disciplinary focus of circular economy innovations calls for a diverse team, the fifteen team members represent a wide variety of backgrounds (both investors and stakeholders): entrepreneurs, marketeers, fashion and product designers, business leaders, tomato producers, students and researchers in the field of chemistry, life change management and economics. *Figure 4* shows all team members of the Tomato Textile team that have been the unit of analysis in this study. The vast majority of the project team met every month with its investors and stakeholder to make decisions on the development of the project and discuss future steps. The researcher and the operating project team met weekly to work and discuss the developments of the project. Developments in the projects were also reported by e-mail to all investors and stakeholders in an update every 14 days.

[8] For an overview of all events and contact moments, please consult Appendix C.

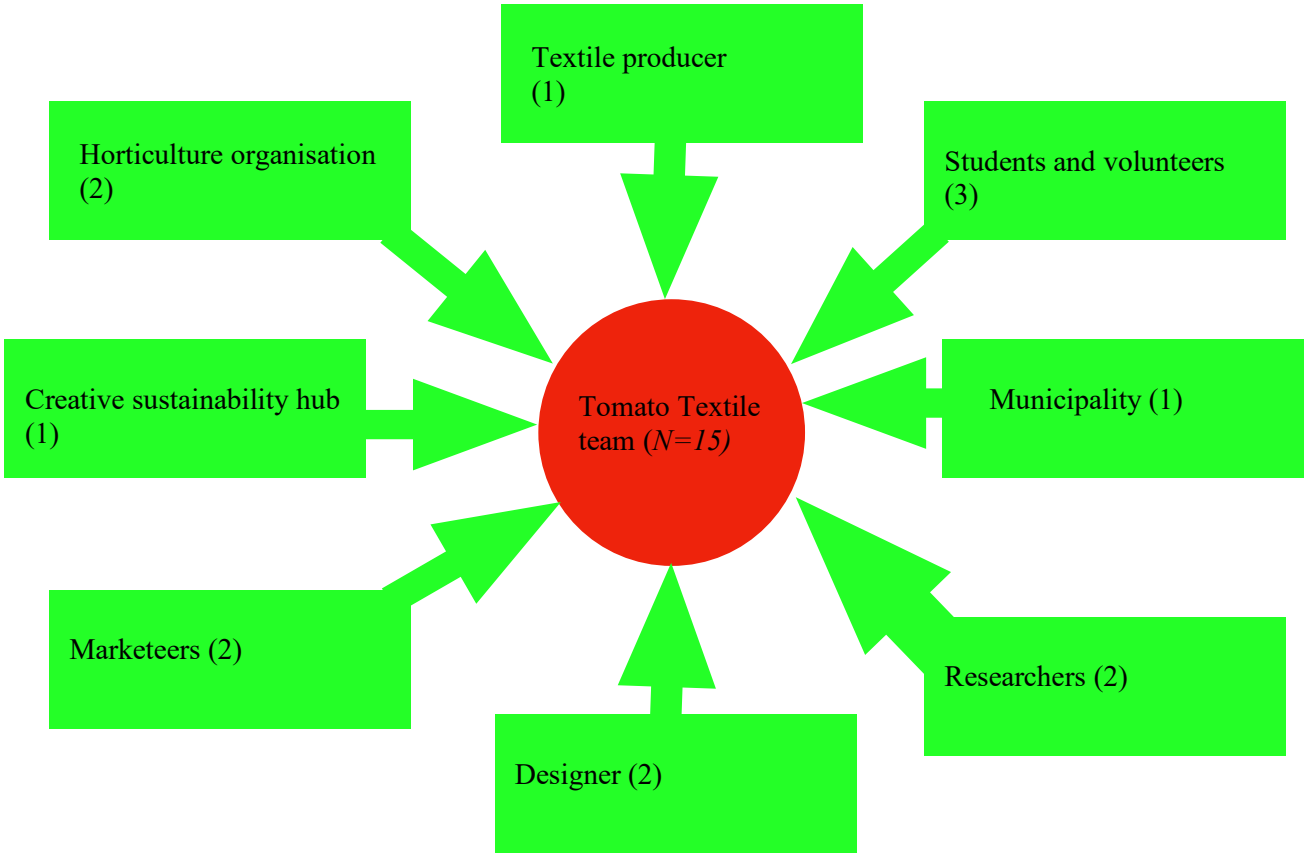


Figure 4: Team of the Tomato Textile project (own elaboration)

One of the main critiques in participant observation data collection technique is the lack of a broad understanding when one case is taken as the focus point (Lacono et al., 2009). Therefore, a qualitative analysis was added to the research. Four semi-structured in-depth interviews were conducted with a purposive sample of entrepreneurs who are already producing and in business with textile products made from residual waste in the Dutch T&C industry. By using semi-structured interviews with open-ended questions, the interviewee was provided the change to elaborate on his/her view and highlight issues and topics that are important in their point of view (Bryman, 2012). All interviews took place in the period from March 2019 to April 2019, were conducted via Skype, telephone or face to face and lasted around 45 minutes each.[9] A similar design was used by for example Geissdoerfer et al. (2018) and Franco (2017), who developed a framework for CBM based on four cases and by Sosna et al. (2010) who took a similarly dynamic perspective to study the antecedents and drivers of business model innovation in a Spanish healthy food business.

3.4 Data Sampling and Analysis

During the observations, the context, location, actions, interaction and conversation were taken into account.[10] When the researcher was in the field, jotted notes (keywords, quotes, phrases) were taken during the day, followed by full fieldnotes written at the end of the day. Additionally, recordings,

[9] The interview guide can be found in appendix A.
[10] An overview of the observations can be found in appendix C.

videos and photos were used to collect the data, which added to obtain a coherent analysis. The analysis included: a number of participants in the setting, a description or picture of the location and described the activities that were observed, as advised by Schensul et al. (1999). An example of the field notes and the method for indicating a pattern and core themes within the data is displayed in *image 1.*

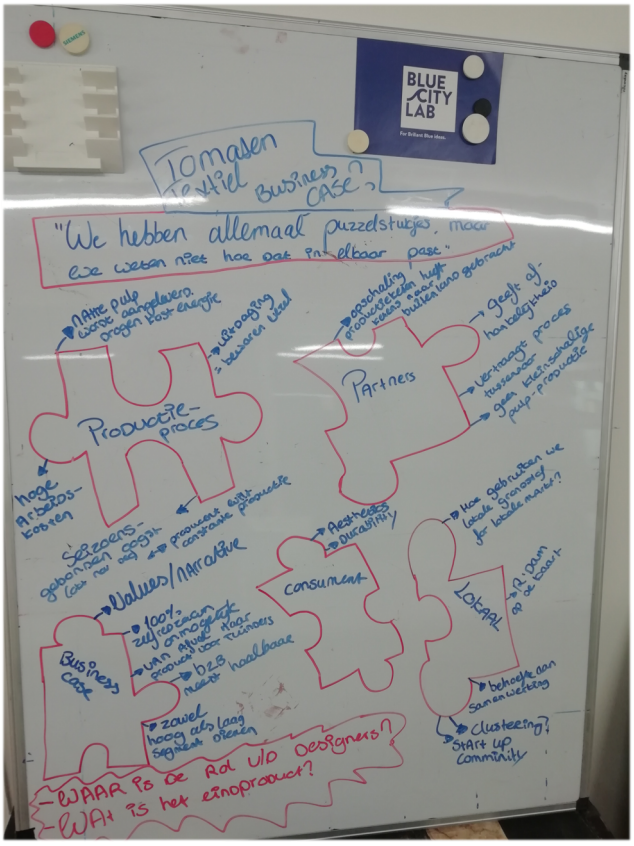


Image 1: Field notes, a summary of challenges in the project (own elaboration)

To further develop theory building and to define the challenges for local production networks operating within circular business models, interviewees that are currently frontrunners and pioneering with the production of new materials based on horticulture residual waste were interviewed. A focus was put on small and medium-sized enterprises (SME), as there is a gap in the literature on social and ecological concerns in SME (Halme and Korpela, 2014) and 99% of Dutch businesses exist of SME (EC, 2017). The data was complemented by published documents and companies' websites, as previously done by Bolis et al. (2015) and Geissdoerfer et al. (2018) in research on circular business models.

Data analysis

Hybrid coding, a combination of inductive and deductive coding was used to analyse the qualitative data that was obtained from the semi-structured interviews. Such a method for analysing data has previously been used by Fereday and Muir-Cochrane (2006) as a tool to interpret raw data and

create themes. Additionally, a process of breaking down, examine, comparing, conceptualising and categorising the data (Strauss and Corbin, 1990), by thematic analysis was conducted.[11]

This hybrid approach resulted in a total of 5 themes:

1. Circular business model types
2. Local production networks
3. Innovation
4. Challenges
5. Future prospects

[11] The detailed codebook can be found in appendix B.

Chapter 4: Findings

The following chapter provides a summary and analysis of the results that were obtained during the participant observation of the Tomato Textile project. Following up, the finding of the semi-structured in-depth interviews which were to address challenges for entrepreneurs and designers developing new material for the garment industry will be set out. This chapter will be divided into two parts: section 4.1 discusses the results of the participant observation which was used to study the Tomato Textile project. This section is divided into a discussion of the role of its stakeholders in 4.1.1, followed by an analysis of the developments in the project in 4.1.2. Section 4.2 focusses on the introduction of the challenges, business models and way of doing business of the four interviewed frontrunners in the field. The findings are structured by the research questions of this study:

1) How do innovative projects merging design and research to develop new materials operate?
2) What are appropriate business models to be used by producers of new materials operating on a local scale?

4.1 The Tomato Textile project.

4.1.1 Key partners and stakeholders

The Tomato Textile project has been initiated by the Dutch horticulture organisation Greenport West-Holland, which consists of entrepreneurs, government and knowledge institutions. To fulfil its goal to be the first horticulture region that isn't dependent on fossil fuel, the organisation is actively searching for stakeholders and projects to stimulate the development and implementation of sustainable solutions. The ambition is to reduce the combined CO2 emissions with 40% by 2030 (from 2013 onward) and to have at least 50% of the organisations' energy demand to be extracted from sustainable sources. To stimulate the development of sustainable practices in the horticulture sector, as well as in the region, the organisation has initiated various projects, amongst others the Tomato Textile project. To showcase a bio-based economy, Green port decided to invest in the waste flows that are created by tomato production, and more specifically the tomato stems that are left behind after grubbing the plants. The fibres in the tomato stems already proved to be a fitting material for paper and packaging material, which was concluded in a previous project in which Green port was a partner. This new packaging material gave tomato growers with sustainable values the opportunity to package their product (tomato) from their own waste streams. The project motivated Greenport to invest in the possibilities of using tomato fibres to create products. Inspired by the Dutch designer and artist Jalilia Essaïdi, who used the surplus of cow poo in the as a material for textile, the Tomato Textile project was created.[12]

[12] For more information on Greenport West-Holland, please consult https://greenportwestholland.nl/

Located in the City of Rotterdam, Blue City refers to itself as 'an incubator for circular entrepreneurs in and around Rotterdam' (Blue city, 2019). The Blue City, that opened in March 2017, was created based on the Blue Economy principles (Pauli, 2010) which have been discussed in chapter 2 of this thesis. In short, the incubator aims at developing a 'Blue City', where valuable waste streams are converted into useful resources by using innovative ideas and initiatives. As a hub, it houses a wide range of entrepreneurs, start-ups and small initiatives that work on sustainable solutions in which values as cooperation, waste elimination and local production are central. Besides creating a hub for entrepreneurs, Blue City also gives volunteers, students, scientists researcher and entrepreneurs the opportunity to use their *wet* and a *dry* lab that is located in the Blue City Lab. Users of this lab are allowed to create and develop products that can be realized into an end-product. [13]

The two key partners of this project initiated the creation of a project team, with various stakeholders to provide all the specific knowledge that is necessary to establish the innovative product. A strong emphasis was put on the promotion of the maker industry, innovation, and local economy to stimulate and create awareness of both consumers and the market. The characteristics of the project are visualized in *figure 5*.

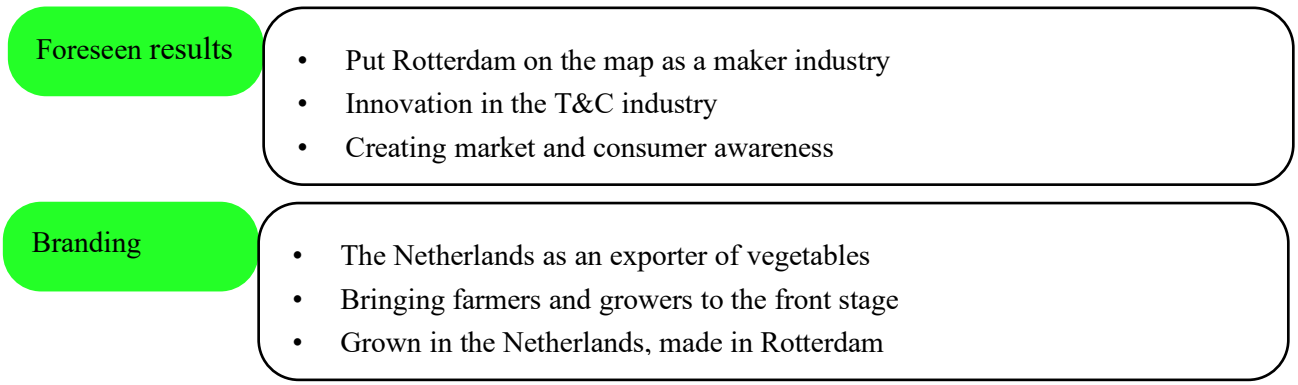


Figure 5: Aims of the Tomato Textile project (own elaboration)

4.1.2 The Path Towards a Tomato Shirt

The following section will discuss the developments within the front-end process of the eco-innovation (Bocken et al., 2013). The innovation process captures the resources that are needed to produce a cellulose mix suitable for the production of a textile product. A simplified explanation of the process that is needed to transform tomato-waste into a textile product is divided into the three following steps:

- Step 1*:* The tomato plant is shredded and made into a 'pulp soup', creating cellulose that can be used to make fibres.
- Step 2*:* The tomato fibres are used to turn into yarn.

[13] For more information on Blue City Lab, please consult https://www.bluecity.nl/bluecity-lab/bluecity-lab/

- Step 3*:* The yarn is used to knit a textile product such as a t-shirt.

Image 2 provides a visualisation of the roadmap. The developments of the projects will be discussed as divided by the former three steps, to create a chronological order of the challenges that dominated within each phase of the project.

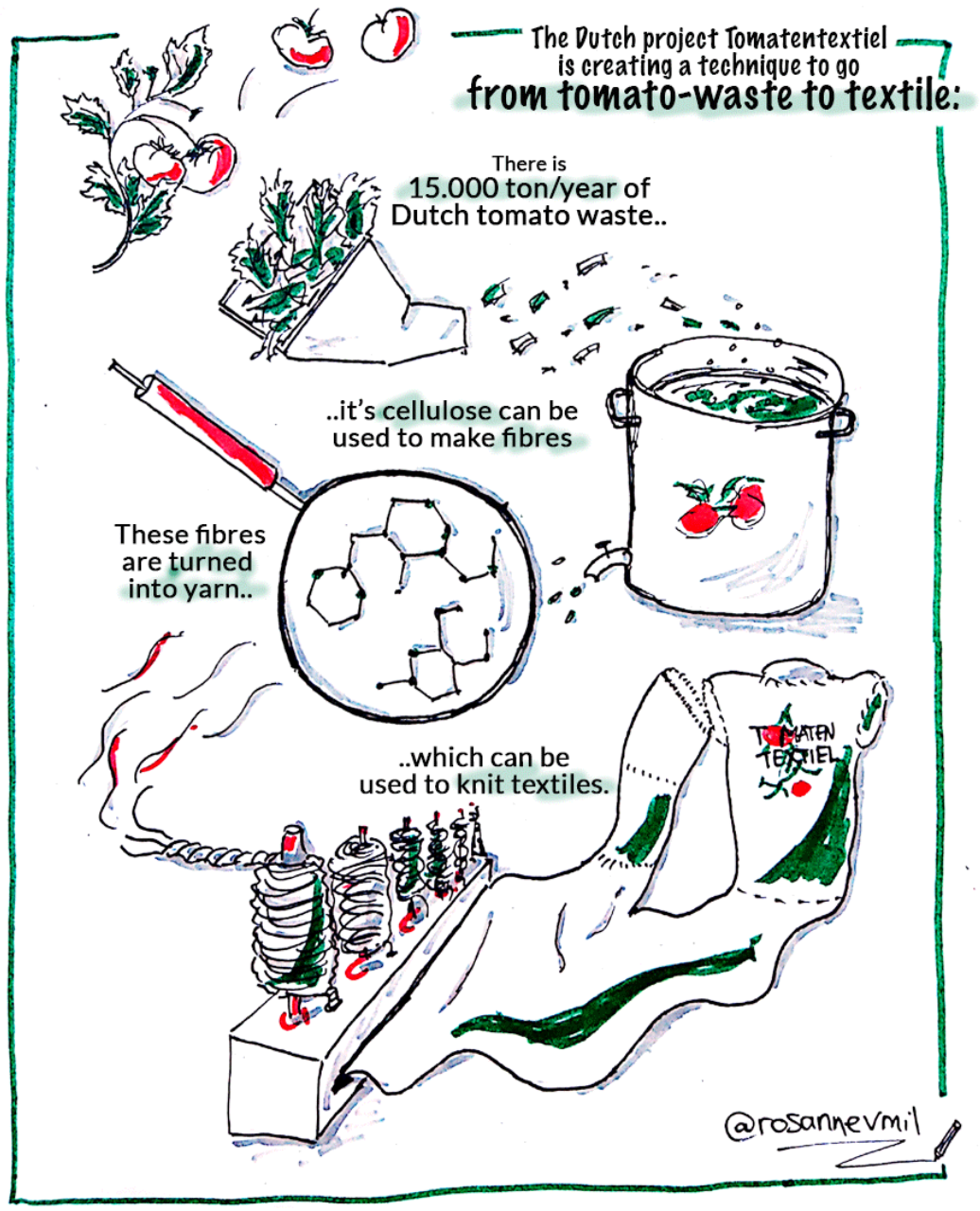


Image 2: The road from tomato to textile (Made by Rosanne van Miltenburg)

From cellulose to fibres

The first phase of the project (between January 2019 – May 2019) was focussed on exploring the possibilities of developing the product. The valuable waste stream in this case was the 15.000 tonnes of waste that is yearly produced by the Dutch tomato sector. The phase was first of all expected to answer the question that would determine the direction of the project: is it relevant and achievable to create this industry?

Within the front-end innovation process, there were three possibilities considered to create cellulose. The balance between consequences for society, the earth, money and time were taken into account within each possibility. Eventually, the decision was made to work with the possibility that required the minimum amount of financial resources, with the prospect to work fast towards a minimal viable product. This direction included welcoming three new partners: a lab in Germany that would test the pulp of the plant and two local entrepreneurs (a pulp specialist and a start-up that collects and recycles second-hand textiles (post-consumer waste) from the Rotterdam region). Eventually, the pulp was created by one of the projects' volunteers in the Blue City Lab and send to the lab in Bavaria (Germany) to test its quality. *Image 3* shows the dried pulp, consisting only of tomato-plants, creating a total of 48 grams of pulp. The pulp was created with the help of the local pulp specialist.

Image 3: Tomato pulp that was send to the lab

A focal point in the decision-making process in this phase was the preference for paths and work methods that would add to the speed of the creation of a minimum viable product. As testified by the project coordinator:

> "We have decided to continue to work on a product level; meaning that for now, we do not focus on researching the most responsible [sustainable] way of producing but focus on craftsmanship production" (Project coordinator).

According to material experts and designers, the quality of the polymers and cellulose of the product should first be analysed, to decide what type of product the most feasible to create out of the particular resource (textile, paper, packaging material etc). In this case, the working process was

the other way around in which the end product (a t-shirt) was already foreseen, and the roadmap to this product needed to be established. This touches upon the different values and knowledge that initiators of such a project can have: a product designer starts from the characteristics of the cellulose to decide on a product, an organization such as Greenport, however, started its project from a foreseen end-product. At the same time, the differences in knowledge and values are vital in overcoming the lack of knowledge in specific fields. Because of the knowledge gaps between science and industrial opportunities and the distinctive value of fashion design versus product design, an enormous amount of interdisciplinarity was needed. This was guaranteed by the collaborative aspect of the project, which also makes this project unique. Similar projects often start off with an individual designer or group of independent artists, at the same time this also creates its challenges. Including a team-member with a specialization in circular textile innovation was, therefore, a crucial part of the process, as this made a necessary connection between fashion- and product designers possible. The interdependency also caused setbacks, with practical restrictions. For example, the waiting time such as waiting for the test results from a lab in Germany.

During this phase, major problems in the possibilities to create this industry have already been identified, which are mostly logistical. First of all, the necessary drying of the pulp and the harvest of the tomato: which is only 3 months a year: from October to December. This will create a peak in the production process and a need for flexible workers and workspace. Another challenge is the location and machines that are necessary to produce the pulp in the first place. Currently, the creation of the pulp is done manually, as a pulp factory is non-existent in the Netherlands at the moment. The business leader of BCL, approaches the problems as follows:

> "It's like a relay race how do we get to the next step? We follow the path towards the garment" (Business leader, BCL).

From fibres to yarn

In this phase (not started at the time of writing this thesis, yet planned to start around the end of June), the main question is if the fibre will be suitable for the production of textile yarns. This phase will provide the 'recipe' of the cellulose that can create the yarn of the textile product, which will be provided by the same lab in Germany. As the team works from an intrinsic motivation to contribute to the knowledge in the field of circular fashion, where the main goal is not to be a frontrunner in the market but rather on horizontal cooperation (Feld, 2012), the recipe will be shared. The product will get a creative commons license, which entails that the author enables users to benefit from and evolve the work that has been created ("Creative commons license", n.d.). Whereas large firms can rely on large legal departments, this is out of scope for small and independently operating designers, which characterises the maker movement (Browder et al., 2019). A creative commons license is

therefore considered as a fair solution. By increasing the knowledge that is shared, the team contributes to possibly future innovation in the T&C industry as well.

For the textile to be produced, the cellulose of the tomato stems will need to be mixed with another cellulose. The project team has found a partner during one of the fashion summits that was organised during the project. A local entrepreneur in Rotterdam is most likely to provide the needed cellulose from post-consumer waste. The entrepreneur collects the textiles and uses a new technology that sort textiles automatically according to their fibre composition, which increases the efficiency of the process.

From yarn to product

The question within this phase is: how to create a high-value product from a low-cost waste stream? Two main problems in this phase are:

- How to produce locally?
- How and where do we create a circular production system?

It is foreseen that the Tomato Textile will be launched as a start-up by a local entrepreneur. Before the project can be transferred to an entrepreneur, the production process (from fibres to the end product) will need to take a form as well.

At this point in the development, the opposing values and interests of stakeholders will quite possibly form a challenge to decide on the next steps in the roadmap. The horticulture organisation Greenport is in search of a product to showcase an iconic project as a tool to stimulate their producers to work more circular and organic. Designers and entrepreneurs in the project seek a long-term vision: a Tomato Textile product to put on the market for everyone. At the same time, collaborations with incumbents in the sector of outdoor clothing are considered by the project team. Up until now, this gives the project three possible directions 1) develop an exclusive tomato t-shirt for the horticulture industry 2) produce a product for the market (B2C) 3) create a collaborative with an incumbent (B2B). The eventual path choice that is made for the end product, will call for a very different business model. The question is where the responsibility for keeping the fabric in the loop remains. When the fabric is sold to an incumbent, it is hard to keep the Tomato Textile in the loop as an extra stakeholder is added between the Tomato Textile producer and the consumer. A fourth option that could be considered is creating collaboratives with smaller stores and brands in Rotterdam. Within this process, it is important to keep the role of the designer in mind. This was supported by a visitor of an event that was organised by the Blue City Lab to discuss the Tomato Textile business case:

> “The freedom for designers is important, if you attach yourself to a product you will limit your freedom” (Participant, Blue business club 21/03)

The drawback of adding more stakeholders into the production process, is the increase in production partners and steps in the supply chain of the future start-up. To reduce the stakeholders and production steps in the process, a preference for knitted production of the textile with a 3D knitting machine was voiced by the designers in the team. In such a manner, the product can be 'printed' by the machine, piece by piece, which automatically eliminates residual waste in the process. Knitting will also save electricity costs, as fewer production steps are needed. Besides, the manual labour that is needed when using a 3D printer is considerably lower than for example weaving.

In this phase, the minimal viable product will need to be put on the market. The choice of the end product will is directly linked to the business model, as indicated by the project coordinator:

> "The eventual product is an important part in the development of the textile and the business plan" (Project coordinator)

As indicated by the European Commission, the added value of the product should be the focal point of circular products (European Commission, 2018). For slow fashion products to be able to succeed in the current paradigm, the added value and aesthetics of the product is vital in order to create an appealing brand for consumers. The added value and aesthetics of the product is necessary to be able to distinguish the brand from incumbents of the fast fashion industry. This emphasis is also highlighted during the discussion of the business case:

> "It [Tomato Textile] will never be fast fashion, we are in a different price category" (Participant, Blue business club 21/03)

A circular business model ideally has a closed loop (Bocken et al., 2014). The business model strategy that is used in creating a valuable waste stream in the case of the Tomato Textile project resembles with the notions of the *industrial symbiosis* (ibidem). In this process, the waste of one industry, in this case the Dutch tomato industry, is used as a resource for another industry. This strategy aims to create an interconnected network that eliminates waste and eventually creates an added economic benefit compared to classic industrial systems. In order to close the loop of the Tomato Textile product, three challenges remain at this point in my point of view: 1) the residual waste in the production process (what will be done with the rest of the tomato plant when the cellulose is extracted) 2) the emissions during transport of the products (considered as one of the bottlenecks in CE (Bocken et al., 2010) 3) the end-use phase (what happens after the usage phase of consumer). When challenges are overcome, the loop of the industrial symbiosis is closed. A proposal for a model that can be used for the project team to close the loop in its production, is showed in *image 5*.

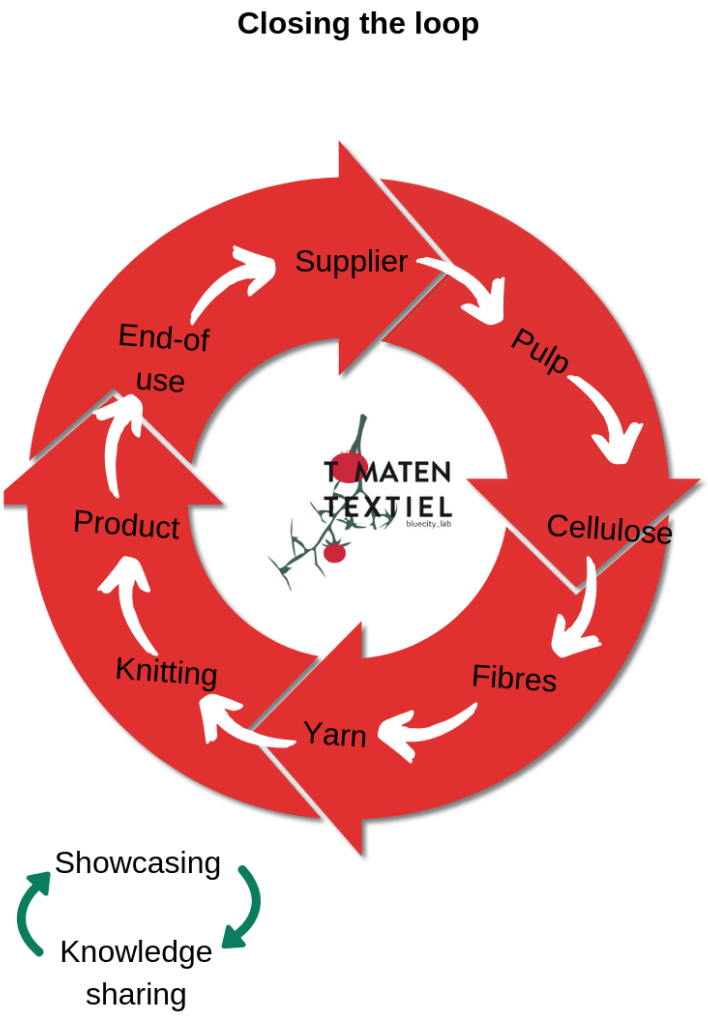


Image 4: Closing the loop in the Tomato Textile production process (own elaboration)

In the image, showcasing and knowledge sharing are always integrated into the process. This notion gives the start-up the possibility to experiment and the opportunity to adjust the business model if needed. The product should be presented to consumers and potential partners from an early stage, to create an optimal product that can be adjusted to their inputs (Ries, 2012). Additionally, it is advised to focuses on the added value and unique selling points of the product (Brydges 2018). Currently, the end product is planned to be launched at the end of September (2019).

4.2 Frontrunners in the Industry

A total of four entrepreneurs running in the slow fashion business in the Netherlands were interviewed. This section elaborates on the results and compares the aspects and focus of their business models, values and view on the industry.

Description of business model company A

Company A is a design studio which that launched in 2015 and has emerged from a student's graduation project. In a team of three, textile products and furniture are produced. Their products are mostly produced for the B2B market, and the process complies with the cradle to cradle principle (making products that are eventually biodegradable). Their focus is on the story and the

added value of the product, defined by them as *experience design*: “by creating an experience, we create awareness” (Founder, company A). The target audience of businesses was not a deliberate decision, but rather a path the studio has grown into, possibly because businesses want to address sustainability and studio creates a narrative for them. In the new economy, cooperation is important; therefore, collaborations with other brands are established and enforced, to create more impact. Collaboration comes in various forms: sometimes they work together with big partners, and other times they act as the spill in the network, and in some occasions. When ties are short, transparency and the pace of the process are increased.

At first, they produced everything themselves, but eventually, partners were found that specialized in certain aspects of the production chain, which led to the outsourcing of these parts. When production is outsourced, local partners are favoured, as working close to home is practical when you are working with innovation, as the ties are short which increases transparency and the pace of the process.

Description of business model company B

Company B is a product design studio, focused on inventing new materials and production techniques through various projects. The founder is an experienced product designer, and the studio has launched various successful start-ups that were created from a project within the studio. One could state this studio is a frontrunner. The owner of the studio is very knowledgeable in the field of circular design and has a practical view on it: “we simply have to transition to circular usage of our products”. Designers, the owner believes, can act as a connecting factor in this transition phase:

> “I understand the complexity between the market and the production side, and there exists a big gap, where design can act as a connecting factor” (Founder, company B).

One of its design projects is fabrics made out of algae, which is grown in the sea. This reduces the impact on agriculture on land, which makes it highly sustainable. At the same time, producing a textile that nobody needs, is not a sustainable business case according to the owner. At this moment, post-consumer textiles are a better business case as there is simply a great amount of supply available for this product. The production process of the algae fabric is still being optimised and innovated and is not yet on the market. For other innovative materials that are for sale, the business case is mostly B2B. Currently, this is the right market for them: if you operate B2B those businesses that you sell to know their consumers and how to sell the products. At this point, B2C is too complicated, as this would require for example a marketing team.

Description of business model company C

The entrepreneur of company C also owns a design studio, with a specific project that focusses on developing new materials from a sea product: seaweed textile. This project started in 2014, when the studio purchased the seaweed material from a Belgian company that had already been producing

this for ten years. The design studio decided to continue working with this material, after the product received many positive reactions at various design weeks. Unfortunately, the Belgian company quit the sales and production of the sea weed material as there was not enough market for it, and from then on, the design studio decided to produce sea weed themselves. At this point, the studio is still in the research and development phase, aiming at finding the right partners to create this material from scratch again. The true commercial, as well as the sustainable and circular value of this product, is acknowledged as a business opportunity by the studio as well as various bigger companies. The studio focusses on a 'holistic process' where awareness is central:

> "I try to see the bigger picture and not just one part of the chain" (founder, company C)

With the algae fabrics, the pharmaceutical and beauty industry could also take parts of its plant to use in products: there is a lot of value in the plan. In the future, the seaweed plant could, therefore, use an industrial symbiosis business strategy (Bocken et al., 2016). For now, however, there is not a business case apart from small scale collaborations with sustainable fashion brands and more art-focused items that are showcased in museums. A lack of funding and production facilities is causing delay in the process, although the market is ready for it:

> "I think the market is ready for it, but something is holding it back, and I don't know exactly what that is" (founder, company C)

Description of business model company D

Company D is the only respondent in this sample that does not have a design background, but a more businesses related and consultancy history. An intrinsic motivation combined with a foreseen gap in the market lead to the launch of the start-up, in 2013, which combines post-consumer textiles with new materials. The start-up sees itself as a textile label and transition firm, that acts as one of the partners within a network. This company offers a mixture of services for designers and makers in the field, offering 'solution development'. Besides, the studio produces its own product which is made out of recycled plastic combined with post-consumer textile. By organizing its own supply chain, it is foreseen that the market will pick up this innovation eventually:

> "The market was not ready for it, so I decided to create it with an innovation. I hope the market will pick it up accordingly" (founder, company D)

The business model consists of a mixture of subsidies and sales but is not profitable up to this point. Products contain collaborative fashion products (bags, ropes) and furniture (sofa). At the moment, the company creates supply as well as demand with its products and collaboratives and foresees a future in the hospitality sector and lease constructions (e.g. Tukker, 2004).

Chapter 5: Discussion and conclusion

With the growing attention on a local and global scale that has been granted to sustainable and circular solutions, opportunities for entrepreneurs to get funding, scale up, grow their brand awareness and increase their recognition have been developing. But what are the challenges in this process? And what business models are suitable in its development?

This chapter discusses the findings of the participant observation and the semi-structured interviews of this research. The discussion is structured along with three themes. First: the circular business models used by the interviewees, as well as the business model creation and innovation of the Tomato Textile project will be discussed. Second: the external factors that influence the circular business models, such as the availability of local production networks and funding, are identified and set out in section 5.2. Thirdly, in section 5, the future prospects and challenges for the development of the slow fashion and circular economy practices in the Netherlands are considered. Finally, limitation and future implications for research are presented in section 5.4.

5.1 Circular Business Models

In BMI and NBM, the role of entrepreneurs and pioneers to foster a society in transition is vital (Kraaienhagen et al., 2016); and it seems that the respondents within the scope of this research were aware of this. The entrepreneurs in this research were merely young and inexperienced. In this case, mostly operating from strong intrinsic motivation. Even more, considering the interdisciplinary nature of the field, knowledge sharing and financial support are necessary for a successful business case.

The strong emphasis on sharing innovation and information was evident in most cases. In the Tomato Textile case, expert meetings and business events focused on the possible business case for their product, fostered the possibilities to innovate and experiment for its business model. The openness and willingness to share knowledge and open up about the challenges in the project showed an eagerness for development where there was no limitation to the amount of information that was shared: “share as much as you want”. Another way to increase knowledge sharing was the launch of a website and an Instagram account, where the mission of the Instagram account was to “look for a new life for tomato stems together”. The Instagram account aims to include followers in the process from an early stage to develop a relationship with the brands’ followers, but also to get in contact with experts, similar projects and entrepreneurs that can share information network and experience.

In the qualitative results, a great variety of business models was used, with different interpretations. In *table 4* an overview of the respondent's business models is displayed according to the introduced strategies by Bocken et al. (2014, 2016) and Bakker et al. (2014)

	Value proposition	**Revenue model**	**Business model strategy**	**Focus market**
Company A	Cradle to cradle Experience design	Lease Product sales	Extending resource value	B2B
Company B	Use design to create valuable life cycle of products	Product sales	Industrial symbiosis Extending resource value	B2B
Company C	Holistic view on the economy	Product sales	Classic long-life model Industrial symbiosis	B2B
Company D	Cradle to cradle Address imbalance between material use and continuous ecological impact	Product sales Subsidies	Extending resource value Extending product value	B2C B2B

Table 4: Overview of respondent's business models (own elaboration)

The results show a strong focus on product sales as a revenue model, which reduces the notion of product responsibility of the producer along the life cycle of the product. Company A indicated that a lease model is used in the B2B market, but only if it is requested by the client itself. The business model strategies that were mostly used were either 'slowing' (classic long-life model, extending product value) or 'closing' the loop (extending resource value, industrial symbiosis). The respondents pointed out that finding the right business model is "very challenging". A leading challenge was the lack of knowledge and industry of new materials in the Netherlands to develop and grow the business, and eventually, scale up. For now, the fashion apparel industry is not a suitable market. Rather, the garment industry such as furniture (company A, B, D), the hospitality sector (company D) and business-to-business (company A, B, C) is favoured at this moment. The fashion industry is slowly adapting, but it will take at least 5-10 years for it to adapt completely (company B).

At this point, creating a competitive advantage through pricing is not achievable, and the focus should be put on the added value of products, as highlighted by the founder of company B:

> "You simply cannot compete with the price of yarn that is currently produced [..] which means you will have to produce something that has a very specific function" (founder, company B)

A critical factor for the transition to the new business models according to company B are designers (to come up with innovation) and business developers (to find a way for the product to go upstream). Company A also articulated the necessity of 'trial and error' in the process of creating a business case, which allows irritations and pivots to the product (Ries, 2012). By integrating customer feedback in the front-end innovation process, feedback is increased to create products the market wants. Additionally, it takes the pressure off to say, "we are just experimenting" and you don't know what is going to happen next. For the Tomato Textile project, the ability to integrate these factors into their BMI will most likely contribute to the success factors of their product (Ries, 2012).

5.2 External factors

5.2.1 Locational factors

A leading question in the Tomato Textile project was "how local can we go?". The focus for the supply chain is within Rotterdam, which resembles the blue economy values (Pauli, 2010). At the same time, production actors necessary for the supply chain to develop, are mostly outsourced because of the de-industrialization. Think for example of the missing pulping factory in the Netherlands, which would result in having to purchase a pulping machine. The Netherlands, and after that West-Europe are considered to be included in the local production network. An overview of the partners needed and their location in the circular supply chain is provided in *table 5*.

Production phase	Rotterdam/ NL / West Europe	Process steps
From cellulose to fibres	Tomato producers (West of the Netherlands)	Collect resources of the product
From cellulose to fibres	1) Pulp machine within BCL (Rotterdam) 2) Local circular waste processor (Rotterdam) 3) Local pulp entrepreneur (Rotterdam)	Creation of the pulp
From fibres to yarn	Local entrepreneur in Rotterdam in collaboration with BCL	Production of the tomato cellulose, fibres and yarn
From fibres to yarn	Local entrepreneur in the Netherlands	Colouring of the yarn
From yarn to product	3D knitting machine (BCL, Rotterdam)	Knitting yarn
From yarn to product	Enschede (NL)	Production of the textile product
Consumer	Throughout the Netherlands	Distribution of the product
Post-consumer	?	Re-use or down cycle of the product.

Table 5: Partners in the Tomato Textile project (own elaboration)

As is shown in *table 5,* different production phases need various stakeholders and partners for the process steps to be successfully succeeded. After all, when a product is purchased by a consumer or business it is no longer the producers' possession and it is up to the buyers to keep the product in the loop (by for example returning the product to the producer or recycle it). The table indicates that partners would ideally be located in Rotterdam or the Netherlands. Within the Tomato Textile team, it is questioned whether the full production chain should be housed into the start-up, as indicated by the project coordinator:

> "The Tomato Textile project still focusses on creating a wearable prototype, but it is important to realize that full management [of the product's supply chain] is not automatically the best option"

Whether it would be possible to outsource parts of the supply chain is questionable at this time. The respondents of the semi-structured interviews also indicated that the T&C industry is not in transition yet (company B): things are moving, but nothing is *really* happening (company B, C, D).

The expert meetings in the participant observation, and to some extent the semi-structured interviews, proved to have a need for a 'local for local' community. The strong reliance on collaborations and the interdisciplinary nature of producing new materials in an industry that is slowly integrating into the political, economic and socio-economic agenda, calls for a need to pinpoint if and where clustering is taking place. The tendency of clustering is in line with the urban agglomeration theory of Lorenzen and Frederiksen (2008) and the start-up communities' theory by Feld (2012). Urban agglomeration discusses how firms co-locate because of spill-over effects and knowledge sharing possibilities, possibly creating interdependency leading to even more knowledge and technology spill overs. Start-up communities, or clusters, are characterized by a high entrepreneurial density operating in agglomeration economies, horizontal networks and a creative class. Agglomeration economies (Lorenzen and Frederiksen, 2008; Porter, 1996) concentrate start-ups in an area that can use common inputs (such as specific knowledge, suppliers, shared fixed costs, resources) which also enhances network effects. Here, adding one member to the network creates a benefit for all existing users. The network furthermore operates horizontally, sharing information amongst all users to contribute to innovation and knowledge creation. The local spill over effects will boost the local economy, reducing the waste and creating jobs for employees currently having poor job prospects. These effects will be picked up by consumers, as well as by producers of the resources, or waste streams that figure as a resource for new material.

5.2.2 The role of gatekeepers

Whereas incumbents in the industry with more resources have their own R&D department to invest in circular products, entrepreneurs and start-ups face difficulties with finding the initial funding for new projects. Start-ups are mostly dependent on external finances, and the initial phase where

research and development take place market a high rate of uncertainty making financing even more challenging (Circle economy, 2016). Particularly, the phase between the start-up and early stage, referred to as 'the valley of death', is crucial. Within the circular economy, business finance is even more of a challenge (Circle economy, 2016; Fischer and Achterberg, 2016). Company A, B, C and D all started with initial funding and participated in design weeks, and sometimes even got granted an award. An overview can be found in *table 6*. This indicates a willingness of the industry to move towards a sustainable, circular production. For the new materials industry, these awards and design weeks act as gatekeepers, that act as an intermediary to help consumers by providing information and selecting certain products for their awards and/or design weeks (Towse, 2010).

	H&M global change awards	**Dutch design week**	**Milan design week**	**New material award (stichting DOEN)**	**Future fabrics expo (London)**	**Dutch Sustainable fashion week**
Company A		x	x			x
Company B	x	x	x	x		
Company C		x				
Company D		x			x	

Table 6: Overview of awards and design weeks respondents (own elaboration)

Larger fashion firms are the ones that can make the difference as they have an impact in production because of their size. This has been defined by the respondents as a *pull function* (Company B, C), in which incumbents in the business (of bigger size) can 'pull' others with them into the direction they choose. At the same time, meaningful innovations are taking place at a small scale in the maker movement. However, these firms are too small or inexperienced to take on all of the resistance of the establishment (Perez, 2002). Therefore, especially in the research and development phase, funding and awards (with price money) and early venture capitalists are needed to foster innovation. Research and development take place at a small scale, without the (financial) resources the bigger incumbents enjoy at their facilities. This makes the production of quality products challenging within this field, as research, time and consumer validation is needed to create a product of comparable quality to for example refined cotton.

5.3 The next big thing?

A recurring theme in the semi-structured interviews was either "the market is not ready for it" or "it is too early". At the same time, a strong belief in the production of new material (company B, C) and usage of post-consumer textiles were identified (company B, D). Building on the notion of Perez (2002), it seems that the current state of the industry can be placed in the so-called 'installation period'. This period starts with a 'big-bang', referring to an innovative breakthrough

that motivates entrepreneurs to start working with similar innovations. Within this period the old paradigm is still not convinced of the new socio-economic practices and is holding on to old practices of the former paradigm, and this battle can take time to overcome (between 20 and 30 years).

Applied to the fashion industry, the 'old paradigm' holds to the economic notion of sufficiency and low-cost production by outsourcing parts of the supply chain (fast fashion). In the new socio-economic paradigm, fashion and product designers are pioneering with new materials, that consist of bio-based-, post-consumer or residual waste streams. In this view, the social notion is that production should not harm the environment nor society. Gradually the new entrepreneurs, referred to as "the potential bearers of the next technological revolution" by Perez (2002, p. 11), will be noticed by funds, investors and financial entrepreneurs. In this period, the role of iconic projects such as the Tomato Textile case is influential, as highlighted by company B:

> "Iconic projects are needed for a society that is in the middle of a sustainability shift" (Founder, company B).

Challenges in the Tomato Textile project

Up until this point, a few key challenges have been identified of which knowledge, balancing of values and the answer to "how local is local" are leading. Operational challenges as these are well known in the business model innovation literature (Linder & Williander, 2017) and can mostly be overcome in practice by experimenting and testing hypotheses. Challenges that are difficult to overcome are related to values in the current paradigm, in which the linear businesses and CBMI hold different propositions.

The knowledge gap that formed a challenge in the project is rooted in the complexity of the production process, which combines product developers, fashion designers, horticulture producers, entrepreneurs and marketeers, who each have their own expertise and view on the product. Finding a balance between the needs and values of the funders is fundamental to decide the direction in which the development of the product will go and how this will influence the eventual business case. Furthermore, the locality of the product is a challenge, as the project team wants to use what is already there as much as possible. However, the network is yet to be established and strengthened as there is no local cluster of circular textile industry present at the moment (but it is slowly growing). Therefore, the pioneering role of Tomato Textile is extra important, as it initiates to connect and cooperate horizontally with other projects. An overview of the assessments that can potentially be realized if Tomato Textile will continue to exist, is provided in *table 7.* It is evident that not only the textile and clothing industry could benefit from such an innovation. Furthermore, innovations as these could catalyse a system wide change, ranging from optimal land usage to the reduction of plastic.

Measure	Scope	Potential ecological benefit
Plastic usage reduced	Horticulture sector motivated to use sustainable materials	Reducing the use of plastic in the Dutch horticulture industry
CO2 emissions reductions	CO2 reduced by establishing local production networks	The total CO2 of transportation is reduced by using circular supply chain networks on a local scale
Waste to land-fill	Waste-stream of one industry became the feedstock for another production process	Reduce landfill of Dutch horticulture industry (specifically tomato) and garment industry
Optimal usage of land	Combining product streams on one land	By using the waste stream as a resource, land is optimally used as it included a resource for two different products (textile and tomato)

Table 7: Overview of assessments based on Short et al. (2014)

5.4 Limitations and Future Research

As indicated before by Short et al. (2014), bridging the literature field of industrial symbiosis (as part of industrial ecology) and business model innovation is developing, and an attempt to bridging these fields has been made in this research. However, there were a few limitations to this study, and it is advised to conduct more qualitative and/or ethnographic studies in this growing field.

The scope of the study was limited to one case study for the participant observation, which allowed for perceptions and observations from the project members as well as from the researcher. The limitation of such a scope is the limited perspective that can be established. More qualitative research on the view of the (potential) consumers on projects and innovation in this field would benefit the consumer-led development of products like these. Additionally, consumers perspectives on product service models such as rental and leasing business models would form a valuable tool to decide the direction of business model innovation in the textile and clothing industry.

Another shortcoming of the research is the limited time frame in which the data could be collected and analysed, as it is a Master Thesis. It would have been beneficial for the research to follow the project until the last step (the eventual end product). Furthermore, by following a project for a long time and up close, the underlying layers and patterns can be identified. Future research on the Tomato Textile project could analyse the challenges and shortcomings of the project over a longer period. Another consequence of the time constraints is the focus on the Dutch textile and clothing industry, future research on the global application of the greenhouse model could improve the applicability of the framework.

Frontrunners and pioneers go against the status quo of the fast fashion practices by creating new materials that are less environmental and socially harmful. These solutions acquire a broad

knowledge, ranging from product and fashion technology to business developers, educators and students. Future research on what is needed to close the gap would benefit the developments and innovations in the industry.

Chapter 6: Recommendations and Future Steps: a Framework Proposal.

The tomato producers in the Netherlands succeeded to create a system in which an optimal and controlled growth of the tomato plant is stimulated. By growing the tomato in the controlled environment of a greenhouse, the optimal growth of the plant is stimulated. Temperature, the amount of sunlight, water and food for the plant is controlled in such a way that it can grow throughout the seasons. The greenhouses form a metaphor that is rooted in the proposed business model framework: if the perfect circumstances are not present, why not establish an environment that fosters the growth to create opportunities? By creating a greenhouse, the most optimal circumstances are created. In an economy external factors influence the production system as well in unexpected ways, the framework is intended to create systematic thinking.

In the literature review, it became evident that circular business models need to be considered as a new system, and way of thinking. The qualitative results have showed a strong need for collaboration and knowledge sharing to foster innovation in the industry. Additionally, design and BMI should be implemented simultaneously to fully capture the business' potential (EMF, 2012; Stahel, 2010). An example of a collaboration method is the maker movement, in which a wide range of actors works together to foster entrepreneurship. In the maker movement methodology, it has been articulated that for entrepreneurship to flourish, social, knowledge and technology are needed. I would like to stress that in the social resource, the context of the socio-economic context should be seen apart from one's intrinsic motivation that roots in an entrepreneur's values (as this is needed to become an entrepreneur in this field apparently). The results of the qualitative analysis raised questions on how to bring the different stakeholders together. The solution lies in integrating systematic thinking.

By introducing the *Tomato Collaboration Model (TCM)*, the industry of new materials of the T&C industry needs to be considered a tomato plant, that needs to grow. The growth is a metaphor for the innovation in the industry: when the different actors work together, innovation is fostered and strengthened. Therefore, the tomatoes in the framework embody the various stakeholders. Besides, in a tomato plant, all tomatoes are merely the same size, referring to the mutual importance of all actors involved. This notion also fosters a feeling of shared responsibility instead of consumers pointing at producers, producers pointing at consumers and the government that operates in an outdated socio-economic environment. In the *TCM*, you don't know which tomato will come out and grow as the first, the innovations can be initiated by all stakeholders. It is a way of thinking that stretches further than a business model but motivates all actors to think of their role in the system and the cooperation and understand their interdependency: tomato cooperation. An innovative aspect of this model is that it stimulates all actors to reflect on their

responsibility and role in the network, and it can therefore be used for producers, designers, consumers, entrepreneurs and policy makers that aim at incorporating systematic thinking. The *TCM* is presented in *figure 6.* The resource dimensions of the maker movement model by Browder et al. (2019) are taken as a source for innovation to occur. Considering the strong focus on value for entrepreneurs that enter a system of circular thinking, this is added as a fourth value. External factors are the location of the innovation (are there local production networks for an innovation to develop), gatekeepers (which can provide access to the market or funding) and government policies (think back of the 'Dutch circular textile valley' discussed in section 2.1.3). As all actors operate under uncertain circumstances, all 'tomatoes' are seen as entrepreneurs that interact and collaborate within the system to foster innovation

By using this framework, buying a t-shirt become more than the product on itself, but reminds that the end-product is part of a system. It is a solution for integrating the consumer and values into the circular economy business system.

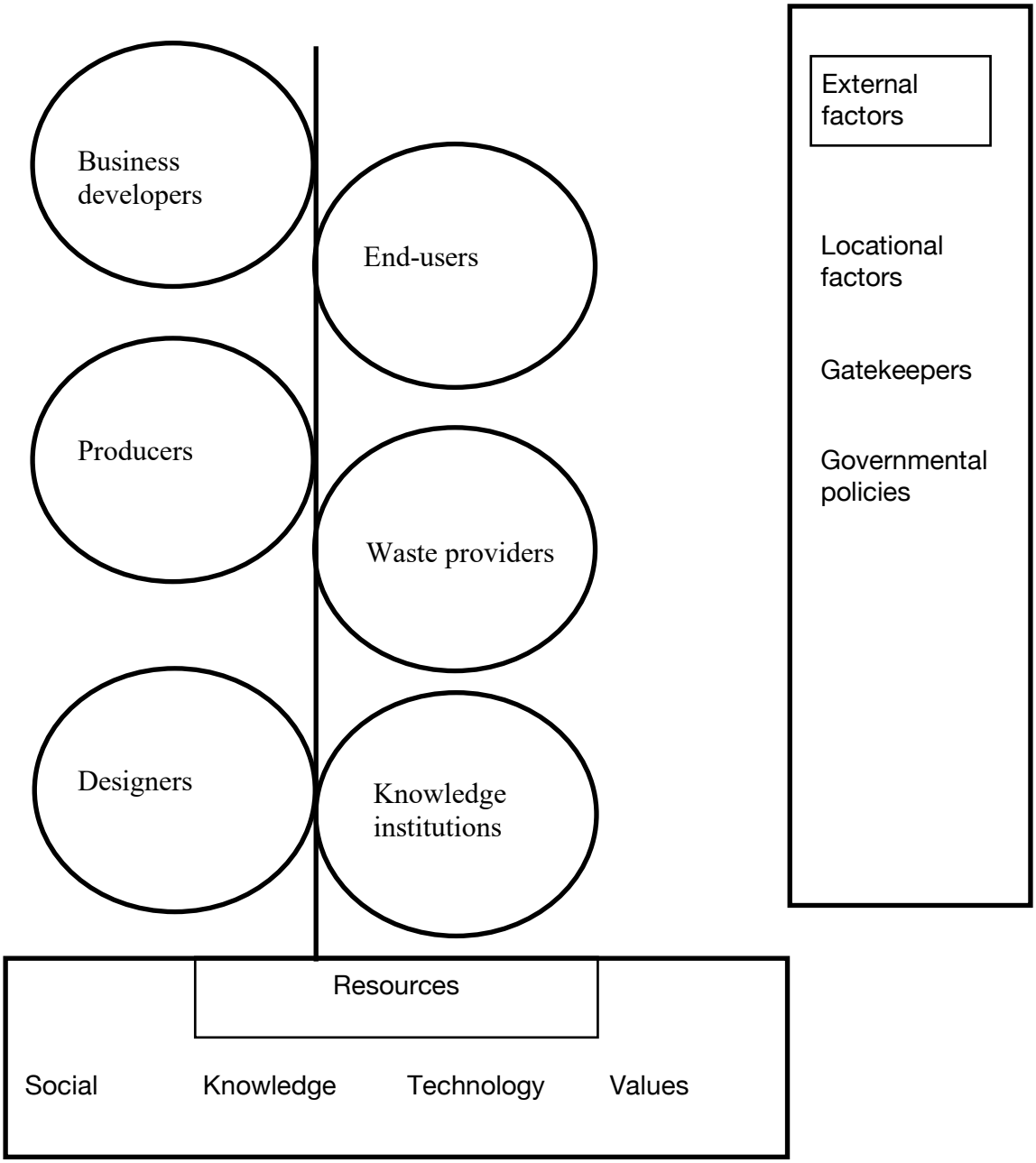


Figure 6: The Tomato Collaboration Model (own elaboration)

7. References

Achterberg,. Hinfelaar,. and Bocken, N.M.P. (2016). Circular businesses with the Value Hill. In: *3 Essential steps to financing circular business models.* Retrieved from: https://www.circle-economy.com/financing-circular-business

Anderson, C. (2012). *Makers: The new industrial revolution***.** New York, NY: Crown Business.

Antikainen, M., Bocken, N.M.P., (2018). Experimenting with circular business models – a process-oriented approach. In: Bocken, N., Ritala, P., Albareda, L., and Verburg, R(eds.). *Innovation for Sustainability. Business transformations towards a better world.* Palgrave Macmillan Palgrave Studies in Sustainable Business.

Antikainen, M. Aminoff, A., Paloheimo, H., Kettunen, O. (2017, March 19-22). *Designing circular business model experimentation - Case study*. Paper presented at ISPIM Innovation Forum, Toronto, Canada.

Antikainen, M., and Valkokari, K. (2016). A Framework for Sustainable Circular Business Model Innovation. *Technology Innovation Management Review,6*(7), 5-12. doi:10.22215/timreview1000

Bakker, C., M. Den Hollander, E. van Hinte and Y. Zijlstra (2014). *Products that last. Product design for Circular Business Models,* Delft: TU Delft Library.

Barney, JB. (2002). *Gaining and sustaining competitive advantage*. Addison-Wesley: Reading, MA

Beinhocker, E. (2012) 'New economics, policy and politics', in: Dolphin, T. and Nash, D. (eds) *Complex new world.* London: Institute for Public Policy Research, pp. 142-144.

Benyus, J.M., 1997. *Biomimicry: Innovation Inspired by Nature*. Harper Collins Publishers, New York.

Blanks, S. (2013). Why the lean start-up changes everything. *Harvard business review*. 91 (5), 63-72.

Blue City (n.d.). *About BlueCity.* Retrieved from: https://www.bluecity.nl/about-bluecity/

Bocken, N.M.P., Ferracho, M., Bosworth, R., Kemp, R. (2014). The front-end of eco-innovation for eco-innovative small and medium sized companies. *Journal of Engineering and Technology management.* 31, p. 43-57.

Bocken, N. M., Pauw, I. D., Bakker, C., and Grinten, B. V. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering,33*(5), 308-320. doi:10.1080/21681015.2016.1172124

Bolis, I., Brunoro, C.M. Szelwar, L.I., 2015. Work for sustainability: case studies of Brazilian companies, *Appl. Ergon*. 57, 72-79

Boons, F. and Lüdeke-Freund, F. (2013): Business Models for Sustainable Innovation: State of the Art and Steps Towards a Research Agenda, *Journal of Cleaner Production*, Vol. 45, 9-19. Available at http://www.sciencedirect.com/science/article/pii/S0959652612003459

Breyer, M. (April 17th, 2019). *Adidas unveils running shoes that never have to be thrown away.* Retrieved from: https://www.treehugger.com

Brito, M. P., Carbone, V., and Blanquart, C. M. (2008). Towards a sustainable fashion retail supply chain in Europe: Organisation and performance. *International Journal of Production Economics,114*(2), 534-553. doi:10.1016/j.ijpe.2007.06.012

Brooks, A. (2015, February 13th). *The hidden trade in our second-hand clothes given to charity.* Retrieved from https://www.theguardian.com

Brydges, T. (2018). "Made in Canada": Local production networks in Canadian fashion industry'. In: *The Canadian Geographer*, 62(2), pp. 238-249 DOI: 10.1111/cag. 12400

Brydges, T, Hracs, Brian J., and Lavanga, M. (2018). Evolution versus entrenchment: debating the impact of digitization, democratization and diffusion in the global fashion industry. *International Journal of Fashion Studies*, *5*(2), 365–372. doi:10.1386/infs.5.2.365_7

Browder, R. E., Aldrich, H., & Bradley, S. W. (2017). Entrepreneurship Research, Makers, and the Maker Movement. *Academy of Management Proceedings,2017*(1), 14361. doi:10.5465/ambpp.2017.14361abstract

Browder, R. E., Aldrich, H. E., and Bradley, S. W. (2019). The emergence of the maker movement: Implications for entrepreneurship research. *Journal of Business Venturing,34*(3), 459-476. doi:10.1016/j.jbusvent.2019.01.005
Bryman, A. (2012, 4th edition). *Social Research Methods.* Oxford University Press
Casson, M. and Wadeson, N. (2007). The discovery of opportunities: extending the economy theory of the entrepreneur. *Small business economics*. 28, 285-300. https://doi.org/10.1007/s11187-006-9037-7.
Cave, A. (November 21st, 2016). *Don't buy this jacket' Patagonia to give away all retail revenues on Black Friday.* Retrieved from: https://www.forbes.com
Caves, R. (2000). *Creative industries: Contracts between art and commerce.* Harvard University Press, Cambridge MA.
Celie, Y. (2017, October 16). H&M verbrandt jaarlijks 12 ton nieuwe kleding, *Algemeen dagblad*. Retrieved from: https://www.ad.nl/binnenland/henamp-m-verbrandt-jaarlijks-12-ton- nieuwe-kleding~a393594c/
Circle Economy (2016, December 13). *6 guidelines to empower decision-making in the circular economy.* Retrieved from: https://www.circle-economy.com/6-guidelines-to-empower-financial-decision-making-in-the-circular-economy/#.XNrHN9MzbBI
City of Rotterdam, Making sustainability a way of life for Rotterdam, Rotterdam programme on sustainability and climate change 2015-2018, city of Rotterdam.
Clark, Hazel (2008) SLOW+FASHION-an oxymoron- or a promise for the future?, *Fashion theory*, 2(4), pp. 427-446, DOI: 10.2752/175174108X346922
Drijver, J., and Broer, W. (2014). Verduurzaming consumentengedrag Mode. *Amsterdam, CREM*.
Eisenhardt, K.M. (1989). Building theories from case study research. *Academy of management review.* 14(4). 532-550.
Eisenhardt, K.M. (1991). Better stories and better constructs: the case for rigour and comparative logic. *Academy of management review.* 16(3). 620-627.
Ellen MacArhur Foundation and McKinsey. (2015). Growth within: A circular economy vision for a competitive europe.
Ellen MacArthur Foundation. (2013a). Towards the circular economy (Vol. 2).
Ellen MacArthur Foundation. (2013b). Towards the circular economy, economic and business rationale for an accelerated transition.
Ellen MacArthur Foundation. (2017). A new textiles economy: Redesigning fashion's future.
Ellen MacArthur Foundation. (2018). Ellen macarthur foundation. Retrieved from https:// www.ellenmacarthurfoundation.org
European Commission (2017). SBA Fact sheet, the Netherlands. Retrieved from: ec.europa.eu
European Commission. (2018). Circular economy. Retrieved from http://ec.europa.eu/environment/circular-economy/index_en.htm
European Commission (2012, October 29th). Small companies, big ideas. Retrieved from: https://ec.europa.eu/environment/ecoap/
European Commission (n.d.). Textile and clothing in the EU. Retrieved from: https://ec.europa.eu/growth/sectors/
Erkman, S. (1997) Industrial ecology: a historical view. *Journal of Cleaner Production.* 5 (1)
Erler, S., and Rieger, E. (2016). Product Evolvement through Entirely Scheduled Lifecycles. *Procedia CIRP*, 48, 79-83. Europa
Farra, E. (2019, March, 26th). *Are plant-derived materials the Future of Fast Fashion? H&M makes clothes from pineapple leaves, orange peels and Algae*. Retrieved from: https://www.vogue.com
Fereday, J., and Muir-Cochrane, E. (2006). The role of performance feedback in the self-assessment of competence: A research study with nursing clinicians. *Collegian,13*(1), 10-15. doi:10.1016/s1322-7696(08)60511-9
Fischer, A. and Achterberg, E. (2016). *Create a financeable product-as-service business in 10 steps*. Retrieved from: https://www.circle-economy.com/financing-circular-business

Fletcher, K. (2010). Slow Fashion: An Invitation for Systems Change. *Fashion Practice,2*(2), 259-265. doi:10.2752/175693810x12774625387594
Fletcher, K. (2008). *Sustainable fashion and textiles: Design Journeys.* Oxford: Earthscan.
Fletcher, K. (February 10, 2019). *Manifesto.* Retrieved from: http://www.concernedresearchers.org/
Franco, M. (2017). Circular economy at the micro level: A dynamic view of incumbents' struggles and challenges in the textile industry. *Journal of Cleaner Production,* 168, 833–845.
Freeman, R. E. (1984). *Strategic management: A stakeholder approach.* Boston: MA: Pitman.
Freeman, C. Clark, J. and Soete, L. (1982). *Unemployment and technical innovation: A Study of Long waves and economic development*. London: Frances Pinter
Frisinger, L. and Forsberg, N. (n.d.). Our story. Retrieved from: https://swedishstockings.com/pages/our-story
Geissdoerfer, M., Morioka, S. N., Carvalho, M. M., and Evans, S. (2018). Business models and supply chains for the circular economy. *Journal of Cleaner Production,190*, 712-721. doi:10.1016/j.jclepro.2018.04.159
George, A.L. and Bennett, A. (2005). *Case studies and theory development in the social sciences.* Cambridge, MA: MIT Press.
Global Fashion Agenda and Boston Consulting Group (2017). *Pulse of the fashion industry.* Retrieved from: https://www.globalfashionagenda.com/initiatives/pulse/
Global Fashion Agenda and Boston Consulting Group (2019). *Pulse of the fashion industry.* Retrieved from: https://www.globalfashionagenda.com/initiatives/pulse/
Gold, R. L. (1958). Roles in sociological fieldwork. *Social Forces,* 36, 217–223. doi: http://dx.doi.org/10.2307/ 2573808http://dx.doi.org/10.2307/2573808
Greenport West-Holland, Tomaten T-shirt: Rotterdams textiel van reststromen uit de regio. *Aanvraag Citylab010.*
Grin, J., Rotmans, J., and Schot, J. (2010). *Transitions to sustainable development; new directions in the study of long term transformative change.* New York, NY: Routledge
Guide, Jr., V. D. R., L. N. Van Wassenhove, eds. (2006). Closed loop supply chains. Special issue. *Production Operational Management*, 15(3and4).
Hart, S.L. Milstein, M.B., 1999. Global sustainability and the creative destruction of industries. *Sloan Management Review.* 41, 23-33.
Hawken, P., Lovins, A., and Lovins, L. (2000). *Natural capitalism: The next industrial revolution.* London: Earthscan.
Hörisch, J., Freeman, E. and Schaltegger, S. (2014). Applying Stakeholder Theory in Sustainability management: Links, similarities, dissimilarities and a conceptual framework. *Organization and environment,* 27(4), pp. 328-346.
Hussain, T. (2018). Re-fashioning the garment industry: Exploring innovations for a circular economy. *Clothing Cultures, 5*(1), 61-86. doi:10.1386/cc.5.1.61_1
Van der Haak, B. (2018). *Future fashion* [documentary]. Retrieved from: https://www.vpro.nl/programmas/tegenlicht/kijk/afleveringen/2018-2019/future-fashion.html
Halme, M., and Korpela, M. (2014). Responsible innovation toward sustainable development in small and medium-sized enterprises: A resource perspective. *Business Strategy and the Environment,* 23, 547–566.
Harvey, F. (2018, December 16). *UN climate accord 'inadequate' and lacks urgency, experts warn.* Retrieved from https://www.theguardian.com
Hoskins, T. (2014, October 1st). *Cotton production linked to images of the dried up Aral Sea Basin.* Retrieved from https://www.theguardian.com
IPCC, 2018: Summary for Policymakers. In: *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [V. Masson-Delmotte, et al. (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Jin, B., and Cedrola, E. (2018). *Product innovation in the global fashion industry*. New York: Palgrave Macmillan.
Jonker, J. (2018). *Nieuwe business modellen* [Oratie]. Retrieved from: https://startcirculair.nl/wp-content/uploads/2018/05/Oratie-J.Jonker-VUB-09.03.18.pdf
Kirchherr, J., Reike, D., and Hekkert, M. (2017). *C*onceptualizing the Circular Economy: An Analysis of 114 Definitions. *SSRN Electronic Journal.* doi:10.2139/ssrn.3037579
Klamer, A. (2017). *Doing the Right Thing: A Value Based Economy*. Ubiquity Press.
Kraaijenhagen, C., van Oppen, C., and Bocken, N. (2016). *Circular business: Collaborate and circulate*. Retrieved from: https://circularcollaboration.com/
Lavanga, M. (2019). Sustainable fashion in the Netherlands. In: A. Gwilt, E.A. Ruthschilling and A. Payne (Eds), *Mapping sustainable fashion: Global Perspectives.* London: Bloomsbury Academic Publishers.
Lacono, J., Brown, A., Holtham, C. (2009). Research methods - a case Example of Participant Observation. *The Electronic Journal of Business Research Methods*, *7* (1), 39-46.
Lee, Michael, Seifert, Miriam and Cherrier, Helene. (2017). Anti-consumption and governance in the Global Fashion industry: Transparency is Key. In: Hira A, M. Benson-Rea (eds.), (2017) *Governing Corporate Social Responsibility in the Apparel: Industry after Rana Plaza*, DOI 10.1057/978-1-137-60179-7_5
Linder, M. and Williander, M. (2017). Circular Business Model Innovation: Inherent Uncertainties. *Business strategy and environment,* 26, 182-196. DOI: 10.1002/bse.1906
Lorenzen, M., and Frederiksen, L. (2008). Why do cultural industries cluster? Localization, urbanization, products and projects. In P. Cooke and R. Lazzeretti (Eds.), Creative Cities, Cultural Clusters and Local Economic Development (pp. 155–179). Cheltenham: Edward Elgar.
Lommerse, I. (2018). *Slow fashion movement.* (BA thesis). Erasmus University, Rotterdam.
Lueg, R., Pedersen, M. M., and Clemmensen, S. N. (2013). The Role of Corporate Sustainability in a Low-Cost Business Model - A Case Study in the Scandinavian Fashion Industry. *Business Strategy and the Environment,*24(5), 344-359. doi:10.1002/bse.1825
Lyle, J.T. (1996). *Regenerative Design for Sustainable Development.* John Wiley and Sons, New York
Maher, R., Maher, M. Mann, S. McAlpine, C. (2018). Integrating design thinking with sustainability science: a research through Design approach. *Sustainability Science*, 13, pp. 1565-1687. DOI 10.1007/s11625-018-0618-6
Maldini, I., Duncker, L., Bregman, L., Duscha, L., Piltz, G., Grevinga, T., …. Vooges, M. (September, 2017). MEASURING THE DUTCH CLOTHING MOUNTAIN: Data for sustainability-oriented studies and actions in the apparel sector. Retrieved from: https://www.researchgate.net/publication/319902973_MEASURING_THE_DUTCH_CLOTHING_MOUNTAIN_Data_for_sustainability-oriented_studies_and_actions_in_the_apparel_sector
McDonough, William, Braungart, Michael, 2002. *Cradle to Cradle: Remaking the Way We Make Things*. North Point Press, New York.
McKinsey and BOF. (2018). *The state of fashion 2019.* Retrieved from:
https://cdn.businessoffashion.com/reports/The_State_of_Fashion_2019.pdf
Moorhouse, D. and Moorhouse D. (2017). Sustainable Design: Circular Economy in Fashion and Textiles, *The Design Journal.* DOI: 10.1080/14606925.2017.1352713
Murray, A., Skene, K., and Haynes, K. (2015). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics,140*(3), 369-380. doi:10.1007/s10551-015-2693-2
Niinimäki K. (2017) Fashion in a circular economy. In: C.E.Henninger et al. (eds.). *Sustainability in fashion*. Pp. 151-169. DOI 10.1007/978-3-319-51253-2_8
Nussholz, J. (2017, November 8-10). *Circular Business Model Framework: Mapping value creation architectures along the product lifecycle*. Paper presented at PLATE conference. Delft University of technology.

op den Brouw, H. (2017, November 25). *Circulaire Economie in de textielketen: naar innovatieve textielrecycling.* Retrieved from: http://www.gidrd.nl/public/themas/ce-textielketen.pdf
Ortjes, J. (May 14th, 2019). Nederlandse bedrijven moeten kinderarbeid voorkomen, anders riskeren ze een boete. *Trouw.* Retrieved from: https://www.trouw.nl/
Osterwalder, A., Pigneur, Y., and Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the Association for Information Systems,* 15(May), 1–125.
Osterwalder, A., and Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers.* Chichester, UK: John Wiley and Sons Ltd
Pauli, G.A. (2010). *The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs.* Taos, New Mexico: Paradigm Publications.
Pearce, D.W., Turner, R.K. (1990) *Economics of Natural Resources and the Environment.* Hertfordshire, UK: Harvester Wheatsheaf.
Perez, C. (2002) *Technological Revolutions and financial capital: the dynamics of bubbles and Golden Ages.* London: Edgar Elgar.
Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st-century economist*. London: Random House Business Books.
Richardson, J. (2008). The business model: an integrative framework for strategy execution. *Strategic change,* 17(5-6), 133–144.
Ries, E. (2012). Welcome to the success factory. *Management today*, 48-52.
Rijksoverheid. (2016). *Circulaire Economie.* Retrieved from: www.rijksoverheid.nl/circulaire-economie
Rijksoverheid. (2019). *Uitvoeringsprogramma Circulaire economie 2019-2023.* Retrieved from: https://www.rijksoverheid.nl/ministeries/ministerie-van-infrastructuur-en-waterstaat/documenten/rapporten/2019/02/08/uitvoeringsprogramma-2019-2023
Ritchie, J., Spencer, L., and O'Connor, W. (2003). 'Carrying out Qualitative Analysis', in J. Ritchie and J. Lewis (eds), *Qualitative Research Practice: A Guide for Social Science Students and Researchers.* London: Sage.
Rockström, Johan, W. L. Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin III, Eric Lambin, Timothy M. Lenton, et al. (2009). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society* 14 (2). http://pdxscholar.library.pdx. edu/iss_pub/64/
Ruppert-Stroescu, M., LeHew, M. L., Connell, K. Y. H., and Armstrong, C. M. (2015). Creativity and sustainable fashion apparel consumption: The fashion detox. *Clothing and Textiles Research Journal,* 33(3), 167–182.
Rusu, V., and Roman, A. (2017). Entrepreneurial Activity in the EU: An Empirical Evaluation of Its Determinants. *Sustainability,9*(10), 1679. doi:10.3390/su9101679
Schensul, S. L., Schensul, J. J., and LeCompte, M. D. (1999). *Essential ethnographic methods: Observations, interviews and questionnaires*. Walnut Creek: Altamira Press.
Short, S. W., Bocken, N. M., Barlow, C. Y., and Chertow, M. R. (2014). From Refining Sugar to Growing Tomatoes. *Journal of Industrial Ecology,18*(5), 603-618. doi:10.1111/jiec.12171
Smale, T. (2018, May 10th). *Why Europe Is the Next Major Startup Hub*. Retrieved from: https://www.entrepreneur.com/
Sociaal-economische Raad. (July, 2016) *Convenant Duurzame kleding en textiel.* Retrieved from: https://www.ser.nl/-/media/ser/downloads/overige-publicaties/2016/convenant-duurzame-kleding-textiel.pdf
Sosna, M., Trevinyo-Rodríguez, R. N., and Velamuri, S. R. (2010). Business model innovation through trial-and-error learning: The Naturhouse case. *Long range planning*, 43(2-3), 383-407.
Stahel, W.R.. (2010). *The Performance Economy*, 2 ed. Palgrave Macmillan UK, Hampshire, UK.
Stahel,W. (1994). The utilization-focused service economy: Resource efficiency and product-life extension. *The greening of industrial ecosystems*, 178–190.
Steffen *et al.* (2015). Planetary boundaries: Guiding human development on a changing planet. *Science* 347 (6223), pp. 736-752.

Statista (2019). *Fashion: The Netherlands*. Retrieved from: https://www.statista.com/outlook/244/144/fashion/netherlands?currency=eur
Stigler, G. and Becker, G. (1977). De gustibus non est disputandum. *American Economic Review.* 76–90.
Strauss, A., and Corbin, J. M. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques.* Newbury Park, CA: Sage.
Teece, D. (2010). Business models, business strategy and innovation, *Long range planning,* 43, 172-194.
Tukker, A. (2004). Eight types of product–service system: Eight ways to sustainability? Experiences from SusProNet. *Business Strategy and the Environment,13*(4), 246-260. doi:10.1002/bse.414
Towse. (2010). *Textbook of Cultural Economics*. Cambridge University Press.
United Nations. (1987). *Report of the World Commission on Environment and Development: Our Common Future*. UN Documents: Oslo, Norway.
United Nations (2015). *Sustainable Development Goals - United Nations*. Retrieved from: http://www.un.org/ sustainabledevelopment/sustainable-development-goals/
van der Velden, N. (2016). Making Fashion Sustainable: The Role of Designers. (dissertation). TU Delft. https://doi.org/10.4233/uuid:8c66ca0a-605e-4f22-a4f1-f59b7e9ac874
van Dijk., S. Tenpierik, M. van den Dobbelsteen, A. (2014). Continuing the building's cycles: a literature review and analysis of the current system theories in comparison with the theory of cradle to cradle, *Resources conservation and recycling.* 82. 21-34.
Waart, S. D., and Oosterhof, H. (2011). *Textielwarenkast: Grondstoffen voor textiel gisteren, vandaag en morgen*. Tilburg: Audax Textielmuseum Tilburg.
Walton, J. (1992). Making the theoretical case. In: C.C. Ragin and H.S. Becker (Eds.), *What is a case? Exploring the foundations of social inquiry* (pp. 121-137). Cambridge, UK: Cambridge University Press.
Wikipedia contributors. (n.d.). Creative commons license. In: *Wikipedia, The Free Encyclopedia.* Retrieved 15:50, May16th, 2019, from https://en.wikipedia.org/wiki/Creative_Commons_license
Wolcott, H.F. (1991). Making a study "More Ethnographic"', *Journal of Contemporary Ethnography*, 19: 44-72
Workman, D. (May 1st, 2019). *Tomatoes Exports per Country.* Retrieved from: http://www.worldstopexports.com/

Appendix A: Interview Guide

- Place convenient for both interviewer and interviewee is chosen, preferably office or working space of the representative of the firm.
- Interviewer introduces himself/herself and explains the purpose of the interview.
- Terms of confidentiality and recording are introduced if requested.
- Verbal agreement to participate is asked.
- Interviewer explains how interview is going to be conducted.
- Interviewee is asked to answer standard background information questions as well introduce himself/herself and briefly explain his/her role in the company.
- Topics of the interview are briefly introduced.
- Interviewer proceeds with questions.

Time and place of the interview:
Language:
Name:
Name of the brand/design studio:
Function:
Year of foundation:
Number of employees:

<u>General</u>
Could you introduce me to the narrative behind your product/store/studio?

<u>Topic 1: The product</u>
What is the role of the design of the product?
What are the challenges in the production of your product?
How does your product capture the values of your business?

<u>Topic 2: Social goals</u>
What values do you aim to express towards your consumer?
Could you describe your target consumer?
How do you build and maintain the relations with stakeholders? *(Investors, employees, consumers, society, environment, government)*

<u>Topic 3: Environmental goals</u>

How would you describe the role of circularity in your supply chain?
Would you prefer local or global production of your product?

Topic 4: Economic goals

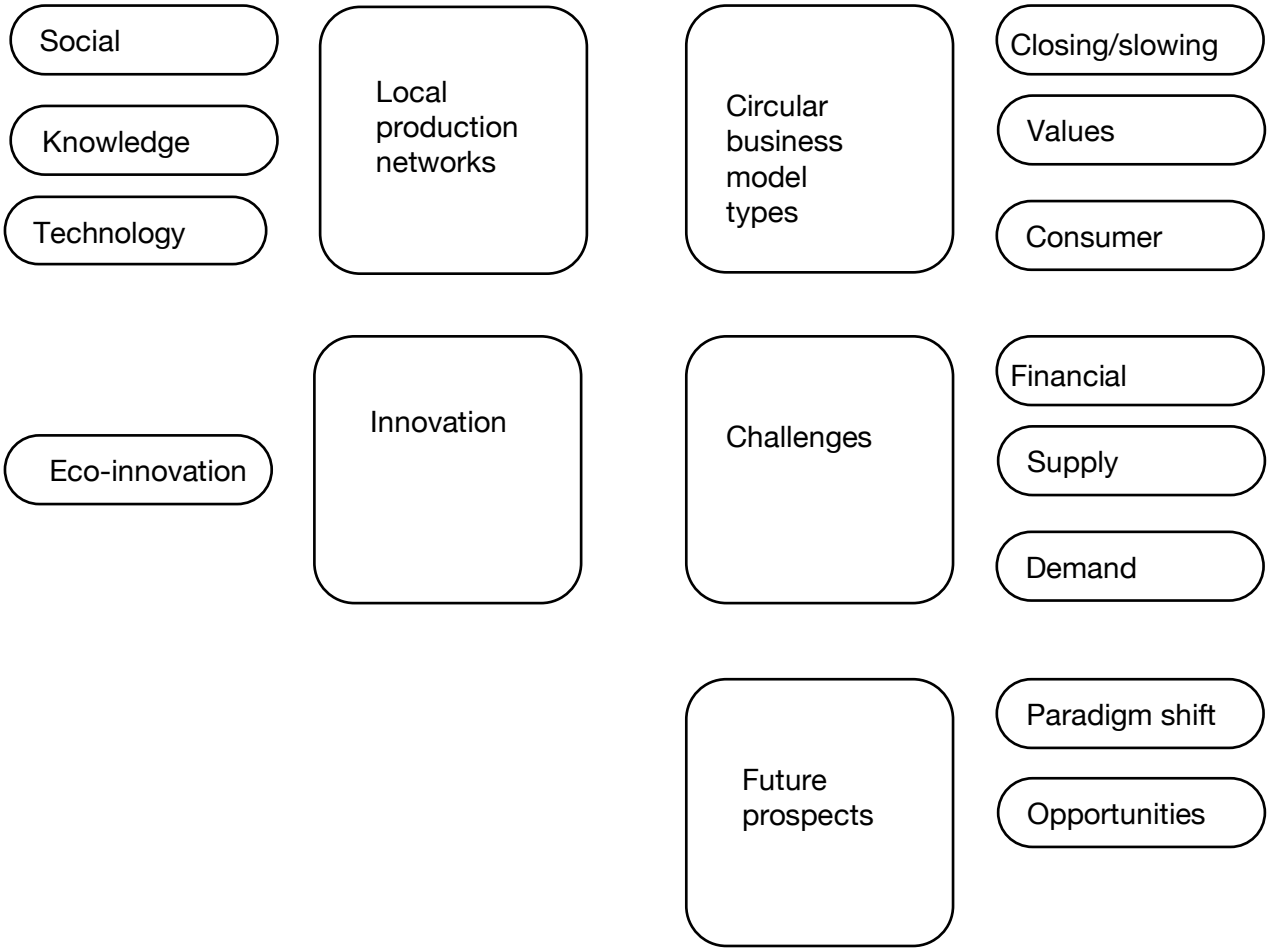
What are your resources and how do you access them?
What are crucial moments in your process?
How would you describe your competitive advantage?

Ending questions

Would you say there is a market/ cluster of new materials in the Netherlands?
    If so, where is this located?

If the earth, money, time and society are accounted for in your product, which one(s) do you account for to the most extent in your product?

Appendix B: Summary of Codebook Interviews



Appendix C: Overview Contact Moments in Participant Observation of the Tomato Textile Project.

What	When
Introduction meeting team	10/1
‘Klankbord meeting’	17/1
EU fashion Summit	21/1
Regular visit BCL	29/1
Launch website	30/1
Update #1 to partners (mail)	31/1
Visit local pulp factory	05/02
Erasmus sustainability day	12/02
Update #2 to partners (mail)	19/02
Internal mail	20/02
Regular visit BCL	21/02
Regular visit BCL	26/02
Interview specialist A	06/03
Waag society event	07/03
Klankbord meeting	12/03
Interview specialist B	13/03
Visit Material District conference	14/03
Expert meeting	14/03
Regular meeting BCL	15/03

Update to partners #3	28/03
Regular meeting	02/04
Regular Meeting	16/04
Regular Meeting	24/04
Update #4 to partners	24/04
Regular Meeting	07/05
Regular Meeting	15/05