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Master Sustainable Business and Innovation – Faculty of Geosciences

BREAKING BARRIERS TO CIRCULAR ECONOMY IN THE DUTCH TEXTILES INDUSTRY

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Words: ~16.500 words excl. (in-text) references (estimate), tables & appendices



Figure 1. Carpet tiles made by Interface, a Dutch frontrunner in applying circular economy principles to the textile industry.



– *The Path* –

A challenging 40 meter climbing route, one of the toughest in Canada, being traversed by Alex Megos for Patagonia. Ever since their creation Patagonia has been a leader for sustainability in the textiles and clothing industry, vouching for the long life-time of its products, without causing any unnecessary harm to the environment during production.

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The road Patagonia has travelled towards sustainable textiles took decades of work, likewise, the transition to circular economy will take time, effort and the need to overcome barriers, such as the mountain wall faced here by Alex Megos.

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0. Foreword

This master thesis study is part of an internship done from within the company of Metabolic ([see appendix A](#)) carried out in the name of Utrecht University and the Master Programme Sustainable Business & Innovation. Metabolic is a consultancy company for sustainability specialized in the circular economy. One of their main operating themes is the (Dutch) textiles industry and over the past years Metabolic has developed a proper network of companies and sustainable frontrunners within the Dutch textiles industry. This study has been positively influenced through working with the network and knowledge base of Metabolic on circular economy and even more so on circular economy within the Dutch textile industry. All in all, this thesis study will be mutually beneficial to both the University of Utrecht and Metabolic and hopes to contribute to and build on the development of research done on sustainable and circular textile industry practices and beliefs.

1. Abstract

Recently, large sample studies were conducted mapping the most pressing barriers for transitioning to circular economy [CE] within the EU. These lead to the conclusion that CE remains a niche discussion among sustainable development professionals and significant efforts are required to push for a transition to CE. Since EU economies are largely driven by SMEs¹ this study examines sector specific barriers to CE for SMEs of an important economic sector in the EU, the Dutch textiles sector². Consequently, insights are established for business models and policy makers to steer a CE transition across industries. 47 Expert interviews were conducted with manufacturers and retailers to map sector specific barriers. The main findings conclude that SMEs of the Dutch textiles industry are mostly hindered by market barriers, specifically high costs for producing and/or selling circular products. Because of these high costs, SME's face a widespread lack of consumer interest. Both barriers appear to be the result of a chain-reaction. Firstly, limited knowledge and design choices make delivering high quality circular products difficult. Secondly, limited availability of consistent circular supply streams combined with a linear supply chain put constraints on the volume and logistics needed to make a cost-competitive CE product or service. Interestingly, the problem caused by these pressing barriers takes place at a wider sector level (the regime), whereas strategies implemented by companies are focussed internally in their own niche bearing zero to low results. To conclude, policy makers are suggested to work together with organisations that have an overarching position in the sector and economy acting as a bridge for catalysing CE related interactions in-between players at the regime level. These organisations are phrased as 'Matchmakers'. 'Matchmakers' working together with policymakers can tackle the identified pressing barriers responsible for the chain reaction at the root of the problem eventually breaking the barriers to CE for the Dutch textiles industry and thus accelerating its transition from a linear to a circular paradigm.

¹ SMEs account for 90% of all firms in the EU and create 2 out of every 3 jobs

² Identified as high textile consuming country and front running economy in terms of CE focussed firms

2. Introduction

The high demand for natural resources cannot longer be sustained by the typical linear, take-make-waste model of current economies (Antikainen et al., 2016; EMF, 2015, 2017; Lacy et al., 2014; McKinsey & Company, 2015; Van Eijk, 2015). Especially non-renewable resources such as rare metals, minerals and fossil fuels are likely to become depleted in the near future (Braungart et al., 2008; Lacy et al., 2014; Lieder & Rashid, 2016). These resources are often essential elements of every day technologies that enable the proper functioning of society. For instance, fossil fuels such as gas, coal and oil basically thrive our economies through their ability to power the machines and devices used in daily operations such as vehicles, electrical appliances, machines for extraction and harvesting or the manufacturing of goods, heat, power and lighting for all types of building amongst others (Braungart et al., 2008; De Groot et al., 2002; Kova et al., 2016; Lacy et al., 2014). Additionally, many technologies and appliances require essential components made of rare metals and minerals such as those found in computers, batteries and cell phones but also technologies that aim to reduce the dependency on non-renewables such as wind turbines, solar panels and electric cars (European Commission, 2017; Simmons, 2011).

The increasing scarcity of non-renewables creates a challenging environment for businesses, characterized by volatile prices and high supply risks (Antikainen et al., 2016; EMF, 2013; Janssen, 2017; Parcon, 2017; Rizos et al., 2015). A new paradigm and way of thinking that aims to replace the existing linear economic model is that of the circular economy (CE), defined by the following definition: “[CE] is an economic system based on business models that replace the ‘end-of-life’ concept by closing the loop through reducing, recovering, reusing and recycling materials in production, distribution and consumption processes with the aim to accomplish sustainable development along the triple bottom line to the benefit of current and future generations” (Kirchherr, Reike & Hekkert, 2017, pp.224-225). The increasingly negative reputation of existing linear practices, with the tendency of producing as much as possible for as little as possible while at the same time destroying the regenerative capacity of production systems, is what fuels much of the hope and enthusiasm for CE. The belief that CE will provide a key answer to tackle most of the aforementioned issues and will majorly contribute to the sustainable development goals is especially what gives it its popularity. It is hard to deny that the need for a more sustainable economic model is urgent and ideally, such an economic model would provide opportunities for businesses to become less dependent on non-renewables for

growth and give them a chance to thrive within the limits that are sustainable for the environment and society on the long term.

Studies into the financial viability of CE point out that embracing CE offers a real opportunity for economic growth (Lacy et al., 2014; EMF, 2017; Janssen, 2017; McKinsey & Company, 2015; Mentink, 2014; Rizos et al., 2015; Van Eijk, 2015). Besides the estimation that CE could reduce CO₂ emissions by 48%, it is also believed to have the potential to generate a net economic benefit of €1.8 trillion including the creation of two million additional jobs by the end of 2030 (European Commission, 2014, Ellen Macarthur Foundation, 2015, 2017; Lacy et al., 2014; McKinsey & Company, 2015). These alleged benefits of CE are certainly not neglected by influential government and business representatives. The European Commission actively supports the CE through their circular economy package, which in total sums €320 billion intended for investments in the systems of mobility, food and the built environment until the end of 2025 (Braungart et al., 2008; EMF, 2017; European Commission, 2016; Hobson & Lynch, 2016; McKinsey & Company, 2015). In addition, market leaders in the consultancy branch, such as McKinsey, Deloitte, PWC, Accenture amongst others, mostly encourage the adoption of circular business models without further delay (Deloitte, 2015; Lacy et al., 2014; McKinsey & Company, 2015; PWC, 2015).

Though opportunities for CE sound promising, firms often face practical challenges to adopt circularity in their business model and make the transition towards CE. This is particularly relevant for the small to medium enterprises (SMEs), that often struggle with a lack of various resources and support from the government to implement CE (de Jesus & Mendonça, 2017; Rizos et al., 2015; Van Eijk, 2015a). Additionally, subjected to the hindrance of these barriers, SMEs are often not able to receive the support from high-end consultancy firms such as McKinsey, Deloitte, PWC and Accenture (de Jesus & Mendonça, 2017; Grandori & Soda, 1995; Rizos et al., 2015; Van Eijk, 2015). Despite the fact that SMEs constitute 90% of all companies and create two out of every three jobs, they represent a highly important but largely underserved sector of the European economy, with an essential role for realizing a transition towards CE (de Jesus & Mendonça, 2017; European Commission, 2015, 2016; Janssen, 2017; Rizos et al., 2015; Van Eijk, 2015b). This accelerates the need for a deeper understanding of the characteristic barriers for SMEs in transition towards CE and how barriers form in the daily work environment of SMEs. Moreover, a deeper understanding is needed for what can be done to overcome the most pressing barriers to CE, especially for SMEs, which is precisely the research gap that this study aims to cover. In follow-up to the first large N-study on the barriers to CE conducted by Kirchherr et al. (2018) with a scope set to the EU, this study aims to go into

more detail to address industry specific barriers to CE and identify sector specific solutions. This study does so by being the second largest N-study to date into the barriers to CE with the scope set to an import economic industry with significant relevance within the EU, the Dutch textiles industry.

For many European countries, the textiles industry plays an important role for the general economic prosperity and development of the country, likewise for the Netherlands. (De Souza et al., 2010; FAO, 2013; Ozturk et al., 2016; Terinte et al., 2014). Still, despite its economic importance, the textile industry is also one of the most polluting industries coming only second to the oil and gas industry. The majority of negative environmental impacts mainly come from the high use of chemicals, water and land with many indirect effects cascading through ecological systems (De Souza et al., 2010; Fischer & Pascucci, 2017; Franco Mosquera, 2017; Muthu, 2017; Ozturk et al., 2016; Terinte et al., 2014). Furthermore, high demands for textile and garments create big waste streams that are now incinerated or thrown in a landfill while there is a high potential for reusing or recycling many textiles that are thrown away in a more circular fashion (De Souza et al., 2010; Fischer & Pascucci, 2017; Franco Mosquera, 2017; Muthu, 2017; Ozturk et al., 2016; Terinte et al., 2014). One of the many countries within the EU that is economically dependent on its textile industry, is the Netherlands. The Dutch textiles industry is one of Europe's largest textile consumers, yet, 61% of textile waste still ends up in landfills or is incinerated (FFact, 2014). Hence, there is yet much to gain when it comes to circular material flows in the Dutch textile industry. Moreover, some academics identified the Netherlands as one of the front running economies for CE (Bastein et al., 2013; van Buren et al., 2016). Altogether, by creating insights for overcoming barriers to CE in the Dutch textiles industry, this study does not only bear academic but also societal relevance. Especially since accelerating a transition to CE within the Dutch (and other EU) textile industries might provide the outcome for mitigating many of the negative socio-environmental impacts tied to the textiles industry. In order to gain these insights, the following research question is posed:

Research Question: *What are the barriers for SMEs of the Dutch textiles industry for transitioning to circular economy?*

Chapter 3 shows the theories that support and justify the research method used to answer the research question. Chapter 4 covers the research methods applied in this study and chapter 5 presents the analysis and findings which are put to discussion. Chapter 6 presents the conclusion to this research and references are listed in chapter 7 followed by appendices.

3. Theoretical framework

This chapter describes the theories and literature that has been used to develop the main arguments of this study leading to a new theoretical framework. The framework's purpose is to justify the scope of the study and the research methods chosen to generate relevant insights for answering the research question. The following table shows the structure of this chapter and the division of the theories used, followed by an argumentation for how the different theories have been identified and chosen to be included in this study.

Table 1. Structure and division of theories used in chapter 3 'Theoretical framework'.

Paragraph	Main Theories (including description)
3.1	Background literature into the (Dutch) textiles industry
3.2	Development of the concept of circular economy
3.3	The transition from a linear to a circular economy seen through the <i>Multi-Level Perspective</i> (MLP) (including Techno-Economic Paradigm shifts (TEPs), Socio-Technical Regime shifts (STRs) and Socio-Technical Transitions (STTs))
3.4	<i>Strategic Niche Management</i> (SNM): SMEs of the Dutch textiles industry operating at the niche-level of the <i>Multi-Level Perspective</i> experimenting with technological innovations for circular economy
3.5	Barriers to circular economy and barrier dynamics; interrelatedness and chain reactions
3.6	The positioning of barriers to circular economy through the loop of the <i>Multi-Level Perspective</i>
3.7	Integration of all theories into a new theoretical framework

3.0.A Identification and application of theories

This paragraph aims to justify the way theories have been identified and integrated into this study and its theoretical framework. In order to define the scope of where the research will be conducted, paragraph 3.1 describes the background and context of the Dutch textiles industry, a general description is given of the different dimension that exist in the Dutch textiles industry and which of these dimensions have been included in this study. Subsequently, to study CE and gather insights on what barriers hinder its transition, a thorough explanation is given regarding the development of the CE concept including a proper definition in paragraph 3.2. To properly analyse the transition to CE this study aimed to conceptualize the CE. For this, a various

selection of transition theories have been examined, the theories that have been examined are the Multi-Level Perspective (MLP) (Geels, 2002, 2011, 2012), Techno-Economic Paradigm shifts (TEPs) (Geels, 2011; Perez, 2009), Socio-Technical Regime shifts (STRs) (Geels, 2011), Socio-Technical Transitions (STTs) (Geels, 2010) and Strategic Niche Management (SNM) (Kemp, Schot, & Hoogma, 1998). With regard to these theories a comparison has been made with the real life situation of what has actually been studied, namely the barriers being faced in the circular economy transition for SMEs of the Dutch textiles industry. Based on this comparison a qualitative assessment and selection has been made by the researcher as to which theories resembled the closest the studied environment. Consequently, circular economy has been identified as an economic model that is subjected to a paradigm shift and thus resembles mostly the theory of a Techno-Economic Paradigm shift (TEPs).

The economic model of CE, and its transition (TEPs), is argued in this study to best resemble a landscape of several regimes (economic sectors) and niches (SMEs) as is conceptualized and described by the theory of the Multi-Level Perspective; paragraph 3.3. The regime that is being studied is the Dutch textiles industry and transitions within this regime are described by the theory of Socio-Technical Regime shifts (STRs). The niches within this MLP are the SMEs experimenting with the implementation of CE technologies in their business model, of which the transition of these business models can be conceptualized by the Socio-technical Transitions theory (STT). In order to analyse, the challenges and the development of CE technologies within these niches, the theory of Strategic Niche Management (SNM) has been applied; paragraph 3.4. To include the theories on circular barriers, the most recent and relevant literature on barriers to CE transition has been implemented; these are the barriers as posed by Kirchherr et al. (2018) and Jesus & Mendonça (2017), on which this paper is also reflecting; paragraph 3.5. The dynamics and interrelatedness of these barriers are also explained through a chain reaction as described in the study by Kirchherr et al. (2018). To better analyse the expression of barriers within the model and system of the transitioning economy, their positioning within the MLP is taken into account; paragraph 3.6. Finally paragraph 3.7. integrates all these theories into one theoretical framework that forms the underlying argument for the entire research that has been conducted in this study.

3.1 Background of the (Dutch) textiles industry

Commonly, the textiles industry is divided in three subgroups: clothing and apparel textiles, interior and furniture textiles and technical textiles, all of which are included within the scope of this study. On a global scale, the textile industry serves an important role for the economic development of many countries (De Souza et al., 2010; Franco Mosquera, 2017; Ozturk et al., 2016). Moreover, in Europe, textile industry is considered one of the most essential consumer goods industries, representing more than roughly 37% of all European industrial activity with at least a total number of 1.7 million employees (EURATEX, 2017; Franco Mosquera, 2017). At the same time, textile industry has the rightful infamous reputation of being characterized for its highly unsustainable practices involving high usage of water, hazardous chemicals, fossil fuel depletion (especially for synthetics) and frequent issues with human rights (Boström & Micheletti, 2016; Franco Mosquera, 2017; Resta et al., 2016). On top of that, due to the typical features of textiles including non-recoverable materials and blends, the potential for recycling is also often limited. The negative impact related to the production and waste of textiles is ever-growing due to the increasing imbalance between the production and consumption of textiles, where production often happens in low-production cost, low-wage countries after which being transported to Western markets for further manufacturing or selling to consumers (Safaya et al., 2016; Saxena et al., 2017; Tyler, et al., 2006).

Altogether, the textile industry has been classified as the world's second most polluting industry (European Commission, 2013). Among the top-consuming countries is the Netherlands, where 61% of textile waste, garments in particular, is deposited in landfills or incinerated (FFact, 2014). Of the 39% that does get collected, 32.7% is reused and 6.3% is recycled. However, the recycling process of post-consumer textiles in practice is often limited to only one second-life, after which the recycled products still end up in a landfill or are incinerated (FFact, 2014). There is still much to gain for the Dutch textile industry in terms of circular material flows. Moreover, some SMEs in the Netherlands have expressed their ambitions to be a pioneer and improve the industry by reducing the impact of textiles through applying CE principles and redesigning the industry from the bottom-up. This study aims to identify the barriers these companies experience in transitioning to a textile industry characterized by CE.

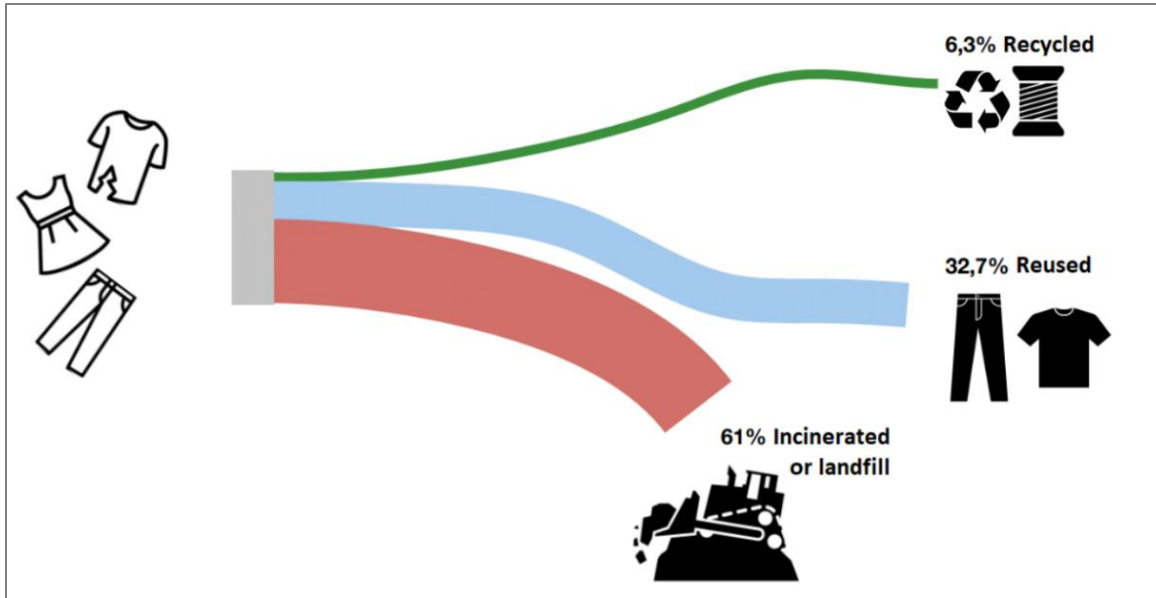


Figure 2. End-of-life scenarios for textile products in the Dutch textiles industry.

3.1.A Secondary and tertiary players within the sector

In the past decades, economic activity has classically been divided in three sectors (Kenessey, 1987). The primary sector including the extraction of raw materials, the secondary sector involving the manufacturing of these raw materials into consumer goods and finally the tertiary sector, relating to the supplying and selling of services and consumer goods to the consumer. Nowadays, the economic activity of the Dutch textile industry is focussed on the secondary and tertiary sector, manufacturing imported (and often already processed) fibres, yarns or fabric material upon which it is transformed into its final product shape and function ready to be sold to the tertiary players such as retailers that sell it to the end-consumers or to other retailers down the chain (Company Info, 2018). Like the division between secondary and tertiary players active in the Dutch textile industry, the companies that will be interviewed in this study will include only businesses from these two sectors. Figure 3 visualizes the textile industry and supply chain from a simplified, Western-based company perspective, indicating a clear division between the secondary and tertiary sector. Depending on the product, i.e. interior, clothing or technical textiles, secondary manufacturing processes can take place in both western as non-western markets, of which the latter is usually more typical.

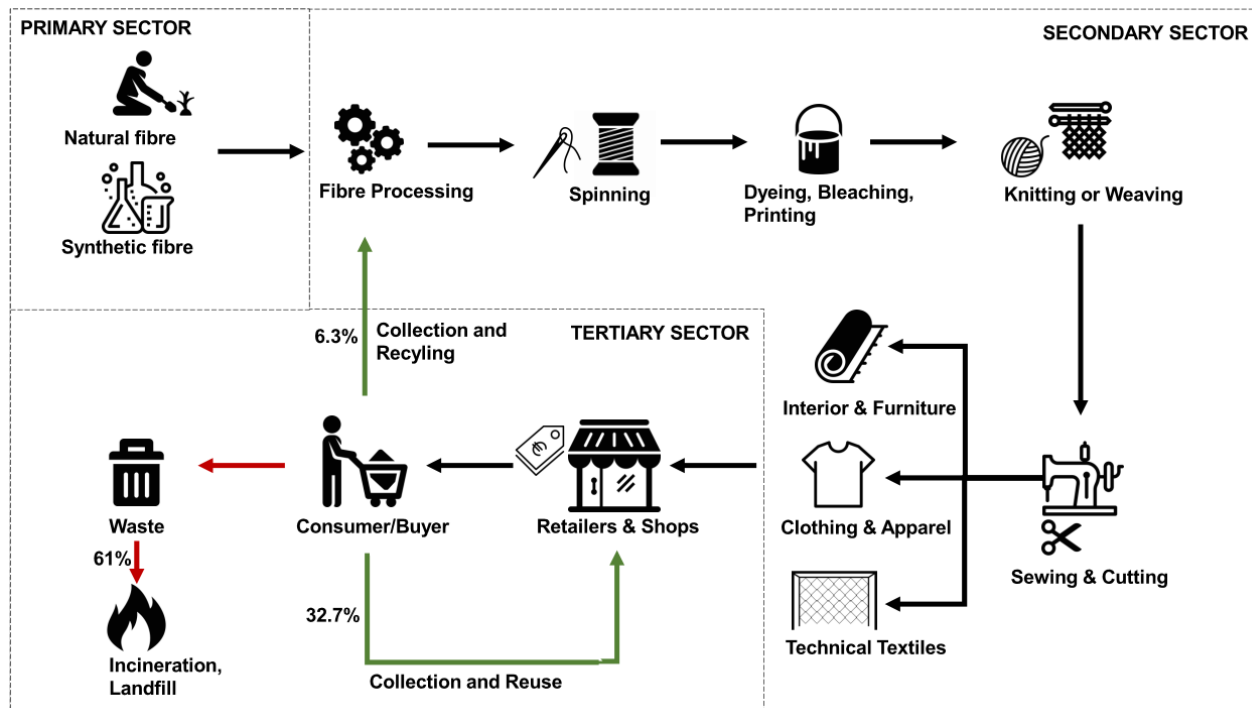


Figure 3. Schematic overview of the modern-day textile industry.

3.2. Development of circular economy

In the past couple of years, the term ‘circular economy’ has been widely adopted by academics, government actors and business players across various disciplines (Geissdoerfer et al., 2017; Kipping & Clark, 2012; Kirchherr, Reike & Hekkert, 2017). In 2016 alone, more than 100 articles were published on CE, a relatively high increase coming from 30 articles in 2014. In June 2017, 1500 key players ranging from CEOs, academic experts and policymakers attended the World Circular Economy Forum in Helsinki, Finland to discuss the most promising advancements and prospects of the transition to CE and how such players could facilitate and accelerate the transition as much as possible (“World Circular Economy Forum,” 2017). The main reason why CE receives so much praise and attention is the believe that it has high potential for operationalizing the sustainable development goals in practice (Ghisellini et al., 2016; Kirchherr, Reike, & Hekkert, 2017). Interestingly, the roots of its concept are not new. In fact, early notions of CE go back as far as the late 1960s (de Jesus & Mendonça, 2017; Ellen MacArthur Foundation, 2017; Fischer & Achterberg, 2016; Gregson, Crang, Fuller, & Holmes, 2004). Consequently, having developed as a trend over the course of time allowed interpretations by different actors to run its course. As a result, due to the many distinctions and publications, no widespread consensus exists over the definition of CE with over a hundred different definitions recorded in academic literature today. Moreover, the effect of this widespread lack of consensus

on the concept of CE creates increasingly difficult conditions for developing a thorough understanding of what factors can benefit or obstruct a transition to CE.

With the aim of providing clarity on the concept of CE, Kirchherr, Reike and Hekkert (2017) collected 114 definitions of CE and coded them on 17 different dimensions to envision an absolute definition of CE. Hence, CE is defined as an economic system that replaces the 'end-of-life' concept with efficiently reducing, reusing, recycling and recovering materials in production, distribution and consumption processes. It operates at a small level for products, companies and consumers, on a medium-sized level for eco-industrial parks and at a larger scale for cities, regions, nations or beyond that. The aim of CE is to accomplish sustainable development, thereby also creating environmental quality, economic prosperity and social equity that can benefit both current as well as future generations. It is created and implemented through novel and innovative business models and responsible consumers (Kirchherr, Reike & Hekkert, 2017).

3.3 Circular economy: a techno-economic paradigm shift within a multi-level perspective

The environmental problems such as resource depletion, loss of biodiversity and even climate change, related to the take-make-waste model of a linear economy, can all be identified as wicked problems. Wicked problems are dynamic problems that are difficult or almost impossible to solve due to incomplete, contradicting and changing requirements that are oftentimes hard to recognize (Rittel & Webber, 1984; Weber et al., 2016). These wicked problems form societal challenges that are difficult to face and need to be addressed from a systems thinking perspective (Elzen et al., 2004; Geels, 2011; Grin, Rotmans, & Schot, 2010; van den Bergh & Bruinsma, 2008). Extensive structural change is needed from within the systems where these problems are embedded and the fundamental mechanisms in place that drive these problems; mechanisms such as policies, technologies, cultural values, consumer practices, market forces and scientific knowledge envisioned by regulators, firms, industries, academics and consumers. Moreover, such all-encompassing systemic changes involving so many different types of actors and mechanisms are best explained as Socio-Technical Transitions (STTs) (Geels, 2004, 2010, 2011).

Transitioning from a linear economy to a circular economy as an effective way to deal with such wicked problems, requires multiple of these socio-technical transitions happening simultaneously at large-scale, consequently setting in motion a shift of the dominant economic paradigm by altering the pervasive methods of production, technologies, institutions and beliefs towards a state that is fundamentally based on the principles of CE. Such a comprehensive

transition of the dominant linear model to a new circular model can be defined as a Techno-Economic Paradigm shift (TEP) (Freeman & Perez, 1988; Geels, 2010, 2011). A TEP focusses on the aggregate of processes happening within a transition of an entire economic paradigm. A TEP in this study can be interpreted as the bulk of STTs needed within each of the systems that compile the structure of an economy (Freeman & Perez, 1988; Geels, 2011). To understand how a TEP towards CE can be addressed and facilitated, it is thus necessary to study each of the underlying systems and levels that construct the economy. For instance, important systems like the agri-food sector, the energy sector or in this case the textiles sector. At this system level, the bulk of STTs that collectively represent the socio-technical mechanisms on which that system thrives, can well be explained as the Socio-Technical Regime (STR) (Geels, 2002, 2004, 2011).

The concepts of STTs, TEPs and STRs are key theories for system thinking that enable researchers to understand and approach the multi-dimensional and wicked nature of sustainability problems from a comprehensive perspective. This perspective of integrating the different levels, where the STT, TEP, and STR apply, is defined as the Multi-Level Perspective (MLP) (Geels, 2002; Kemp et al., 2001; Rip & Kemp, 1996). Based on the work of previous academics on the concept of MLP, this study adopts the principles of the MLP framework to explain the transition to CE in an innovative way. Figure 4, adapted from Geels (2002), Rip & Kemp (1996) and Kemp et al (2001) aims to present a clear overview of the use of MLP in this study with the purpose to clarify how the different levels of the multi-level perspective and the individual theories within those levels (TEP, STR & STT) take place in the framework for this study. Furthermore, the different levels wherein the transition theories are expected to happen in practice are added; TEPs take place at the economy level representing the *landscape* of the dominant economic paradigm, STRs occur at the sector level representing the dominant *Regimes* and finally, STTs happen at the company level representing the *Niches* in which these companies operate, innovate and develop (figure 4).

Leading from the theoretical conceptualization (figure 4), in order to set in motion a shift of an economic paradigm (TEP) it is important that barriers are identified for their positioning in the MLP to learn whether they take place at the niche level or at a regime level. In a scenario where this has been identified, targeted solutions and strategies to break barriers to circular economy can be applied in order for socio-technical transitions to take place, consequently this alters the socio-technical regimes of the sectors in which companies operate. Therefore, for this study it is vital that this conceptualization of CE as a TEP in the MLP is integrated as a first main structure for the eventual theoretical framework of this study.

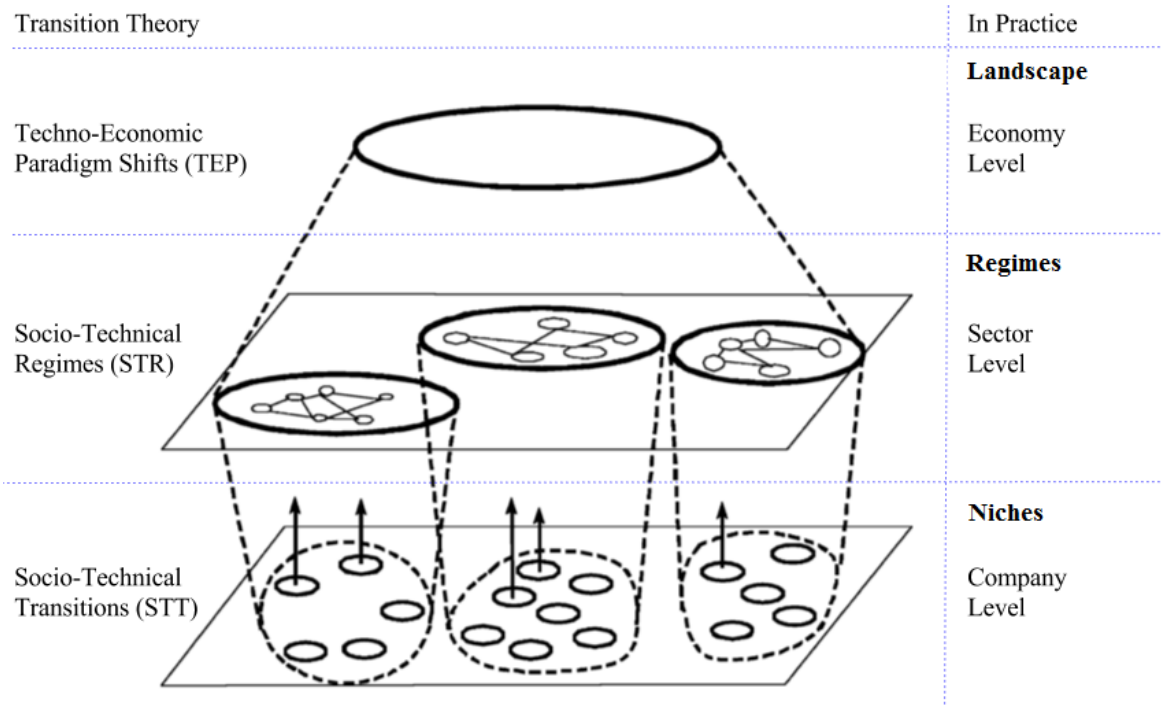


Figure 4. Conceptualization of the MLP integrated with the transition theories of TEP, STR and STT and the different levels at which they take place.

Several statements can be made:

1. Barriers for circular economy are distinctively present at different levels of the MLP-framework (figure 4) and can therefore be solved by targeted action from the relevant actors that operate on the same level in which a barrier is identified.
2. Tackling barriers for circular economy at the right level of the MLP (regime/niche) according to their expression (either as regime barrier or niche barrier) can accelerate the transition from a linear to a circular economy.

A deeper understanding is needed of the development of barriers to CE, their dynamics and their positioning within the MLP in order to gather relevant insights for breaking these barriers. One of the proposed methods to create a deeper understanding of CE barriers is through applying the theory of Strategic Niche Management (SNM) and integrating this element into the MLP conceptualization as described in this paragraph. Paragraph 3.4, will describe how SNM will contribute to understanding the barriers to CE, which will be identified in paragraph 3.5. Subsequently, paragraph 3.6 will disclose on the positioning of these barriers in the MLP. Finally paragraph 3.7 will integrate all the discussed theories into one comprehensive theoretical framework.

3.4 Strategic Niche Management: SMEs experimenting with CE business models

As explained in the previous paragraph, in order for a techno-economic paradigm shift such as the transition to CE to happen, it is essential to study the underlying regimes and niches in which the transition starts to develop. The successful adoption and implementation of CE technologies within the niche environments of a regime can eventually lead to a tipping point, or thus a STT (Kemp et al., 1998; Raven et al., 2010; Schot & Geels, 2008). In that way, it could be stated that the accumulation of multiple STTs can eventually initiate the shift of the STR and together with other STRs shift the landscape and thus the TEP from a linear to a circular economy. Consequently, a vital component of the transition is the successful adoption of CE technology & innovation which are developed at the niches of the regimes (Kemp et al., 1998; Raven et al., 2010; Schot & Geels, 2008). Therefore, a proposed approach to analyse and study closely the development and progress of the adoption of CE innovations and technology, is the Strategic Niche Management (SNM) approach. The idea of the SNM approach is that particular technical innovations that are exposed to the market in a certain niche that is being properly managed, developed and facilitated have the potential to eventually become the new dominant technologies and replace the old ones, thus successfully completing a technological transition (Kemp et al., 1998; Raven et al., 2010; Schot & Geels, 2008). In this case technical innovations relate to new technologies for implementing CE and old technologies can be seen as the dominant linear practices. The goal and aim of SNM is to learn about the desirability, viability and adoption of the new technical innovations and to eventually be able to enhance the further development of these innovations and thereby the rate of implementation of these technologies (Kemp et al., 1998; Raven et al., 2010; Schot & Geels, 2008). In this way, SNM is an important approach that can help academics to examine and analyse niches and the technical innovations that are happening in these niches in order to gather relevant insights on how to properly manage and accelerate these technical transitions. Consequently, in this study, the transition to CE will be examined from a SNM perspective.

As phrased by Raven et al. (2010): “niches are the location where radical innovations are developed and from where they can grow and replace regime practices...niches can be specific application domains, which act as stepping stones for learning and wider diffusion (of technologies)” (p.62-63). In this study, the regime is represented by the Dutch textiles industry, and the niches of that regime are represented by the SMEs that operate in this sector. The Dutch textiles industry is indicated by previous literature to be a front running sector when it comes to (attempts of) CE adoption and experimentation, therefore SMEs of the Dutch textiles industry are likely to have experimented with CE innovation trying to implement it in their

business model and are at the frontier of the transition experiencing all the barriers that come with it. Since SMEs normally make up 90% of the economic activity in a sector, they are very important players in the transition to CE, especially taking into account that they represent the niches where CE innovations are being adopted and diffused throughout the sector in case of successful adoption. SMEs in this study are defined as every company from 1-50 (small) and 51-250 (medium) employees operating within the Dutch textiles industry (European Commission, 2015; Iraldo et al., 2010). Through examining and studying the SMEs of the Dutch textiles industry, the development of the niches essential for the CE transition are likewise studied and a SNM approach can be applied to investigate the development, progress and viability of CE innovations among these SMEs and thus the niche environment. Moreover, by doing so, important insights are gathered for the specific barriers to circular economy these SMEs are facing in their attempt to transition to CE. Insights in these barriers help identify what slows down the socio-technical transitions happening in the technological niches of these SMEs and thus the knowledge needed to manage and accelerate a wide-scale transition to CE. The conceptualization of SNM integrated within the MLP including the transition theories is visualized in figure 5.

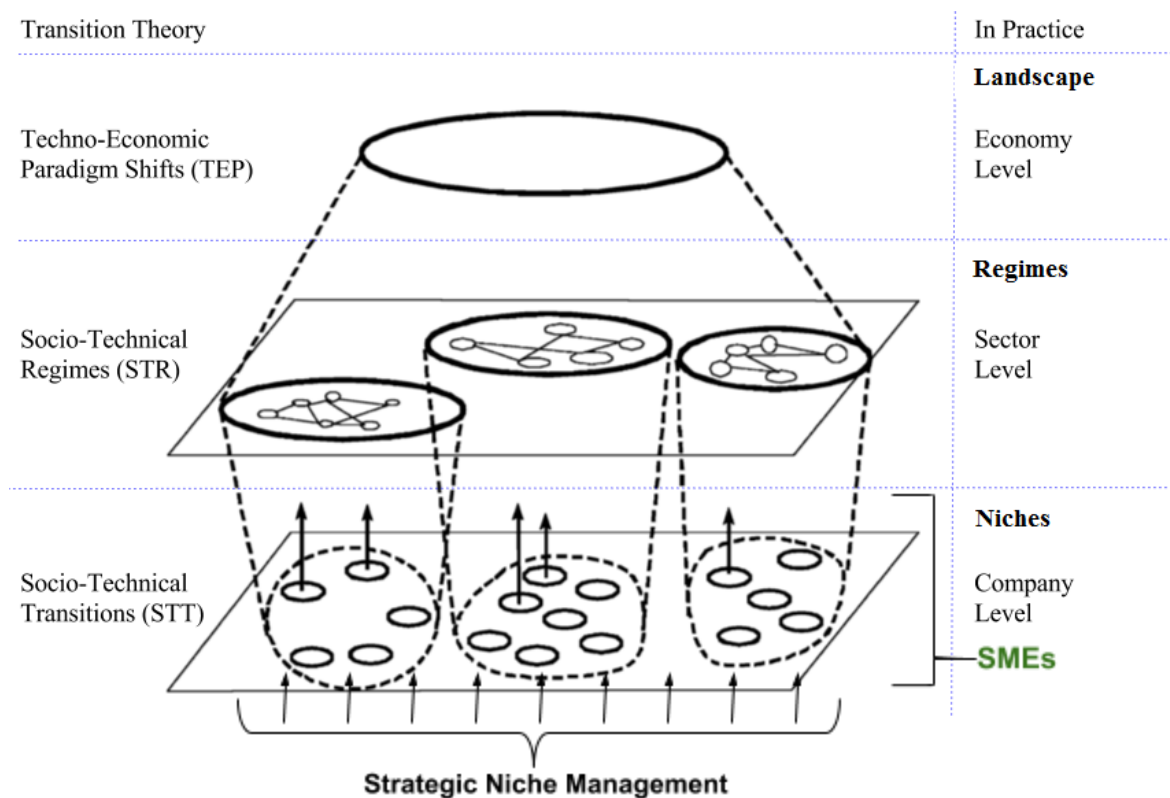


Figure 5. Strategic Niche Management (SNM) approach as an element to the MLP.

3.5 Barriers to the circular economy

A transition and paradigm shift to CE, involving so many different factors at play, comes with tough barriers that provide challenging situations to the SMEs operating at the niche level aiming to implement CE in their business model. Within the scope of this study, such barriers are identified as obstacles that can be overcome by effective coordination of efforts, creative management and an innovative manner of thinking (Moser & Ekstrom, 2010), for instance a well-developed SNM. It takes many resources and time to develop an understanding of the factors that lead to the formation of barriers hindering the CE transition (de Jesus & Mendonça, 2017; Kirchherr, Reike, Hekkert, 2017; Rizos et al., 2015; Van Eijk, 2015b). Over 40 case studies, 80 interviews and 150 academic articles regarding CE barriers have been analysed to come to a distinction of fifteen characteristic barriers for CE divided in four categories: cultural, regulatory, technological and market barriers (de Jesus & Mendonça, 2017; Kirchherr et al., 2018; Korhonen, Honkasalo, & Seppälä, 2018; Pheifer, 2017; Ranta, Aarikka-Stenroos, Ritala, & Mäkinen, 2017; Ritzén & Sandström, 2017; Rizos et al., 2015; Shahbazi, 2015; Van Eijk, 2015b; Vanner et al., 2014). The fifteen barriers are presented in table 2.

Table 2. Summary of the characteristic barriers for CE, adapted from Kirchherr et al. (2018).

Category	Barrier
Cultural barriers Lacking awareness and/or willingness to engage with CE	Hesitant company culture
	Limited willingness to collaborate in the value chain
	Lacking consumer awareness and interest
	Operating within a mostly linear system
Regulatory barriers: Lacking policies in support of a CE transition	Limited circular procurement
	Obstructing laws and regulations
	Lacking global consensus
Market barriers Lacking economic viability of circular business models	Low virgin material prices
	Lacking standardization
	High upfront investment costs
	Limited funding for circular business models
Technological barriers Lacking (proven) technologies to implement CE	Lacking ability to deliver high quality circular products
	Limited circular designs (i.e. knowledge, options) <
	Lack of data e.g. on impacts
	Too few large-scale pilot projects

Kirchherr et al. (2018) conducted the first large sample size study with practitioners, scholars and policy makers to examine which of the fifteen barriers these groups indicated to be most pressing in hindering a transition to CE and how these insights aligns with previously conducted academic literature reviews on CE barriers. Despite the majority of literature indicating technical barriers as the main hindrance for the manifestation of CE (de Jesus & Mendonça, 2017), the study by Kirchherr et al. (2018) concludes that it is not technical blockades but rather cultural barriers that restrain CE from being implemented. Especially 'lacking consumer awareness and interest' and 'hesitant company culture' seem to come forward based on the insights gathered from the interviews conducted. The implication from these insights coming from Kirchherr et al. (2018) is that the technology for implementing CE is there but that CE as a concept has not been convincing enough yet to be adopted by the mainstream. This may be the cause of an underlying chain reaction coming from several market barriers resulting in a lack of competitive business models. In reply to the recently conducted study by Kirchherr et al. (2018), this study too, has tested the characteristic barriers by conducting the second largest N-study (41 expert interviews) with practitioners from the Dutch textiles industry. Based on the new results, insights will come forward that will define what barriers these players experience to be most pressing for implementing CE business models and what underlying chain reaction causes these barriers to come to expression thereby reflecting on the previous findings by Kirchherr et al. (2018). Furthermore, a method is showcased for repeating this study in other important economic sectors of the EU to create a cross-industry wide mapping of the most pressing barriers for transitioning to CE and what business models, policies and interventions are required to accelerate the transition to CE

3.5.A Interrelatedness and dynamics of CE barriers

Certain interactions exist in-between the fifteen characteristic barriers for transitioning to CE (Kirchherr et al., 2018). This means that one barrier can have a direct or indirect effect on another barrier creating a particular chain reaction eventually resulting in the failure of in this case, a transition to CE (Kirchherr et al., 2018). It is likely that the expression of these interactions and the chain reaction that is the result of it, is highly dependent on the economy (landscape), sector (regime) and companies/SMEs (niches) studied. By analysing the interrelatedness and interactions between these barriers for the Dutch textiles sector and SMEs operating in the niches of that sector, the dynamics and chain reaction resulting in the possible failure of a transition within the Dutch textile sector can be identified and targeted strategies and interventions can be formulated and developed for the proper management of these SMEs

operating in their niche (SNM) (Kirchherr et al, 2018). In this way, it might be possible to reverse the chain reaction and create the means to accelerate the successful adoption of CE innovations in the business models of these SMEs and thereby accelerate the transition to CE altogether. The following figure shows an exemplary chain reaction from the study conducted by Kirchherr et al. (2018).

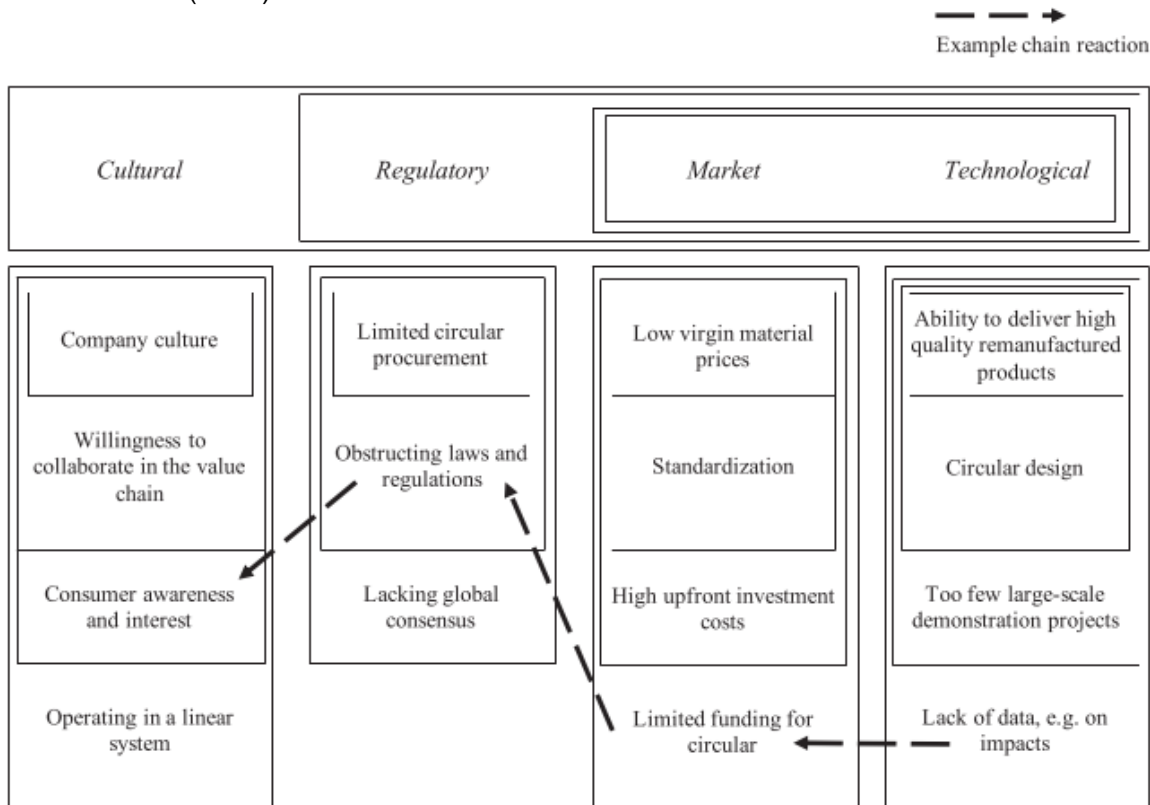


Figure 6. Exemplary chain reaction for the barriers hindering the transition to CE.

3.6 CE barriers and their positioning in the Multi-Level Perspective

Transitioning to CE and shifting the currently embedded socio-technical systems of the Dutch textile industry is a difficult and timely process, especially since such systems move slow and because regimes that exist now are characterized by lock-in and path dependency on multiple fronts (technological, cultural, financial and governmental) (Geels, 2010). Many of the solutions that are proposed or experimented with at the moment, for instance the CE package by the EU or subsidies for renewable resources can be seen as top-down approaches aiming to adapt current linear systems towards a more sustainable (circular) state. However, especially in light of the theories discussed leading to the framework of STTs, STRs and TEPs and the dynamics of change related to the MLP framework including the SNM approach, this study proposes that top-down approaches need to be accompanied and facilitated by strategically managed and

properly facilitated bottom-up approaches at the niche where CE innovations are being adopted initially. Moreover, it is vital that interventions should be properly targeted at barriers according to where they come to expression, at either regime or the niche or both. Therefore, it is necessary to apply a SNM approach in combination with a proper identification of the barriers and their positioning within the MLP. In this way, targeted strategies and interventions can be suggested in combination with recommended policies to apply a SNM approach from a top-down approach at the regime and a bottom-up approach at the niche. This enables the successful facilitation and enhancement of the development and adoption of CE innovations at the business models of SMEs.

In order to identify how to develop interventions that are designed to break barriers to CE at the right place in the system, it is necessary to assess CE barriers from a multi-level perspective. By applying this element of analysis, the necessary insights are gathered for properly steering CE innovations and policy makers to properly facilitate the adoption and development of CE innovations at the niche and eventually the regime. In short, to create interventions that can properly solve barriers by recommending the right solution for the right actor, either to be implemented from a top-down, bottom-up or simultaneous approach, it is necessary to exactly identify at which levels of the MLP the characteristic barriers for CE are coming to expression. Only then can the relevant actors that operate on those levels implement proper interventions to overcome identified barriers to CE and accelerate a wide-scale transition towards CE. Altogether, it is expected that at the niche level, where companies operate, technical barriers are prominent, at the regime level, where the sector thrives, cultural and regulatory barriers are expected to come to expression and at both the niche and regime level, distinct market barriers prevail with smaller market barriers at the niche level and larger market barriers at the regime level.

3.7 Integration of all theories into one framework

Combined, the theories from paragraph 3.3, 3.4, 3.5 and 3.6 represented in figures 4 and 5 and table 2, lead to the integration of one final framework that is functioning as the fundamental structure on which a research method and a questionnaire is based that will obtain the data used to build a constructive argument for answering the research question. This framework is presented in table 3 and sets out the characteristic barriers for companies in transition to CE against the theory of the MLP. Identifying which barriers are experienced as pressing and where they come to expression (regime or niche) will provide the insights needed to create targeted interventions that can tackle the identified barriers and strategically manage and facilitate the

successful adoption and implementation of CE innovations in their business model. Following the theoretical framework as presented by table 3, the research method should aim to find an answer to the following sub-questions:

1. *What is the positioning of the barriers on the MLP?*
2. *Which barriers are experienced as pressing by SMEs operating at the Niche?*
3. *Which strategic management approaches can tackle the barriers expressed as pressing by the SMEs and enhance the development of the niches in which they operate to properly facilitate the CE innovations being adopted in the business models of these SMEs?*

Table 3. Integrated theoretical framework for analysing the barriers of SMEs in CE transition.

Category	Barriers	MLP level	SMEs (niche)	SNM (approach)
Cultural barriers	Hesitant company culture	Regime/Niche?	?	< ?
	Limited willingness to collaborate in the value chain	Regime/Niche?	?	< ?
	Lacking consumer awareness and interest	Regime/Niche?	?	< ?
	Operating within a mostly linear system	Regime/Niche?	?	< ?
Regulatory barriers	Limited circular procurement	Regime/Niche?	?	< ?
	Obstructing laws and regulations	Regime/Niche?	?	< ?
	Lacking global consensus	Regime/Niche?	?	< ?
Market barriers	Low virgin material prices	Regime/Niche?	?	< ?
	Lacking standardization	Regime/Niche?	?	< ?
	High upfront investment costs	Regime/Niche?	?	< ?
	Limited funding for circular business models	Regime/Niche?	?	< ?
Technical barriers	Lacking ability to deliver high quality circular products	Regime/Niche?	?	< ?
	Limited circular designs (i.e. knowledge, options)	Regime/Niche?	?	< ?
	Lack of data e.g. on impacts	Regime/Niche?	?	< ?
	Too few large-scale pilot projects	Regime/Niche?	?	< ?

4. Methods

Obtaining the right insights to answer the research question requires a proper and comprehensive method of retrieving the right amount of data with the right quality and a clearly outlined manner of data analysis. Doing so will ensure the ability to form a scientifically justified answer to the research question set for this study. The research methods that have been applied are divided in the three sections as described below:

Table 4. Structure of research methods

4.1 Acquiring a qualitative dataset through semi-structured expert interviews	
A.	Interview sampling process and strategy
B.	Table of interviews
C.	Structure of the questionnaire and question strategy
i.	Understanding and adoption of CE (transition) in the Dutch textiles industry
ii.	Barriers for transitioning to CE and their positioning in the MLP
iii.	Strategies and challenges indicated to overcome barriers for CE
4.2 Analysis through transcribing and coding	
A.	Transcribing, coding and portraying the results
B.	Structure and strategy of the analysis
C.	Coding dimensions applied in NVivo 11
4.3 Complementation of the qualitative dataset – data triangulation	
A.	Methods used to achieve data triangulation
i.	Event 1: The Circular Fashion Games (CFGs)
ii.	Event 2: Shaping Fashion Event (SFE)

4.1 Acquiring a qualitative dataset through semi-structured expert interviews

4.1.A Interview sampling process and strategy

Baker & Edwards (2012) and O’Cathain et al., (2014) state that 15 to 20 interviews is a sufficient amount to obtain an adequate sample size for reaching thematic saturation. Thematic saturation refers to the scenario where no new answers are generated by conducting more interviews. Thematic saturation allows the researcher to terminate the sample size once no new information can be gathered (Baker & Edwards, 2012; Francis et al., 2010; Ragin, 1994). In light of thematic saturation, the aim of this study was to obtain at least 15-20 interviews for both sectors (secondary and tertiary). With a total of 47 scored interviews, 41 excluding the six validation interviews, this study successfully reached thematic saturation for both sectors comprising a highly representative dataset of the Dutch textiles industry. More specifically, interviews have been conducted with 10 small-sized and 11 medium-sized secondary players counting up to 21 interviews. Respectively, interviews were completed with 10 small-sized and 10 medium sized tertiary players counting up to 20 interviews. Furthermore, six validation interviews have been done beforehand with three players from each respective sector and industry sub-category to test the validity of the questionnaire. All samples, except for the validation interviews vary randomly between the three sub-categories of the textiles industry, namely clothing and apparel, interior textiles and functional textiles.

For every interview, a request for recording the interview was made. Not all requests were agreed upon resulting in 27 recorded and 14 non-recorded interviews. Data from non-recorded interviews has been captured by making notes on paper and/or digitally. In this study, the names of the interviewees and the interviewees’ companies will remain anonymous. Anonymity is safe-guarded through a coding system. Interviews are coded based on several elements. All interviews were conducted through telephone, representing the first element of the code, namely T for telephone. The second element represents the sector in which the SME is active, i.e. S for secondary or T for tertiary. The third element covers the size of the SME where S stands for small-sized and M for medium-sized. The number at the end i.e. 1,2,3 ... 10, indicates the order of interviews in that category. Table 5 shows all conducted interviews. The response rate for acquiring interviews was increased through applying snowball sampling where interviewees referred to other relevant interviewees in their network (Handcock & Gile, 2011).

4.1.B Table of Interviews

Table 5. Conducted Interviews, table of interviews and interviewees, N=47

Code	Active in	Recording allowed	Code	Active in	Recording allowed
TSS1	Clothing & Apparel	Yes	TTS1	Clothing & Apparel	Yes
TSS2	Interior textiles	Yes	TTS2	Clothing & Apparel	No
TSS3	Functional textiles	Yes	TTS3	Clothing & Apparel	Yes
TSS4	Functional textiles	No	TTS4	Interior textiles	No
TSS5	Functional textiles	No	TTS5	Clothing & Apparel	Yes
TSS6	Clothing & Apparel	Yes	TTS6	Interior textiles	Yes
TSS7	Clothing & Apparel	Yes	TTS7	Clothing & Apparel	Yes
TSS8	Functional textiles	No	TTS8	Clothing & Apparel	Yes
TSS9	Clothing & Apparel	Yes	TTS9	Clothing & Apparel	Yes
TSS10	Clothing & Apparel	Yes	TTS10	Clothing & Apparel	No
TSM1	Interior textiles	Yes	TTM1	Clothing & Apparel	No
TSM2	Interior textiles	Yes	TTM2	Clothing & Apparel	No
TSM3	Functional textiles	Yes	TTM3	Interior textiles	Yes
TSM4	Interior textiles	No	TTM4	Interior textiles	No
TSM5	Functional textiles	Yes	TTM5	Clothing & Apparel	No
TSM6	Functional textiles	Yes	TTM6	Clothing & Apparel	No
TSM7	Functional textiles	Yes	TTM7	Functional textiles	Yes
TSM8	Interior textiles	Yes	TTM8	Functional textiles	Yes
TSM9	Functional textiles	No	TTM9	Clothing & Apparel	Yes
TSM10	Interior textiles	Yes	TTM10	Functional textiles	Yes
TSM11	Interior textiles	No			
Validation Interviews					
TVS1	Clothing & Apparel	N/A	TVT1	Interior textiles	N/A
TVS2	Functional textiles	N/A	TVT2	Clothing & Apparel	N/A
TVS3	Interior textiles	N/A	TVT3	Functional textiles	N/A

4.1.C Structure of the questionnaire and question strategy

The questionnaire ([see appendix B](#)) has initially been derived from the framework set out in table 3, where the main structure's purpose is to find out what the barriers are behind the SMEs' attempts to implement CE in their business model and consequently how the development and viability of CE innovation among SMEs (niches) is progressing in order to reflect on it from a SNM approach. The questionnaire has been validated through testing it with three interviews for each sector and industrial sub-category, 6 in total. As a result, the questionnaire has been improved based on the feedback of these validation interviews aiming to ensure the quality of data retrieved from the interviews. Essentially, the questionnaire as well as the analysis of this research can be divided in three main themes:

- i. Understanding and adoption of CE in the Dutch textile industry
- ii. Barriers for transitioning to CE and their positioning in the MLP
- iii. Strategies and challenges indicated to overcome barriers for CE

Questions 1 and 2 of the questionnaire are introductory questions to create an abstract company profile of the interviewee and their company. Question 3 aims to identify familiarity of the interviewee with CE and to find out what their understanding is of the concept of CE; theme 1. Question 4 aims to identify the CE related activities the company has already adopted in their business model; theme 1. Both question 3 and 4 intend to gather insights on the desirability and adoption of CE innovations to reflect on it from a SNM approach. Question 5 aims to identify the barriers a company is facing or has faced in its attempt to implement CE in their business model and to learn whether these barriers happen at the niche level, the regime level or both; theme 2. Question 6 aims to retrieve detailed examples for these barriers to provide supportive evidence for why barriers are being faced, what causes barriers to happen and where in the MLP they are positioned; theme 2. Questions 7 and 8 aim to retrieve data for what strategies the company have already initiated to overcome barriers faced for transitioning to CE and what challenges the company faces with executing one or more of these strategies to see whether they are actually effective in their attempt to break one or more barriers faced for CE; theme 3. Questions 5, 6, 7 and 8 will retrieve insights on the viability of CE innovations in the business model of the SME (niche), the current development of the sector and niches in which the SMEs operate and the strategies and solutions that are initiated that could possibly enhance the development of CE innovations in these niches. These insights will also enable a proper reflection on the SNM currently in place and which targeted interventions could be implemented

to enhance the (development of) SNM in order to accelerate a CE transition within the Dutch textiles industry.

4.2 Analysis through transcribing and coding

4.2.A Transcribing, coding and portraying the results

All recorded interviews have been transcribed using *Wreally Transcribe*. This programme has been chosen especially for its functionality using keyboard shortcuts and an integrated audio player allowing efficient transcribing in one screen without switching. The notes of non-recorded interviews have been captured in *Word* from written notes and digital notes and were cross-examined with the interviewee when necessary. All 41 transcriptions have been coded and analysed in *NVivo 11*. During the coding process, numerous dimensions have been set up that categorize trends in answers by frequency and key phrases coupled to a certain trend. The following sections discuss what strategy has been applied to identify trends and what coding dimensions have been used. Results are presented in tables and figures, mostly constructed with the program *Think-Cell*. Based on the data analysis and figures resulting from the interviews, meaningful insights for answering the research question have been obtained.

4.2.B Structure and strategy of the analysis

Similar to the set-up of the questionnaire, the analysis also adheres to the three indicated main themes. Theme 1, the understanding and adoption of CE in the Dutch textiles industry. Theme 2, the barriers for transitioning to CE and their positioning in the MLP and theme 3, strategies and challenges indicated to overcome barriers for CE. For theme 1, data has been gathered for familiarity with the concept of CE resulting in a simple yes or no answer, the understanding of the concept of CE and the type of activities related to CE already conducted in the business model of the interviewee to check for adoption of CE. To test the level of understanding, the academic definition as given by Kirchherr, Reike & Hekkert (2017) has been broken down in four key elements to measure the completeness and level of understanding of the interviewees: (A) CE takes place at various process levels such as production, distribution and consumption and/or can take place at different scales such as companies, cities, nations or beyond that, (B) CE can be created and implemented through innovative business models and responsible consumers, (C) CE aims to accomplish sustainable development through serving both people, planet and profit and is intended to benefit both current as well as future generations and (D) CE intends to replace the 'end-of-life' concept by closing the loop either through reducing, reusing, recycling and/or recovering materials.

Responses given to the questions testing the level of understanding were accordingly coded within these dimensions (elements) to identify the completeness of definitions given by interviewees compared with the academic definition for CE as described in this research. Comparing answers to the elements of the academic definition makes it possible to analyse how comprehensive the understanding of CE is within the Dutch textiles industry. For theme 2, the barriers for transitioning to CE and the position of the barriers in the MLP, responses of interviewees have been mapped and categorized among the fifteen typical barriers for transitioning to CE as represented in the framework of table 3. Newly encountered barriers have been named and were coded under that name in addition to the fifteen previously discovered barriers for CE. In addition, barriers for transitioning to CE were also analysed for their position in the MLP, i.e. taking place at either the niche level, regime level or both. Barriers have been coded accordingly. For theme 3, the strategies and challenges indicated to overcome barriers for CE, answers were identified and categorized in different categories of strategies and challenges. Leading from theme 1, 2 and 3 just as described in the breakdown of the questionnaire, the aim of this analysis next to mapping the barriers for CE, is to develop a proper understanding of the development, adoption, desirability and viability of CE innovations in the niche environments in which the SMEs of the Dutch textiles industry operate. Only then can a proper reflection be made on the progress of the transition towards CE and can insights be generated for targeted interventions that can break the mapped out barriers, accelerating the transition from a SNM approach.

4.2.C Coding dimensions applied in NVivo 11

In total, answers and responses have been coded on different dimensions divided over eight questions in three main themes. For coding dimensions, see [appendix C](#).

4.3. Complementation of the qualitative dataset – data triangulation

4.3.A What is data triangulation and how does this study appeal for it

Data triangulation describes the process where validity of data is strengthened through cross-verification with information from multiple types of data from different sources, for instance using both primary research (new data) and secondary research (literature data) (Denzin, 1970, 2012; Thurmond, 2001). The term triangulation is derived from variations in data caused by three elements, time of data collection, location of data collection and the person(s) from whom data was collected (Denzin, 1970, 2012; Mitchell, 1986; Thurmond, 2001). Evidence of data triangulation varies from a combination of either of the following methods: primary research,

secondary research, interviews, public records, photographs and observations (Denzin, 1970, 2012; Mitchell, 1986; Thurmond, 2001).

This study appeals to data triangulation by combining primary research and secondary research through interviews, where primary research is defined as conducting new research for instance by means of surveys, focus groups, interviews and observations and secondary research is defined as taking into account previous research on the subject to re-confirming and/or improve the answers of previous studies (Glass, 1976). In this study, new data has been gathered through interviews (primary research) with the aim to reconfirm and/or improve the data and results obtained in the research previously conducted on the barriers for transitioning to CE by Kirchherr et al. (2018). In this previous study done by Kirchherr et al. (2018), fifteen barriers were identified to be typical for transitioning to CE. By re-analysing and re-testing these barriers, their validity and meaning can be increased and/or improved. Additionally, gathered data from the interviews has been cross-verified by information retrieved from unstructured interviews, collective brainstorm sessions captured in public records, photographs and observations made by multiple CE experts that attended CE events for the Dutch textiles industry. These events are the Circular Fashion Games and the Shaping Fashion Event held in the Fashion For Good centre in Amsterdam.

i. The Circular Fashion Games

The Circular Fashion Games is a CE event hosted for 76 young professionals and entrepreneurs. Over the course of one week, multiple groups collaborated to work on creating new solutions to challenges brought to the light by multiple companies from the industry. Challenges posed by the companies were focused mostly on overcoming barriers for limited circular design knowledge, stimulating responsible consumer behaviour and applying innovative business models.

ii. The Shaping Fashion Event

Due to successfully having won the circular fashion games by being awarded the best idea and presentation, a follow up event, the Shaping Fashion event, was attended. At this event the research question was stated as a personal challenge to the stakeholders and experts that attended this event, where multiple speed-date brainstorm sessions resulted in new information and data included in this study.

5. Findings & Discussion

In this chapter the results from the interviews are presented and discussed in accordance with the structure of the three main themes of the questionnaire. In addition, results and evidence of data triangulation from the CE events are presented and discussed

5.1 Understanding and adoption of CE in the Dutch textile industry

When asked about the familiarity with the concept of CE, a large majority, namely 88% of all interviewees acknowledged to be familiar with the term and its meaning and could provide a definition in the interview. Only 12% (5 out of 41 interviewees) had never heard of CE before even though they were unknowingly conducting CE related activities. These interviewees were given the academic definition when asked what activities they conducted. The 36 interviewees that were already familiar with CE were asked to provide a definition. This definition was measured in how many elements were corresponding with the breakdown of elements from the academic definition of CE as given by Kirchherr, Reike & Hekkert (2017). The large majority, namely 86% of the answers covered element D 'closing the loop by replacing the 'end-of-life' concept through either reducing, reusing, recycling and/or recovering materials' in their definition. Only a handful of interviewees provided a definition that covered a more comprehensive meaning of CE where more than one element was mentioned, for instance element D and C or element D and B. Still, element D 'closing the loop' represents how CE is interpreted by the majority of players in the Dutch textile industry. In addition to most answers covering element D 'closing the loop' as core interpretation of CE, differences could still be identified for how 'closing the loop' itself is interpreted.

The most frequent aspects of 'closing the loop' that were mentioned was the reuse and recycling of materials, 'Reuse' covering 36% of answers and 'Recycle' 32%. Figure 7 gives a complete overview of the level of understanding of CE by the interviewees and the variation among them per sector (secondary and tertiary). Overall, 26 out of 41 interviewees had a basic understanding of CE (64%, 1/4), 7 out of 41 interviewees had a good understanding (17%, 2/4), 3 out of 41 interviewees had an advanced understanding (7%, 3/4) and 5 out of 41 interviewees (12%, 0/0) had no understanding of the concept at all. No interviewee had full academic understanding of CE (0%, 4/4). Out of the different subgroups, the medium-sized secondary players (TSM) scored the highest coverage of the four elements out of all subgroups with 1 player having an advanced understanding, 3 players having a good understanding and 6

players having a basic understanding. Medium-sized players from the tertiary sector (TTM) scored the lowest overall understanding of CE with 3 players never having heard of the concept before and half of the players (5/10) having just a basic understanding. Altogether, the secondary sector on average had a better understanding than the tertiary sector. This might be due to the fact that these players have had more hand-on experience with designing and producing circular products since they are manufacturers, whereas medium tertiary sector players were often large retailers trying to engage in circular procurement, which is far less hands-on than manufacturing.

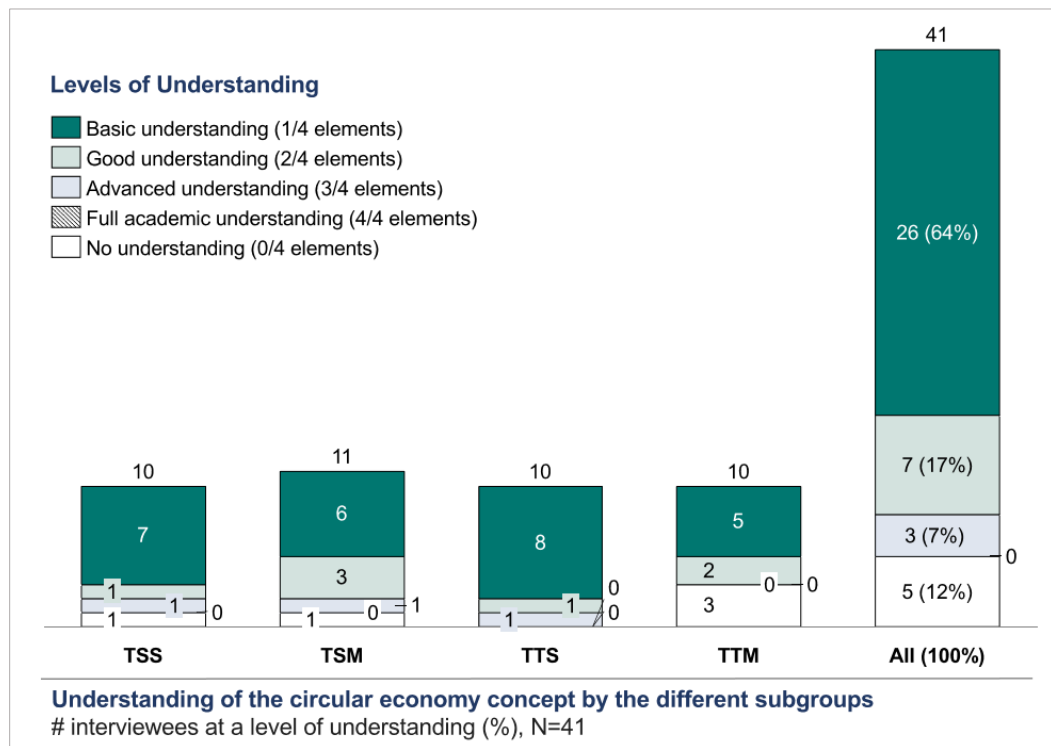


Figure 7. General level of understanding of CE by the interviewees.

Figure 8 shows what CE related activities were conducted within the interviewed firms related to the adoption of circular business models in the textiles industry. In total, eight different categories of circular activities were identified as can be seen in figure 8. The most dominant circular activity is the recovering of products for reuse or recycling, accounting for 28% of all activities conducted. One of the major differences noticeable between the secondary and tertiary players is the difference for the activity of direct recycling and/or reusing products which was done frequently by secondary players (20%) but never by tertiary players (0%). Tertiary players mainly engaged in the recovery of products for recycling. Likewise the creation and development of circular product designs was higher for secondary players (25%) than for

tertiary players (16%). Both these observations fit with the fact that manufacturers were more often involved with in-house production and recycling or reusing than retailers. In contrast, tertiary players engaged far more in circular procurement than secondary players (26% over 15%), the same applied for using a product as a service model (8% over 2%) which fits with the fact that retailers are more likely to procure end-products and are in direct contact with consumers allowing the possibility of a leasing (product as service) business model. Overall, 'Using a product as service business model', 'Reducing waste streams actively within the product process' and 'No activity conducted yet', were the least frequent activities conducted by the 41 interviewees.

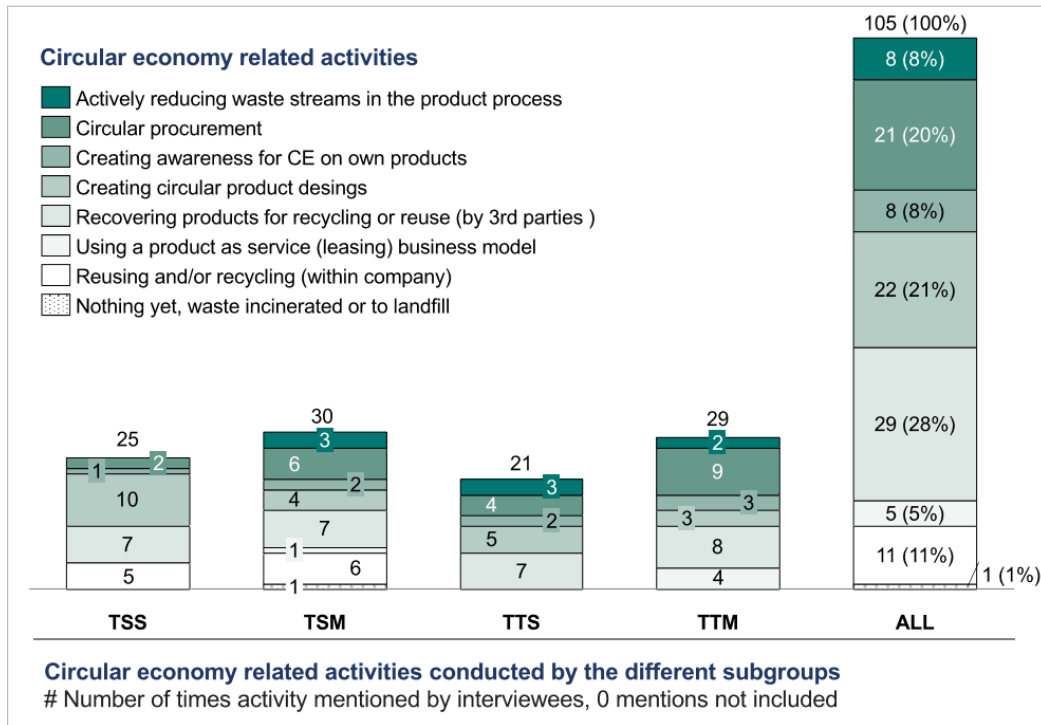


Figure 8. Circular activities conducted by players of the Dutch textiles industry.

Based on the high familiarity (88%), a mostly basic to good understanding of CE (64%) and high adoption count of CE within the business models of these players (99%), this study argues that for the Dutch textiles industry CE is not merely a buzzword used by academics or sustainable development professionals as stated by Kirchherr et al. (2018). Rather, CE is highly present in the niches in which the SMEs operate and can thus be seen as a desirable concept with a need and demand for implementation. Of course, that does not take away the fact that there are still many barriers hindering the transition to CE suggesting yet a low viability of CE innovations that are trying to be adopted in the business models of these SMEs. Furthermore, it is likely that

circular activities still cover only a small fraction of all operations of these SMEs. Interviewees still have a basic understanding of CE on average and could improve their understanding of the concept to enhance the development of CE innovations in their business model. Additionally, circular activities adopted in the business model could focus more on the actual reuse and recycling of products rather than just recovering materials for third parties to recycle and procuring circular products when possible. Shifting to a more actual first-hand recycling, recovering, reducing and reusing of materials could improve the learning process and adoption of CE innovations among the SMEs and help mature the experimenting now done in the niche to actual successful adoption and implementation (SNM approach). Moreover, targeted interventions for a higher rate of direct applications of CE (for instance recycling and reusing) could accelerate socio-technical transitions happening in the niches of these SMEs and shift the regime (STR) and thereby the techno-economic paradigm to a new state where CE is dominant (SNM approach).

5.2 Barriers for transitioning to CE and their positioning in the MLP

5.2.A New barriers

Interviewees were asked to mention their five biggest barriers for transitioning to CE. The identified barriers were assessed for their total number of mentions in answers given by the interviewees. From the interviews three previously undefined barriers have been identified to be relevant for the Dutch textile industry, namely: 1) Opportunistic competition, a market barrier, score: 2% of answers; 2) Limited volumes of circular supply streams, a technical barrier, score: 37% of answers; 3) High costs for producing/selling CE products, a market barrier, score: 66% of answers.

Opportunistic competition describes the process of opportunistic behaviour by competitors, for example one interviewee said: “Competitors all want to find something in your initiative to boost their own circular ideas but they will not be proactive and help you, even though you might need it. Unfortunately, they are all quite opportunistic in the end” (TSS1). Limited volumes of circular supply streams describes the issue of not finding or receiving enough volumes of waste material or additionally not finding enough volumes of the right quality consistency. For instance, some interviewees stated: “New circular products cannot be created in volume which already existing products do have, meaning we cannot scale up easily” (TSS3); “It is essential to have a lot of waste streams to create an economically viable process for circularity, which we do not have” (TSM11) or “For us, the greatest barrier is that we lack a constant flow of waste streams that we can use, we have to scrape it together here and there and that is problematic since we cannot give any guarantees to fill orders” (TTS4). Finally, high costs for producing and selling circular textile products describes the process where actually producing or retailing a circular product is not price competitive enough in comparison with standard products.

Many players mentioned this as a barrier, for instance: “Working with circular products in our business model, reducing material use as much as possible, simply means that we will be more expensive. These are certain choices we have to make” (TTS7); “We need to adjust the product to the most competitive price possible for recycling options, we apply new technologies but it cannot go at a cost of the competitive price. We need to internalize and streamline the recycling scheme to be just as efficient as with the normal linear industry process” (TSM1) or “Being circular is a lot more expensive, there are many more labour hours that go into making a good circular product, disposal is in many cases much cheaper” (TSS10).

5.2.B Most pressing barriers and interrelatedness

Table 6 presents the scoring of the barriers by percentage of being mentioned by the answers given by interviewees. Ranking is concluded as follows: the highest percentage receives rank 1, from there the second highest percentage is assigned rank 2, and so on. Equal scores of percentages share an equal position in the ranking and are perceived in this study as an equally pressing barrier for the industry.

Table 6. Mentioning of barriers: percentage and rank, according to the Dutch textiles industry.

Scoring of barrier: percentage and rank (in brackets)		Percentage of answers	Ranking
Cultural	Hesitant company culture	5%	9
	Limited willingness to collaborate in the value chain	20%	7
	Lacking consumer awareness and interest	49%	<u>2</u>
	Operating within a mostly linear system	32%	<u>4</u>
Regulatory	Limited circular procurement	0%	11
	Obstructing laws and regulations	27%	<u>5</u>
	Lacking global consensus	0%	11
Market	Low virgin material prices	7%	8
	High costs for producing/selling circular products	66%	<u>1</u>
	Opportunistic competition	2%	10
	Lacking standardization	0%	11
	High upfront investment costs	24%	6
	Limited funding for circular business models	7%	8
Technical	Lacking ability to deliver high quality circular products	32%	<u>4</u>
	Limited circular designs (e.g. knowledge, options)	37%	<u>3</u>
	Lack of data e.g. on impacts	5%	9
	Limited volumes of circular supply streams	37%	<u>3</u>
	Too few large-scale pilot projects	2%	10

Figure 9 displays table 6 as a bar chart. Barriers that scored below 5% of total answers have been excluded from the diagram.

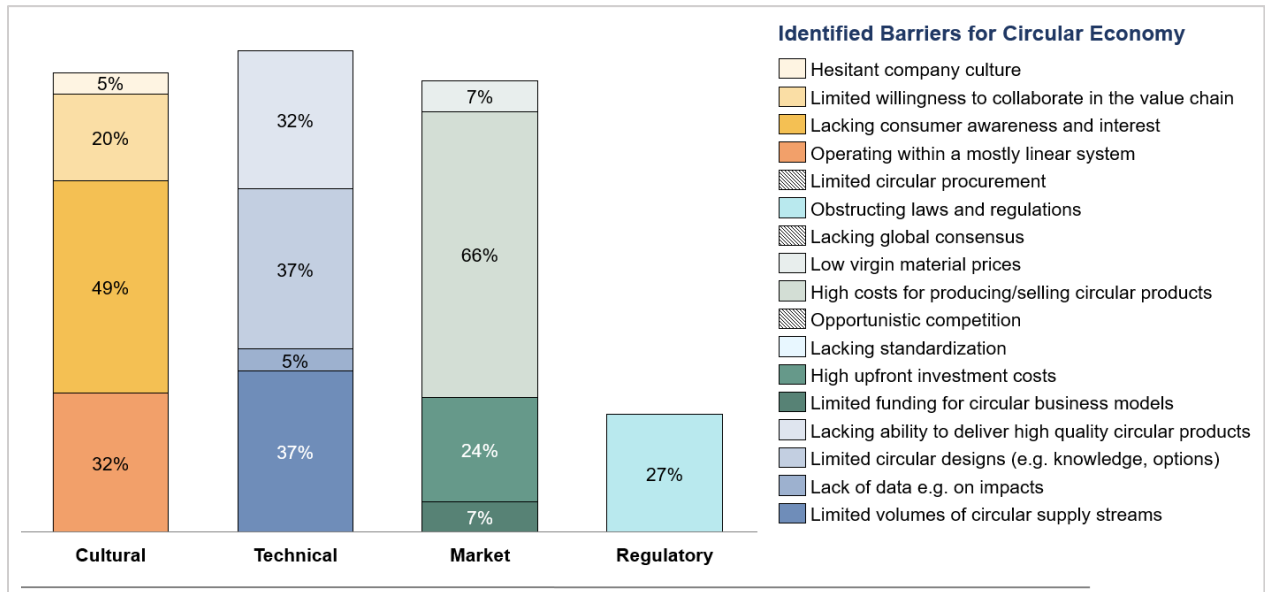


Figure 9. Mentioning of barriers by the interviewees (%), with a total of 41 interviews (n=41).

Leading from the table and figure the five most pressing barriers are presented in table 7 including their percentage of the total answers and their final ranking.

Table 7. Most pressing barriers for transitioning to CE for the Dutch textile industry.

Category	Most pressing barriers for transitioning to CE	Score	Rank
Market	High costs for producing and selling circular textile products	66%	1
Cultural	Lacking consumer awareness and interest	49%	2
Technical	Limited volumes of circular supply streams	37%	3
Technical	Limited circular designs (e.g. knowledge, options)	37%	3
Cultural	Operating in a (mostly) linear system	32%	4
Technical	Lacking ability to deliver high quality circular products	32%	4
Regulatory	Obstructing laws and regulations	27%	5

5.2.B.1 Market barriers

The absolute most pressing barrier for the Dutch textiles industry is the barrier of 'High costs for producing and selling circular textile products' (66% of answers), a market barrier. This is in line with what previous academic literature (see chapter 2) and the study by Kirchherr et al. (2018) stresses, which is that market barriers frequently form a big obstacle for transitioning to CE.

However, in this study they are the first most pressing barrier, whereas in Kirchherr et al. (2018) they represent only the second most pressing group of barriers. While previous studies often indicate 'Low virgin material prices' or 'High upfront investment costs' as the main market barriers that are the cause for many other barriers happening, interviewees from the Dutch textile industry argue from an opposite perspective. Rather than indicating that market barriers are the cause of the lack of transition to CE, they better explain that market barriers such as 'High costs of producing and selling circular products' are the result of other underlying technical and cultural barriers creating a chain reaction that forms the eventual problem stopping a transition to CE. Moreover, these underlying barriers happened to come forward among the most pressing barriers in this study as well, namely the barriers of 'Limited volumes of circular supply streams', 'Limited circular design options' a 'Lacking ability to deliver high quality circular products' (technical barriers) and also the barrier of 'Operating in a (mostly) linear system' (cultural barrier).

It are these barriers that can explain the low cost-competitiveness of CE product prices compared to their linear equivalents and in turn can thus also explain the barrier of 'Lacking consumer interest and awareness'. Some statements from interviewees are presented as evidence: "Especially since producing circular is a new way of producing, scaled up volumes are definitely not existing yet, therefore it is really pricy, both investing in the process as the end price. In the end the cost-price is always a sensitive issue for the consumer, we are currently working on this" (TSS4). "With the most commonly used textile material types, I can just buy the amount of material I need per product, I cannot do this for our more circular products, designing the regular way is thus cheaper" (TTS7); Other interviewees said: "Currently, setting up a circular system to return your end-products is quite difficult and not financially attractive for the customer. It could be improved by offering a discount when they buy a new (recycled) product, but it has to be economically viable, otherwise it is just a disadvantage to make it even work" (TSM3); "In our price class, people prefer to choose authentic leather rather than synthetic leather, which can be made circular. In that case it is just extremely difficult for us to deliver the same quality for the same price range in our circular products" (TTS2)

5.2.B.2 Cultural barriers

The second most pressing group of barriers in this study are the cultural barriers, namely 'Lacking consumer interest and awareness' (49%) and 'Operating within a (mostly) linear model' (32%). Despite the majority of academic literature stating that cultural barriers are often not that pressing (see chapter 2), this study shows that for the Dutch textiles industry cultural barriers

are actually often experienced as pressing barriers for practitioners and businesses in transition to CE. This finding happens to be in line with what Kirchherr et al. (2018) concluded in their study, which is that cultural barriers do often prove to be obstructing for companies aiming to transition to CE. Whereas this study places cultural barriers as the second most pressing group of barriers, the study by Kirchherr et al. (2018) puts cultural barriers as the first most pressing group of barriers with an emphasis on 'Lacking consumer interest and awareness', a 'Hesitant company culture' and 'Operating in a mostly linear system'. This study only agrees with two of these barriers, namely 'Lacking consumer interest and awareness' and 'Operating in a mostly linear system'. Much in agreement with the academic literature and Kirchherr et al. (2018), the barrier of 'Lacking consumer interest and awareness' is interpreted as an indirect effect of a market barrier, in this case the first most pressing barrier of this study, namely: 'High costs for producing and selling circular products'.

This theory is backed up by what most interviewees said: "The biggest barrier for us is that we can't change anything about the fact that consumers don't want to pay more, they just want products where the price is so cheap that you can almost guarantee there is unfair labour involved" (TTS6); "We also experience a challenge with the consumers, they lack a long term vision when purchasing products, the recycled products are more expensive and are therefore not accepted by the consumer" (TSS8); "Another thing is, when you mention that you work with waste streams, consumers expect the prices to be low, but they are higher and they don't understand why." (TTS2) and "Because the price is often too high, the consumer prefers choosing our standard products" (TSM4). As mentioned earlier in the section on market barriers, the barrier of 'Operating in a (mostly) linear system' is also argued to be responsible for the barrier 'High costs to produce and sell circular products'. What interviewees stated is that their attempts to implement circularity was often the cause of a lack of proper reverse logistics driving up the costs of production, meaning that the linear system in which they operate could not properly sustain their implementation strategies for CE: "Reverse logistics is the biggest challenge for us because a lot of steps are involved, you can't be with your product every moment of the day. We have a return-programme and we couple several circular models to that, you can lease, buy or rent. We take that responsibility but to manage it logistically remains very challenging." (TSM10), "We have a lot of barriers, for example the lack of proper logistical networks with a focus on recycling textiles and mainly cotton is one of them." (TTM6) and "One barrier that is very straightforward is the problem with logistics, it is very challenging to convince customers to send back their products at the end of their lifetime so that we can use it again,

there are also extra costs connected to it, that makes it financially challenging too to realise such a circular chain properly.” (TTS8).

Finally, the barrier that this study disagrees with in contrast to Kirchherr et al. (2018) is the barrier of ‘Hesitant company culture’, which received a low score in this study (5%). Moreover, it can be argued that a lot of players are already experimenting with CE and trying to implement certain CE strategies as can be seen in figure 8 for the CE activities already conducted; only 1% of the answers indicated doing absolutely nothing circular related. This further backs up the finding that ‘Hesitant company culture’ is not a particular issue within the Dutch textiles industry.

5.2.B.3 Technical Barriers

The third most pressing group of barriers are the technical barriers: ‘Limited volumes of circular supply streams’ (37%), ‘Limited circular design’ (37%) and a ‘Lacking ability to deliver high quality circular products’ (32%). Previous academic literature on CE barriers states that technical barriers often form a bottleneck for implementing CE initiatives (see chapter 2), however, Kirchherr et al. (2018) challenges this belief since none of the technical barriers emerge as any of the core pressing barriers in their study. Rather, technical barriers appear among the lowest scoring barriers in their work. Still, even though technical barriers represent the 3rd most pressing group of barriers in this study, these technical barriers are argued to be a major cause of a chain reaction leading to the highest pressing barriers in this study, namely that circular products and services are more expensive and less cost-competitive than virgin products resulting in a lack of consumer interest. Therefore, this study agrees with what the majority of literature states in contrast with Kirchherr et al. (2018) Technical barriers are in fact seen at the source of the toughest challenges regarding CE implementation within the Dutch textiles industry.

Numerous statements from interviewees support this theory: “It is very difficult for us to find suppliers that can give a continuous stream of circular related products, we have to take what we can get to keep our head above the water” (TSS10), “There is simply too little supply and demand for the right materials to use for reuse and recycling” (TSS9), “With the most commonly used textile material types, I can just buy the amount of material I need per product, I cannot do this for our more circular products, designing the regular way is thus cheaper” (TTS7), “One of the barriers we face is that we cannot yet create every type of thickness in our yarns yet, so very thin yarns are not possible although we are closing in on it” (TSS7), “It is very hard to find the right balance between quality and price, that has to be perfect when you are

handling a product as service model” (TTS10), “In our price class, people prefer to choose authentic leather rather than synthetic leather, which can be made circular. In that case it is just extremely difficult for us to deliver the same quality for the same price range in our circular products” (TTS2) and finally “We know too little about the designing technologies available, so we cannot breakthrough with an opportunity to make it technically sustainable and profitable at the same time” (TTM4).

5.2.B.4. Regulatory barriers

Finally, regulatory barriers present the least pressing group of barriers, with only one barrier ‘Obstructing laws and regulations’ among the list of most pressing barriers (table 7) and a score of 27% mentioned in the answers. This result is somewhat in line with the study by Kirchherr et al. (2018), where regulatory barriers were also not strongly represented as core barriers but the barrier ‘Obstructing laws and regulations’ was however the most strongly represented barrier of the regulatory barriers, as is in this study. Statements on obstructing laws were given by the interviewees: “Currently we face barriers from regulation, these are not made to support circular economy. This is definitely one of the major issues because it would help so much if the authorities and the economic environment was to be more driven towards circular economy. For example, if the existing EU regulations that are addressing the selection of materials would prefer a market for recycled products it would create much more incentive” (TSM1), “If the government would give us a little more freedom to experiment with the recycling of clothing and materials that would help a lot, at the moment when we recycle post-consumer waste, for example a shirt from the 80s, we cannot guarantee its contents, there we receive some resistance, but it is better in the end because you still save virgin material” (TSS7), “The government should help by subsidizing our initiatives but they do not, this is still lacking” (TTM1) and finally “There are a lot of rules you have to comply with for safety, otherwise you will get scandals, those rules are there for a reason but also hinder you sometimes when working a bit differently” (TTM8).

Based on the quotes given by the interviewees, the regulatory barrier of ‘Obstructing laws and regulations’ does not really seem to directly or indirectly affect the course of the chain reaction itself but rather functions as an all-encompassing obstacle that enforces the other barriers, increasing the perseverance of these pressing barriers through creating a generally challenging environment for the implementation of circular initiatives or strategies and solutions aimed at breaking barriers to CE.

5.2.C Most pressing barriers and their positioning in the multi-level perspective

According to the answers and examples given by interviewees, barriers have been assigned a corresponding level of the MLP framework. Barriers were divided based on whether the barrier could be directly influenced by the company (niche level), or whether this barrier is something that happened outside the sphere of influence of the company at a wider sector level (regime level). Table 8 presents which barriers take place at which level including the obtained score per barrier.

Table 8. Identified barriers, their level on the MLP and the scoring ratio of regime/niche barriers.

Category	Barrier	Level on the MLP	Score
Cultural	Hesitant company culture	Niche (company)	5%
	Limited willingness to collaborate in the value chain	Regime (industry/sector)	20%
	Lacking consumer awareness and interest	Regime (industry/sector)	49%
	Operating within a mostly linear system	Regime (industry/sector)	32%
Regulatory	Limited circular procurement	Regime (industry/sector)	0%
	Obstructing laws and regulations	Regime (industry/sector)	27%
	Lacking global consensus	Regime (industry/sector)	0%
Market	Opportunistic competition	Regime (industry/sector)	7%
	High costs for producing/selling circular products	Regime (industry/sector)	66%
	Low virgin material prices	Regime (industry/sector)	2%
	Lacking standardization	Regime (industry/sector)	2%
	High upfront investment costs	Niche (company)	24%
	Limited funding for circular business models	Niche (company)	7%
Technical	Lacking ability to deliver high quality circular products	Niche (company)	32%
	Limited circular designs (i.e. knowledge, options)	Niche (company)	37%
	Lack of data available e.g. on impacts	Niche (company)	5%
	Too few large-scale pilot projects	Regime (industry/sector)	37%
	Limited circular supply streams available	Regime (industry/sector)	2%
Ratio	Total score of regime barriers/total score of niche barriers		
X:Y	Score regime barriers/Score niche barriers	in number	2.22 : 1
:%: %	Score regime barriers/Score niche barriers	in percentage	69% : 31%

The hypothesis for the positioning of barriers on the MLP stated that cultural barriers were expected to take place mostly on the regime level since these barriers would be outside of the direct sphere of influence at the firm level. As can be seen in the table this is mostly true. However, only the barrier of a 'Hesitant company culture' is argued not to be at the regime level. One interviewee explained how company culture was influenced in their firm "Personally, I try to stimulate the whole organization to think more sustainably, therefore we collaborate together to actively help and support the restoration of surrounding natural habitats in the environment and I also rent out a cinema once in a while to watch sustainable documentaries with the whole company, it are these sort of things that help steer the creativity and development of ideas, if you bring all small ideas together you might create a tipping point for a big decision" (TSM8).

Regulatory barriers and market barriers fall in line perfectly with the initial hypothesis for these barriers, namely that regulatory barriers would happen at a wider regime level, and for market barriers that they were expected to happen both at the regime level and on the niche level. In this case, the larger (macro) market barriers would happen at the regime level outside of the sphere of influence of firms, such as "Low virgin material prices" and "Lacking standardization" and smaller (micro) market barriers would take place at the niche level within the sphere of influence of firms such as "Limited funding for circular business models" and "High upfront investment costs". On the other hand, technical barriers do not support the initial hypothesis at all. Technical barriers were expected to be fully operating at a niche level, as it turns out however, many of these barriers are outside the sphere of influence of most companies and rather happen at a wider sector level. Overall, the majority of barriers seem to be happening at the regime level and lie outside the direct sphere of influence of companies. Especially technical barriers which are argued to be at the source of the challenge for the key barriers seem to happen more at the regime level than expected. At the bottom of table 8, the ratio of regime barriers versus niche barriers is presented based on the total score obtained by both categories, namely 69% of the score assigned to barriers belong to regime barriers, whereas niche barriers represent 31%, of the mentioned barriers making regime barriers twice as prominent than niche barriers. This is relevant for strategies on how to overcome CE barriers.

5.3 Strategies indicated to overcome CE barriers and challenges faced therein

In total, 8 different strategies were identified in the 41 interviewees, as can be seen in table 9. The most frequently applied strategy by the interviewees was creating extra marketing efforts for raising awareness mostly on own circular initiatives in order to consolidate extra sales, 37% of the answers (26/71). Other strategies often indicated were internal research and development 18% of answers (13/71), working with universities 17% (12/71) and looking for collaboration within the supply chain 17% (12/71). Based on these results we see the majority of strategies to deal with CE barriers are internally focussed (80%), rather than looking for solutions that target the wider sector such as collaborating with the supply chain (17%) or conduct pilots (3%). Additionally, six Types of challenges were identified by the 41 interviewees for the indicated strategies, as can be seen in table 9.

Table 9. Strategies indicated to overcome CE barriers and challenged faced with strategies.

Strategies to overcome CE barriers	% (#answers/total # answers)
Looking for collaboration within the supply chain	17% (12/71)
Compensating with extra sales from circular initiatives	3% (2/71)
Conducting pilots	3% (2/71)
Extra marketing and raising awareness	37% (26/71)
Pursuing a circular company culture	4% (3/71)
Working with universities and scholars	17% (12/71)
Internal research & development	18% (13/71)
Challenges faced with those strategies	% (#answers/total # answers)
Limited circular budget	11% (5/47)
No measurable progress	15% (7/47)
No challenges with given strategies	11% (5/47)
Strategy works effectively	22% (10/47)
Strategy shows too little results	45% (21/47)
Strategy is too time consuming next to core activity	9% (4/47)

Taking into account that the most pressing barriers happen at the regime level while the majority of strategies are focussed internally on the firm and niche level, it is no surprise that only 67% of the interviews mentioned that the strategies were not effective, were too costly, too time consuming, did not give any measurable results or only gave just little results. Just 33% of the answers covered statements that indicated no challenges were experienced with the given strategies (22%) or that the strategies mentioned were actually effective when executed (11%). Based on these results, it is straightforward that there is more need for strategies focussing on the regime level and that take into account the problems happening at a wider sector or industry level. Overall, it can be stated that the viability of CE innovations that are trying to be adopted in the business models of the SMEs at the niche is still low. Despite the desirability of CE and at first sight high adoption of it, the development and successful implementation of the CE innovations is still hindered by the identified barriers and the chain reaction of these barriers representing the problem at large for a transition to CE within the Dutch textiles industry. With the insights gathered in this chapter, the concluding chapter to this research states targeted interventions to enhance the development of CE innovations within the business models of SMEs of this sector and increase the rate of implementation of said business model innovations, successfully completing a technological transition.

5.4 Results from circular economy events for the Dutch textile industry

Evidence for triangulation is presented for the two CE events by means of unstructured interviews with CE and industry experts, observations, public records and photographs.



Figure 10. Panel of textile experts and thought leaders for CE within the industry, taken at the final presentation of the Circular Fashion Games (CFG, 2018).

5.4. The Circular Fashion Games

At the first event, results follow from observations from industry experts and thought leaders on the area of circular economy within the textile industry, backed up by public records (CFG, 2018) and photographs. Barriers were observed from the feedback and challenges posed by the some of the industry leaders on CE within the textile industry. The first barrier identified comes from the company Lenzing, that creates garments from renewable cellulose fibres and posed their challenge as: “What are the solutions that could stimulate and improve the availability of circular designing and circular design options?”. The corresponding barrier within the context of this research is: ‘Limited circular design’, a technological barrier happening at the niche level. The second and third barrier identified comes from the company Circle Economy, a circular consultancy firm with expertise in the textiles industry, and posed their challenge as: “How can we raise awareness and knowledge on responsible consumer behaviour through digital innovation?”. The corresponding barriers within the context of this research are: a ‘lack of available knowledge (e.g. on impacts)’ a technological barrier at the niche level, and ‘Limited consumer awareness and interest’ a cultural barrier at the regime level. The fourth and final barrier identified at this event comes from the company Waste2Wear, a manufacturer of garments from circular materials, and posed their challenge as: “How can we deliver high quality garments from recycled plastics?” The corresponding barrier within the context of this research

is: a 'Lacking ability to delivering high quality circular products' All four barriers posed by the experts and companies seem to support the identified most pressing barriers in this study, validating these results.

5.4.B Shaping Fashion Event

At the second event results follow from unstructured interviews with industry and CE experts. Multiple brainstorm sessions were conducted in short periods of time with expert groups, where ideas and thoughts were shared on the following question: *What are the main barriers for transitioning to CE within the Dutch textile industry?* The ideas, answers and shared thoughts on this question were collected on a large paper. The photograph displayed in figure 10 shows a summary of these answers and can be found in [Appendix D](#). The main trends within the answers are as follows: In order to overcome barriers for transitioning to circular economy: "There needs to be more education for designers on how to design circular" (expert group 1), "There need to be trend setters on social platforms to stimulate circular textiles for consumers" (expert group 2), "There needs to be more standardization and certification for cradle-to-cradle designs" (expert group 3), "There should be regulation and taxation on textile products with a short life-time" (expert group 4) and "Companies should hire freelance circular design experts to overcome lack of knowledge" (expert group 5). The conclusion of expert group 1 reflects on the need to overcome the barriers "Lack of data available" and "Limited circular design", which are both pressing barriers in this study. The conclusion from expert group 2 gave a solution for how the barrier "Lacking consumer interest and awareness" could be overcome, which is relevant for actors that experience that barrier, which is also a barrier experienced as one of the most pressing barriers in this study. The conclusion from expert group 3 reflects on the need to solve the barrier "Lack of standardization" which was not a very pressing barrier in this study. Expert group 4 suggested a recommendation for policy makers to reduce the pressure of regulatory barriers such as: "Obstructing laws and regulations" which is highly relevant since it was one of the more pressing barriers and experienced as pressing by many players.

5.4.C Reflection on data triangulation

Both events helped to validate results from the study and additionally, event two also gave some insights for strategies on how to tackle barriers to CE for the textiles sector. Ultimately, the insights gathered from both events positively supported data triangulation in this study and increased the validity of the findings and discussion.

6. Conclusion

6.1. Summary of the research

This study focused on identifying the most pressing barriers for SMEs for transitioning to CE in the Dutch textiles industry. By having identified barriers for CE, insights have been created on how to possibly break the barriers for implementing CE in the Dutch textiles industry and which institutions and organizations should be targeted to act on these insights. Ultimately, a strategy is formulated for accelerating a transition to CE in the Dutch textiles industry and a model is created for other economic sectors to follow in line. Additionally, the status quo of the transition of CE in the Dutch textiles industry has been analysed to reflect on its progress. In this study, insights were gathered by means of semi-structured interviews with 47 SMEs of the Dutch textiles industry ranging from small to medium and from secondary to tertiary players. Furthermore insights and findings have been extra validated through data triangulation by means of applying both primary and secondary research and gathering extra data from CE expert events targeting the Dutch textiles sector. All in all, this study aimed to provide an answer to the following research question:

What are the barriers for SMEs of the Dutch textiles industry for transitioning to circular economy?

Table 10. Heat map of the most pressing barriers including chain reaction.

Cultural	Market	Technical	Regulatory
Lacking consumer awareness and interest 2	Opportunistic competition	Lacking ability to deliver high quality 'circular' products 4	Lacking global consensus
Operating in a (mostly) linear system 4	High costs for producing/selling circular products 1	Limited circular design (e.g. options, knowledge) 3	Obstructing laws and regulations 5
Hesitant company culture	High upfront investment costs	Limited volumes of circular supply streams 3	Limited circular procurement
Limited willingness to collaborate in the value chain	Lacking standardization	Lack of data available e.g. on impacts	
	Limited funding for circular business models	Too few large-scale pilot projects	
	Low virgin material prices		

Most pressing Barriers
 Less pressing barriers
 Least pressing barriers
 Chain reaction
 Negative influence

6.1.A Barriers to circular economy in the Dutch textile industry

Based on the findings that have been discussed in the findings and discussion chapter, the main barriers for SMEs of the Dutch textiles industry are presented in table 10. The most pressing barriers are (1) 'High costs for producing/selling circular products', (2) 'Lacking consumer awareness and interest', (3) 'Limited circular design' and (3) 'Limited volumes of circular supply streams', (4) 'Lacking ability to deliver high quality 'circular' products' and (4) 'Operating in a mostly linear system' and finally (5) 'Obstructing laws and regulations'. These most pressing barriers are representative of what seems to be the main problem for hindering a wide-scale transition to CE in the Dutch textiles industry. Moreover, based on the findings and statements of interviewees, the barriers appear to be subjected to a chain reaction as is portrayed in table 10. The technical and cultural barriers of 'Limited circular design', 'Limited volumes of circular supply streams', 'Lacking ability to deliver high quality 'circular' products' and 'Operating in a (mostly) linear system' indirectly are at the root of the problem all resulting in the expression of the barrier 'High costs for producing and selling circular products' by driving up the costs and selling price of circular products in several ways. In turn, the market barrier of 'High costs for producing and selling circular products' is argued to be largely responsible for the expression of the cultural barrier 'Lacking consumer interest and awareness' due to consumers preferring a lower price. Finally, the regulatory 'Obstructing laws and regulations' is argued to be further intensifying the difficulty of overcoming the other barriers (cultural, technical and market) due to creating a generally challenging environment where solutions and strategies to break barriers are obstructed.

Comparing the insights on barriers to CE to previous academic literature and the study done by Kirchherr et al. (2018) several remarks are made. Similar to the previous literature and Kirchherr et al. (2018) market barriers come forward yet again as one of the most pressing group of barriers. However whereas Kirchherr et al. (2018) explains market barriers as the cause for other barriers, this study claims that market barriers are in contrary the result of other underlying barriers at the end of the chain reaction rather than the cause at the beginning of the chain reaction. Much in agreement with Kirchherr et al. (2018) cultural barriers appear as a pressing group of barriers, this is interesting as previous literature indicates cultural barriers are rarely a pressing group of barriers. Yet, these two studies are the only in depth large sample size studies closely testing the barriers through semi-structured interviews with primary research and thus can be argued to hold relatively more validity. Regarding technical barriers, both this study and the previous academic literature indicated them as being at the root of the problem, where in the case of the Dutch textiles industry even form a major bottleneck initiating a chain

reaction that eventually leads to the most pressing barrier of 'High costs for producing and selling circular products'. However, technical barriers were not really indicated to be pressing at all in the study by Kirchherr et al. (2018) creating an interesting point for discussion by further research to confirm whether technical barriers are or are not as prominent as stated by this study and other previous literature. Finally, much in agreement with the major body of literature on the topic as well as the study by Kirchherr et al. (2018), regulatory barriers were the least pressing group of barriers not directly affecting the chain reaction forming the main problem for the Dutch textiles industry to transition to CE. Moreover, regulatory barriers create an obstructing environment for any solutions and strategies aiming to break the more pressing barriers for transitioning to CE (see table 10).

6.1.B Status quo of the transition to circular economy and the way forward, a SNM approach

This study analysed the status quo of the transition to CE in the Dutch textiles industry. The majority of players interviewed were well familiar with the concept of CE (88%) and could even provide a definition that showed basic understanding of the core principle of CE (64%), namely to reduce, recover, recycle or reuse materials in a closed loop which was partially in compliance with the academic definition. 24% Of the remaining interviewees gave even more complete definitions and only 12% could not give a definition that at least partially covered elements of the academic definition. Moreover almost all of the interviewees acknowledged to be conducting at least in some way CE innovations in their business model referring to either recovering, reducing, reusing or recycling to some extent (99%). Therefore, this study confirms notions made by previous studies that the Dutch textiles industry is a front running sector when it comes to the adoption of CE and that the desirability of CE and its adoption is high. Whereas previous literature indicated that CE is most of the times merely a buzzword used by sustainable development professionals and academics, the Dutch textiles industry shows the contrary.

Despite the fact that initial adoption is high, the development and successful implementation of the CE innovations are still hindered by the identified barriers and the chain reaction of these barriers creating the larger problem hindering a transition to CE in the Dutch textiles industry. An analysis of the positioning of these barriers on the Multi-Level perspective concludes that 69% of the pressing barriers are happening at a wider sector level outside of the direct sphere of influence of the companies operating in their niche. Still, a big majority (80%) of all the companies' strategies to deal with these barriers were fully focused internally, and not at a wider sector level. Consequently it comes to no surprise that 67% of the interviewees, again a large majority, stated their strategies were unsuccessful and failing. This concludes that the

viability of CE business model innovations is indeed low and that there are several targeted interventions that can be suggested to properly enhance the development of CE innovations and facilitate the SMEs and the niches in which they operate in order to accelerate the technological transition towards CE from a SNM approach.

This study suggests several recommendations for a scenario that involves both policy makers as well as a new business model for organisations aiming to solve the main problem and its barriers from a SNM approach. This newly suggested business model will from here on be referred to as the 'Matchmaker' business model and organisations executing this model are referred to as 'Matchmakers'. 'Matchmakers' are organisations with an overarching position in the sector operating in the regime at a wider sector level. They act as a connecting bridge in the supply chains initiating interactions between one or more players at the niche level to (1) increase the flow of circular supply streams tackling the barrier 'lack of circular supply streams', (2) provide source of information on circular designs through their consulting services tackling the barrier 'Lack of circular designs', (3) Organize and structure the reverse logistics of circular initiatives together with waste handlers or as waste handlers themselves thereby tackling the barrier 'Operating in a linear system' and (4) Offer guidance on decision making to ensure quality in 'circular' products and tackle the barrier 'Lack of quality in 'circular' products'. 'Matchmakers' should target multiple industries and sectors and act as a catalyst for accelerating the CE transition. By tackling the underlying barriers of the problem, eventually high costs and prices of circular products are tackled stimulating consumer interest to choose circular products. These targeted interventions implemented through the business model of a new player in the market (the Matchmaker) will create an artificial enhancement of the niches where the SMEs operate (SNM approach). The Matchmaker will enable an environment for the SMEs where CE innovations are easily facilitated allowing a faster rate of development, a proper management and a higher viability of CE innovations in their business model. Moreover, this form of SNM will accelerate the transition to CE from a mixed top-down and bottom-up approach where the pressing barriers happening at both the niche and the regime level are tackled according to where they come to expression. The 'Matchmaker' business model is portrayed in the following figure:

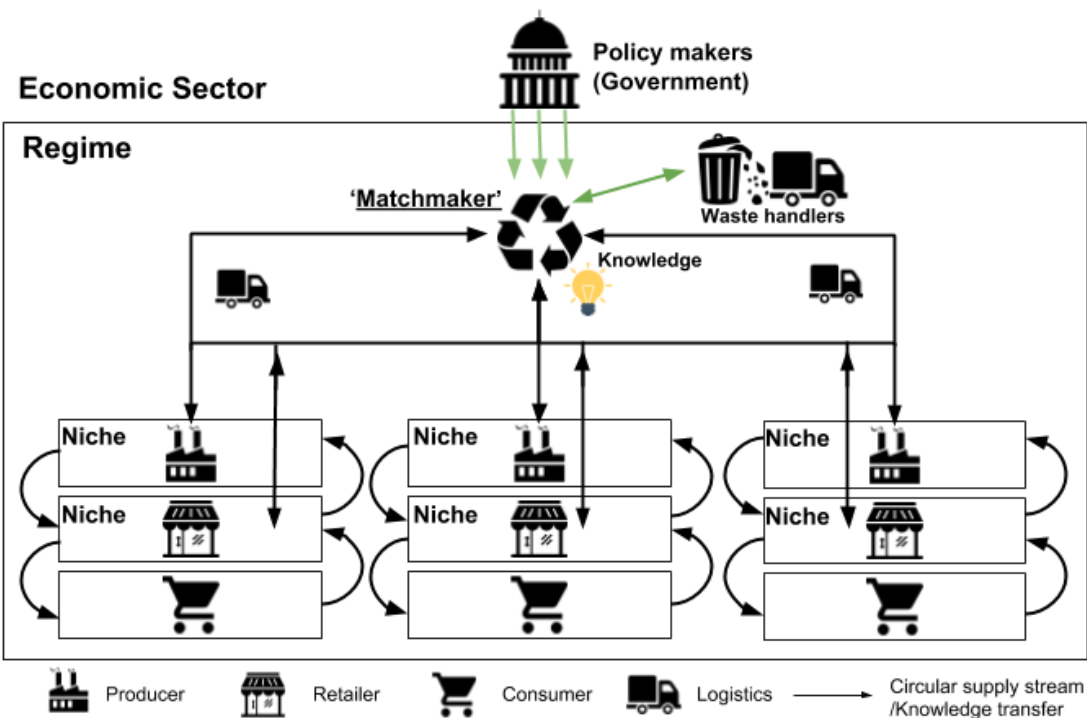


Figure 11. ‘Matchmaker’ Business model

Table 11. ‘Matchmaker’ main activities belonging to the ‘Matchmaker’ business model

#	‘Matchmaker’ main activities	Barrier tackled
1	Identify and stimulate matches between demand and supply for circular interactions/material transfers	‘Lack of circular supply streams’
2	Be a source of knowledge and stimulate knowledge transfers between players regarding circular design options and possibilities	‘Lack of circular design’
3	Work closely together with waste handlers and act as a waste handler to influence, steer and stimulate reverse logistics models	‘Operating in a mostly linear system’
4	Ensure quality of circular products through consulting, offering decision making tools and/or metrics for circular designs and working together with waste handler or as waste handler to verify and stimulate the creation of higher quality circular supply streams	‘Lack of high quality ‘circular’ products’

There are several recommendations to be made for policymakers how they can play their part in the enhancement and development of the SMEs niches in which they initiate the adoption and implementation of CE innovations. The recommendations focus mostly on the support of ‘Matchmakers’. The following table summarizes the recommendations to policymakers for supporting the ‘Matchmaker’ business model in addition to general policy recommendations targeted more on general material flows and circular products facilitating the niches of SMEs.

Table 12. Recommendations for policymakers

#	Recommendations for policy makers
1	The EU commission should extend permits to 'Matchmakers' to allow more freely the trading of 'waste' streams for circular products, or alternatively create regulated zones with less strict trading laws for 'waste' streams and conducting 'circular' pilots.
2	Policy makers should extend funding for the innovation and development of 'Matchmakers' and their business models and promote the demand for these type of business models through interactive entrepreneurial programmes such as Climate KIC, but also in tenders for circular projects and government programmes.
3	Subsidies should be extended for circular matches/trade deals between two parties aiming to create a circular product by reusing or recycling their waste streams.
4	Policy makers can work closely with waste handlers to support and steer reverse logistics and increase the amount of circular procurement by the government.
5	Rather than creating favourable tax regimes for virgin materials, products made from virgin material should be taxed higher than circular products.
6	Any firm or project aiming to reduce their socio-environmental footprint through either using/producing/procuring circular products (etc.) should be given tax returns based on their amount of reduced/positive socio-environmental footprint (similar to the carbon tax where extra emissions need to be 'bought' but then the other way around).

Through firms implementing the suggested 'Matchmaker' business model being supported by policymakers in the suggested way, the barriers that now form the main problem for a transition to circular economy in the Dutch textiles industry and possibly other economic sectors could be alleviated much enhancing the development of CE innovations in the niche environment of the SMEs that are at the root of the transition. In this way, applying targeted interventions from a SNM approach, the transition to CE can be properly facilitated accelerating its potential to overcome the linear model and become the new dominant paradigm. Enabling CE has the potential to bring the much desired positive social and environmental impact for society. Moreover, if the estimations by Mckinsey and the Ellen Mac Arthur foundation are correct, realizing a transition to circular economy could be the key to generate trillions worth of economic growth within the EU and many jobs over the next decades alongside contributing to many of the sustainable development goals thereby truly creating shared value. Despite all this, further research is still needed to improve validate these insights and test the suggested model and framework in other economic sectors. The following paragraphs reflect on this.

6.2 Suggestions for further research

Several suggestions are made for further research. Firstly, further research should target textile industries and sectors from other European countries to further validate the findings and insights made in this study. Moreover, further research should target other important economic sectors with the same methods and underlying theoretical frameworks to fully map the most pressing barriers overall that hinder a wide-scale transition to CE in the European economies. Based on these follow up studies, theories and statements made in this study can be validated or rejected. Follow up research should also aim to find real examples of the described recommended business model type (Matchmakers) and the recommendations made for policymakers in order to put these to the test and validate whether these indeed accelerate the transition to CE by breaking the identified pressing barriers. Additionally, the recommendations to policy makers made in this study can be adapted and improved and ultimately be lobbied to the European Commission.

6.3 Limitations

Several limitations during this study possibly could have hindered the quality of this research. Firstly, since this study shows further evidence of the suggestion that the Dutch textiles industry is a front running sector when it comes to circular economy both in terms of familiarity as adoption of it in the business models of SMEs, the sector might not be representative of the general adoption and transition of CE in the Netherlands or other important economic sectors in the Netherlands. Secondly, interviewees were requested to indicate what circular related activities they were conducting in their business models already. However, a general confusion exists in society when it comes to the interpretation of the two terms reusing and recycling where both terms are often used interchangeably without recognizing the different meaning of the terms. This too may have been the case during the interviews in this study resulting in certain limitations for the results on CE related activities. Finally, it must be stated that despite some barriers being mentioned more often than others by interviewees, this does not per se imply that more frequently mentioned barriers are perceived by the interviewees as a barrier that is more significantly obstructing their adoption of CE (Rizos et al., 2015). This study has been conducted however from the principle that frequency indeed implies significance.

7. References

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Appendix A – Metabolic

Metabolic, founded in 2012 by Eva Gladek, is a consulting and venture building company that uses systems thinking to tackle global sustainability challenges. The main recurring element in this is the circular economy. From the principles of circular economy, Metabolic executes their mission in three ways:

- 1) Providing insights:** Metabolic provides influential organisations and individuals with the knowledge and tools to understand the global metabolism and support improved decision-making.
- 2) Implementation:** Metabolic develops transformative ventures and technologies and support existing networks that can address sustainability challenges at scale.
- 3) Activation:** Metabolic hopes to inspire a new generation of changemakers by breaking down complex information and by providing actionable resources.

The metabolic philosophy follows five core principles:

Thinking in systems: Solving the biggest challenges requires always addressing them as a holistic system. By focusing on these systems, and the leverage points within them, the most impactful changes can be ensured.

Aiming high: The world needs big ideas and organizations who have the courage to follow through on making them a reality. Setting ambitious goals, engaging in epic projects, and expecting a lot from ourselves defines our culture.

Collaboration: The challenges of the world can't be faced alone, therefore collaboration with other organizations is sought for to maximise impact. Making the work of Metabolic accessible and easy to build is supported by an open source community.

Scalability and Execution: Ideas are only as good as the actions they lead to. The work of Metabolic is practical and scalable, so it can really take off. Metabolic innovates around new solutions and turns these ideas into ventures that can accelerate the transition to a circular and sustainable economy.

Empowerment: At Metabolic, the belief is that everyone has the potential to achieve great things. Therefore, Metabolic invests in individual development and encourages the entrepreneurial spirit in us all.

Appendix B – Questionnaire

Introduction

Question 1:

Could you please give us a short introduction of yourself including your role in the company?

Question 2:

Could you please explain the business model of your company?

Question 3:

We are here today to talk about circular economy, could you please explain to us what your current understanding of circular economy is in the form of a definition?

(Provide academic definition from Kirchherr, Reike & Hekkert (2017) if the interviewee has no definition)

Question 4:

Taking the definition of CE into consideration, can you please tell us about what your firm has already done on the implementation of circular business models?

No actions on CE yet, go to back-up questions, (see end of this questionnaire)

Question 5:

What are the most challenging barriers your firm has faced, or is facing in trying to implement a circular business model, can you try to give us 5 barriers and order them from 1 being most challenging to 5 least challenging?

If the interviewee is unable to provide 5 barriers, this is not an issue, moreover, it is important the interviewee states as many as possible.

Question 6:

For every barrier indicated, if possible, could you please provide specific examples relevant to your firm?

Question 7:

If any, what solutions or actions is your organization currently implementing to overcome these barriers? Please be as specific as possible about these solutions or actions.

Question 8:

What challenges does your firm face in trying to implement these solutions?

Closing sentences, end the interview

Back up Questions: Circular Economy not part of the business model yet

Back-up Question 1:

We would like to ask you, for what reasons have you not implemented any elements of circular economy in your business model yet?

Back-up Question 2:

If any, what actions is your organization currently undertaking in order to try and adopt elements of the circular economy in your business model?

Appendix C – Coding dimensions

1. Familiarity with CE (theme 1)

- a. Yes
- b. No

2. The understanding of the concept of CE (theme 1)

- a. CE occurs on different process levels and or scales
 - i. i.e. Production, distribution and consumption level
 - ii. i.e. Product, company, city level or beyond that
- b. CE is created through innovative business models and/or responsible consumers
 - i. Through innovative business models
 - ii. By responsible consumers
- c. Aim of CE is to accomplish sustainable development
 - i. For people, planet, profit
 - ii. For current and future generations
- d. Replacing the 'end-of-life' concept by closing the loop
 - i. Recovering
 - ii. Recycling
 - iii. Reduce
 - iv. Reuse

3. The company's activities related to CE (theme 1)

- a. Actively reducing waste streams in product process
- b. Circular procurement
- c. Creating awareness for CE on own products
- d. Creating circular product designs
- e. Recovering products for recycling and or reusing (by 3rd party)
- f. Using a product as service (leasing) business model
- g. Reusing and/or recycling (within company)
- h. Nothing yet, waste incinerated or to landfill

4.1 The barriers for transitioning to CE (theme 4)

- a. Cultural barriers
 - i. Hesitant company culture
 - ii. Limited willingness to collaborate in the value chain
 - iii. Lacking consumer awareness and interest
 - iv. Operating in a (mostly) linear system
- b. Market Barriers
 - i. Opportunistic competition
 - ii. High costs for producing/selling circular products (non-competitive pricing)
 - iii. High upfront investment costs
 - iv. Lacking standardization
 - v. Limited funding for circular business models
 - vi. Low virgin material prices
- c. Regulatory Barriers
 - i. Lacking Global consensus
 - ii. Obstructing laws and regulations
 - iii. Limited circular procurement
- d. Technological Barriers
 - i. Delivering high quality 'circular' products

- ii. Lack of data available e.g. on impacts
- iii. Limited circular design (knowledge, options)
- iv. Limited volumes of circular supply streams (availability, quality, consistency)
- v. Too few large-scale pilot projects

4.2 Placement of barriers in the multi-level perspective

- a. Barriers at the niche level (company level)
 - i. Technological barriers
 - ii. Market barriers
 - iii. Cultural barriers
- b. Barriers at the regime level (at industry/sector level)
 - i. Cultural barriers
 - ii. Technological barriers
 - ii. Regulatory barriers
 - iv. Market barriers

5. Strategies indicated for overcoming mentioned barriers for CE (theme 5)

- a. Looking for collaboration within the supply chain
- b. Compensating with CE advantages
- c. Conducting pilots
- d. Extra marketing and raising awareness
- e. Pursuing a circular company culture
- f. Working with universities and consultants
- g. Internal research & development
- h. Shaping a circular oriented company culture
- i. None

6. Challenges faced with the indicated strategies for overcoming CE barriers (theme 6).

- a. Limited budget
- b. No measurable progress
- c. No challenges with strategies
- c. Strategy is effective most of the times
- d. Strategy is effective only sometimes
- e. Strategy still in progress, no results yet
- f. Too time consuming next to core activities

Appendix D – Brainstorm sessions CE event II

The following photographs was taken of the notes of the expert brainstorm session speed date during the Shaping Fashion event.



Figure 12. Brainstorm session with CE experts