

# Closing the materials cycle in the clothing industry: Exploring circular business models in the Netherlands

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## Summary

Many environmental problems arise from production and consumption of goods. One of the problems is the rising amount of waste associated with discarding used products. As for clothing, made of materials which are not by definition biodegradable but nevertheless degrade in material quality over time, the conventional options are disposal (135 million kg of clothing is disposed in the Netherlands annually), donating to charity and shipping to third world countries, or remanufacturing into other products such as chair upholstery. However, experiments of retailers in the Dutch clothing industry point towards an interesting, new shift in closing the materials cycle. This shift can be placed in the trend of the circular economy, where used products are no longer seen as waste but as a resource, which should be made available for infinite remanufacture and reuse.

This research explores the business practices associated with closing the materials cycle for clothing. The business strategies of seven example retailers were explored on four aspects: value creation, materials, actors and technologies. Then, the found strategies are combined into business models, resulting in three combinations. In addition, central actors and drivers of retailers were defined. In a third step, these business models are combined with conventional after-use options, eventually discussing the favorability of circular business models compared to conventional ones. The used main factor for favorability of each option was the potential for recovery, reuse and remanufacture of clothing. The research was conducted using literature, business reports and interviews (by email, telephone and in person) with several companies, including field experts, retailers and recycling agents. The used framework for analysis was based on literature.

The first results concentrate on four found circular business strategies by retailers: the recollection of used garments, the remanufacture of used garments into new ones using fiberization and mixing with new yarn, the selling of remanufactured garments and the leasing of garments in order to keep ownership on the material. For the four aspects mentioned above there are different barriers which hinder further development. For example, technology development for remanufacturing is complex because of several aspects such as the use of complex material combinations in current garments and the fashion industry being focused on short-term fashion seasons. For leasing and selling of remanufactured clothing, the actor configuration poses the largest strains, as competition with other retailers is high and consumers need to commit to the new niche market and take the demand to a higher level. As for recollection of used garments, the recovery of materials depends on follow-up processes. Larger retailers hand over the recollected garments to conventional recycling agents, therefore the recollected garments are not likely to be recovered into new materials but are being treated in the conventional ways. Combining the four strategies, three circular business models are seen among the example retailers: recollection only (two larger retailers), all strategies except leasing (one large and two smaller retailers) and all four strategies combined (the two other smaller retailers). When comparing conventional after-use options with circular business initiatives, it appears that direct reuse by other consumers is the most efficient for material recovery, followed by a second hand store as a step between the first and second round of rewearable garments. For more expensive and durable garments, leasing can be a good alternative for buying, if the rewearable garments return to consumers in the Netherlands. If garments are not rewearable anymore, the most favorable option in a materials perspective is to fiberize and reproduce the fibers into new yarn for garments. The developments towards closing the materials cycle for clothing in the Netherlands looks promising, and are realistic if all involved actors commit to a circular economy.

## **Acknowledgements**

This thesis has been written as a part of the master study Environmental Sciences, under supervision of prof.dr.ir. C.S.A. (Kris) van Koppen. The Environmental Policy chair group stimulates the development of own ideas and research subjects. The Circular Economy movement grasped my attention about a year ago. As I am very interested in recent developments to a more sustainable society, I decided to write my thesis on such a development. As I wrote my proposal, at first the focus shifted to other concepts along the line of sustainable business innovations, industrial ecology, and the like. Eventually I managed to choose my eventual subject, after many discussions with Kris, my family and friends. My methods of analysis developed and changed along with the research itself; a very interesting process. Hopefully I can continue exploring business initiatives towards a sustainable society in the future.

I would firstly like to thank Kris van Koppen, for being enthusiastic about my subject, for guiding me through the difficult and complex process of doing thesis research, and for some very fruitful brainstorm sessions. Secondly, I would like to thank all interviewees for their time, enthusiasm and their willingness to share their knowledge and opinion. I would like to thank my family and friends as well, for their valuable suggestions, pep talks and support.

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### Abbreviations

*CBS*: Circular business strategy

*CBM*: Circular business model

*CE*: Circular Economy

*DfR*: Design for Recycling

# 1. Introduction

## 1.1 Background

Societies of nowadays deal with many environmental problems, among which are climate change, pollution and decreased availability of water. These problems originate from multiple related causes and factors (Harris, 2004). One of these factors to environmental problems is large scale production and consumption. Apart from social disruptions, there are many environmental problems associated with production and consumption of goods. On the production side, resource depletion, pollution and biodiversity decrease are common environmental side-effects. On the consumption side, waste is one of the unwanted side effects. One of the causes for the waste is the current linear consumption model and a linear product chain. In this consumption model, companies extract materials and resources, use these for production of goods, and sell the product to consumers, which discard the product after its usage period. This linear consumption model is increasingly seen as inefficient and problematic, for waste is currently not effectively used for other purposes, neither does it degrade effectively in the natural environment (Ellen McArthur Foundation, 2012).

As a reaction to cope with waste and convert it to close the product cycle, many different concepts have evolved. Some of these, for example cleaner production, focus on minimizing pre-consumer waste by decreasing the volume needed for the earliest stages in the production process. Other approaches focus on making the used product return to an appropriate state for reuse or conversion to raw materials for recycling. Another approach, related to material recovery and ownership changes, is changing the whole model of value creation. In a new value model, money, consumption and waste are dealt with in a different way (Ellen McArthur Foundation, 2012; Boons & Lüdeke-Fairhurst, 2012). This new value creation trend could be viewed from two perspectives: the economy perspective and the business perspective.

Considering the economy perspective, there are many emerging views, providing an alternative to the current focus on money and linear production. One of these views is the Circular Economy (CE), in which industrial and economic systems are regenerative in nature and the concept of waste is eliminated. The production cycles are linked and optimised for disassembly, remanufacture and reuse. This large-scale linking of product cycles is a core characteristic, combined with using renewable energy and a systematic distinction between biodegradable and durable goods (Ellen McArthur Foundation, 2012; EMF, 2013).

Another perspective on new ways of value creation is a business perspective, when a company designs or adapts a sustainable business model (SBM) as guidance for greening the modus operandi. A sustainable business model includes different ways of value creation other than money exchange. Environmental impact of the business and relations with the larger system are accounted for, in contrast to conventional business models (Boons et al, 2012; Jonker et al, 2012). There are many ways of configuring such a business model, including value creation, actor networks and recycling practices. One example is a strategy for which not the product itself is the centre of consumption, but the service provided by the product. As the product stays within ownership of the retailer and is remanufactured internally, waste is prevented (Mont 2002). A take-back scheme could also be an aspect of an SBM. With this scheme, products are taken back by the retailer or another organization after they are used, but the consumer has the choice to deliver the used goods to several intake points. Then the used products are remanufactured and sold again, preventing waste from discarding broken products (Kennett, 2012). A circular business

model, one form of an SBM, has mostly the same specifics. However, this kind of SBM is specifically aimed at rethinking the concept of waste, and it is set up according to Circular Economy principles (Ellen McArthur Foundation, 2013). This specific form of a sustainable business model will be used as a central concept throughout the thesis.

In the context of circular value creation on business and economy scale, the clothing sector is interesting to investigate. This sector is the second largest when considering spending from consumers. Circular business models, associated product service systems and take-back schemes are very innovative in this sector, and more advanced technologies for remanufacturing are emerging. However, they are still small relative to the large volume represented by clothing globally (Ellen McArthur Foundation, 2013). Additionally, an increasing number of consumers strive for a more sustainable way of life. These consumers would be willing to buy more environmentally friendly products, if these are available. Large retailers recognize this trend and start to invest in sustainable clothing initiatives (Celie, 2012). Another reason for a focus on the clothing sector is that retailers have increasing concerns over water shortage and land degradation because of large-scale cotton harvesting. One of the solutions would be to increase the recycling rate from clothing, thus being less dependent on the production of virgin cotton (Bom, 2012b).

## **1.2 Problem**

The waste problem from clothing has several causes and factors which increase the volume and complicate recycling. There are two direct causes for the increasing waste pile from clothing. Firstly, the largest percentage of used clothing is not even donated but discarded in the waste bin. The cause is the sale of cheap, poor quality clothing in retail stores. This poor quality shortens the wearing time of clothing. Consumers do not mind; it is becoming a trend among consumers to wear different clothes each day and throw away what is out of fashion (Labour behind the Label, 2008, pp.38-40).

Secondly, the emergence of 'fast fashion' has given rise to 10 to 12 clothing 'seasons' a year, in which retailers offer a new collection. A design can be in stores in 6 weeks, and is mostly a cheap imitation of recent styles seen on the catwalk. This fast pace of fashion gives retailers an incentive to demand more flexibility from their suppliers and have lower quality standards (Bhardwaj & Fairhurst, 2010).

Next to causes for the waste problem, recycling of clothing is increasingly difficult. Firstly, the complexity of both materials and products has increased dramatically. Many garments are made of a combination of natural fibre such as cotton, and synthetic fibres such as polyester. The clothes are dyed with different mixtures and have increasingly complicated applications and accessories (Chen et al, 2003). For example, old wool clothes were once collected and recycled into blankets and pea-coats after a complicated process of remanufacturing by hand. Today, because of the use of blends of natural and synthetic fibres, recycling of textiles requires much more effort (Ayres&Ayres, 1996, p.13).

Secondly, manufacturers, retailers and waste handling organizations are separate parties, with different or competing interests. Additionally, the supply chain is globally operated along all these parties, and therefore it is a complex chain where it is difficult to find the origin of specific garments. To implement new business models, it is necessary to investigate the profit making principles of the different types of organizations. In addition, assessment of their impact on profitability for the different niches is needed (Ellen McArthur Foundation, 2013).

Many options exist for tackling the problems of clothing waste. One path is substituting non-biodegradable materials for biodegradable materials (substitution). This topic will not be covered in this thesis. The other path is dematerialization by decreasing material input, which can be achieved through reusing, remanufacturing and recycling materials. When closing the cycle (in circular economy society), several actors along the chain cooperate to exchange and remanufacture materials. Nowadays, this intelligent remanufacture is not the norm. Most recycling of clothing takes place by shipping to developing countries. This results in geographically shifting the problems associated with clothing waste to developing countries, and hindering possibilities for setting up local clothing production businesses there (Claudio, 2007). To increase re-use and recycling rates, it is necessary for manufacturers to sell services, rather than products, and/or to take back products they have previously made (Ayres & Ayres, 1996). As discussed earlier, Circular Economy principles and circular business models provide for means to systematically achieve this (Ellen McArthur Foundation, 2013).

There is a lack of academic research on the development and implementation of circular economy principles from a business perspective. For sustainable business innovations such as take back systems or selling services, there is little knowledge on possible actor configurations, value communication and technical innovations. As a result, uncertainty exists about the right application and possibilities for large-scale implementation. Therefore research on this topic is needed. With the outcomes of this research, industries and consumers have a more insight in possible set ups of circular business models. Additionally, there will be insight in motivations, opportunities and barriers for implementing a circular business model. This knowledge provides a constructive basis for investigating the possibilities of expanding the discussed business models to an industrial sector or even an economy scale.

### **1.3 Research objectives**

The aim of this thesis is to explore and clarify circular business strategy characteristics in the clothing product chain, using example studies from the Netherlands. A part of this objective is to generate knowledge on the development, the current situation and possible barriers for the future development of circular business models in the clothing chain. The underlying thought is to make a commitment towards a more sustainable clothing industry by providing knowledge as a basis for innovation and action.

### **1.4 Research questions**

A main question can be derived from the problem and the research aims: *What are the characteristics of, and possibilities for circular business model incentives in the clothing industry in the Netherlands?*

To support an answer to the main question, the following sub-questions are relevant.

- 1. What are characteristics of circular business strategies currently being developed in the clothing sector in the Netherlands, in terms of value creation, actors, material flows and technology?*
- 2. What are the main drivers, barriers and key actors considering the found circular business models?*

*3. How do the strategies from circular business models compare to conventional after-use options, and how are all the possible after-use options ranked on material recovery possibilities?*

*4. What steps should be taken by involved actors in order to overcome the found barriers in realizing optimal after-use possibilities?*

## **1.5 Scope**

Several boundaries are in place for the research. Firstly, only apparel is examined, meaning only clothing which is actually worn by consumers. Products such as carpets, chair upholstery, curtains and such are not investigated, for these products have a longer lifespan and a different product chain. Secondly, the type of material of the clothing does not matter for the degree of recyclability, only the number of materials combined in one piece (Bom, 2012b). Thus, when researching sustainable business models, I take into account all clothing materials meant for recycling. Clothing which is produced for biodegradation after use (currently under experiment), is not included in this research, as these clothes have a different life cycle and are not mechanically recycled at all. Thirdly, the retailers used as examples are all based in the Netherlands; however the origin of the retailer does not have to be Dutch. Even, a worldwide scope is necessary when describing the clothing life cycle and its effects. Also for exploring the material flow for the researched business strategies, some processes and actors are based outside the Netherlands. Only cotton and polyester are described in the chapter on the current product chain and background on the industry, as most garments are currently made of these two materials (Seuring, 2004, p.1064).

## **1.6 Reading guide**

The following chapter describes the methodology of the thesis, in which literature, text review and interviewing will be specified for this research. Chapter 3 treats the clothing product chain, including production processes, actor relationships, environmental impact and current end-of-life practices. In chapter 4, terms and concepts are explained, relating to product chains, business models and recycling practices. It also treats theories and models which provide a basis for analytical research and motivation, opportunity and barrier determination. From chapter 5 on, the results are categorized on three levels. In the first level, the circular business strategy level, the four found strategies are discussed. For each strategy, several factors are treated: The value creation, chain actor configuration and cooperation, flows and materials, and where applicable a section on technology applies. Then in chapter 6 the second results level is discussed, which is the circular business model level. In this section, the different strategies are combined to shape the models in chapter. In the same chapter, the added values for involving in circular business models and a discussion on central actors are given. In chapter 7, the third level of the results, all circular business models are connected to the conventional after-use options, creating a model of all available options for after-use processes and associated decisions. These options are shown and compared on favourability. In addition, a section on success factors and barriers is given, and a set of recommendations. Chapter 8 discusses the theoretical application, future research possibilities and research progress. Finally in chapter 9, a conclusion is given.

## 2. Methodology

### 2.1 Literature and text review

Mostly scientific literature is used during literature review. Other more informal sources such as newspapers, magazines and company reports are used as well. The scientific sources were found by searching university libraries, reference lists of found papers and by searching online libraries as Scopus and Google Scholar. Used search terms were for example 'circular business models', 'textile recycling', 'product service system' and 'garment product chain'. The more informal sources were found by browsing the Internet and searching in newspapers with search terms such as 'sustainable fashion'.

### 2.2 Interviews

As a form of qualitative research, semi-structured expert interviews are taken. In these interviews, general information about sustainable business innovations in the clothing sector was gathered. A number of experts, companies and other organizations was selected for an interview. Companies include clothing retailers, recycling agents and consultancy companies. Clothing retailers have been selected on the basis of current pilots and projects on closing their clothing materials cycle; not many companies operate yet in this field. Other organizations include NGOs, consumer organizations, branch organizations and a governmental agency. These organizations are chosen on the basis of having clothing, sustainable business or related topics as a main focus. Table one below shows the approached and interviewed companies.

*Table 1. Types and specifications of approached and interviewed organizations*

| Type of organization | Approached | Interviewed | Name of interviewed companies    |
|----------------------|------------|-------------|----------------------------------|
| Retailer             | 8          | 3           | DutchSpirit, Witte Boorden, RE-5 |
| Recycling company    | 4          | 2           | 2Switch, NVRD                    |
| Branch organizations | 5          | 0           |                                  |
| Field expert         | 5          | 2           | Texperium, Awearness Fashion     |
| Consultancy company  | 2          | 1           | CREM                             |
| NGO                  | 4          | 0           |                                  |
| Other                | 1          | 1           | MVO Nederland                    |
| Total                | 29         | 9           |                                  |

As seen in the table, the number of interviewed organizations only accounts for one third of the approached organizations. As a consequence, the amount of interviewed organization is less varied and less representative of the results. Nevertheless, the interviewed organizations offered valuable contributions and gave sufficient information for the research.

## 2.3 Investigated retailers

Seven retailers have functioned as a basis for distinguishing the four found business strategies. The overview does not show all the Dutch retailers which have implemented a circular business strategy. The strategies are taken to a higher level in chapter 10, where they are combined to form circular business models.

### 2.3.1 C&A

This clothing company is one of the largest clothing retailers in Europe, with more than 1500 stores in 20 European countries. They sell clothing for women, men and children of all ages. Sustainability initiatives are taken on many aspects, of which the use of a certain percentage of certified organic cotton, implementing standards for workers' rights and the recycling of clothing hangers (C&A, 2012). C&A started to take back used garments in 2012, and donates 1 euro to charity for each returned bag of used garments. The collected clothing is being transported to recycling agents (Fashion United, 2013a).

### 2.3.2 H&M

This international retailer holds about 2,900 stores worldwide in 49 countries, selling clothes for consumers of all ages. There are many initiatives for improving environmental and social circumstances within the company production processes (H&M, 2013a). H&M is the number one user of organic cotton worldwide, and releases a Conscious Collection with recycled PET bottles, as well as re-used, as it is stated that 95% of all textiles can be recycled (H&M, p.13, 2012). H&M has implemented a take-back system in spring 2013, handing out a discount of 15% on a new garment for each delivered bag of used clothes (van Rossum, 2013).

### 2.3.3 WE Fashion

WE Fashion is an internationally known fashion company. The firm holds about 250 stores in several European countries and in China, and sells clothing for men, women and children. The target group is the section of self-secured consumers between 25 and 35 years old. CSR is expressed through several initiatives in a WE Care program. The sustainability strategy consists of several measures for improving working conditions for producers of garments, a CO2 reduction plan, waste separation in-store and clothing hand-in. Since 2010, there has been a possibility to hand in used garments in the Netherlands at the main office in Utrecht, which was donated to Sam's Kledingactie (Willemsen, 2010). From August 2013 onwards, two collections, made from fiberized and reproduced garments, will be sold in the Netherlands. These collections will consist of sweaters and vests for men (Fashion United, 2013b).

### 2.3.4 RE-5

A smaller Dutch brand and retailer which started in 2008. The company was started because of disappointment about the conventional clothing system. Thus, the sold clothes, for men, women and children, are biological and/or fair trade (Re-5, 2013). The name Re-5 originates from a five way stimulation of sustainable consumption: Rethink, stimulating the consumer to buy fair and ecologically made clothes. Return, stimulating the return of used clothes from consumers. Recycle, to fiberize and reproduce the returned clothing into new garments. Refund, to stimulate honest pricing and rewarding the consumer with a discount for handing in their worn clothing. Finally, revive, to remanufacture old clothing into new, based on the cradle to cradle principle, and to enlarge the percentage of biological cotton in the clothing industry (H3PMotives, 2013). This retailer only sells garments through the online shop.

### 2.3.5 Witte Boorden

This smaller retailer started after the investigation of recycling of clothing from KLM at Texperium (Witte Boorden, 2013a). The name refers to the most important target group, namely men with an office job. This target group is important, because Witte Boorden only sells white t-shirts for men through their web shop. The shirts are all made of 100% biological cotton, and there is a subscription service for the shirts. Customers can get two new t-shirts sent every three, four or six months for a fixed price. The shirts can be returned with the envelope which is received with the new shirts. The returned t-shirts are then fiberized, remanufactured and sold again by Witte Boorden (Witte Boorden, 2013b).

### 2.3.6 Mud Jeans

This retailer started in 2008 with fair and ecological fashion. The brand is operating nation-wide through the web shop and several in-store selling points. Jeans, trousers, shirts, tops and accessories for men and women are sold. Mud Jeans advocates sustainability for all possible aspects of clothing. The range of sold clothes is made out of recycled material, biological cotton and fair trade materials. A new concept, designed by Mud Jeans, is Lease a Jeans. With this concept, consumers can lease jeans for a fixed amount per month for a fixed time period, after which they can trade the jeans for a new one, lease it longer or hand it back in. The returned jeans will be recycled (Mud Jeans, 2013).

### 2.3.7 DutchSpirit

DutchSpirit focuses on another niche, namely tailor-made suits and shirts. This retailer operates nation-wide with a web shop as a main selling point. The collection is designed to fit a remanufacturing and recycling process which is theoretically endless; DutchSpirit calls this 'Design for Reincarnation' (DutchSpirit, 2013a). Similar as for Mud Jeans, DutchSpirit offers a lease option for the suits and shirts. For a fixed amount per month, the suits can be leased for a year or longer. After handing in the used suits, these will be recycled into new ones. Additionally, DutchSpirit sells or leases workwear, which is also meant for recycling after use (DutchSpirit, 2013b).

## **3. Background: the clothing chain**

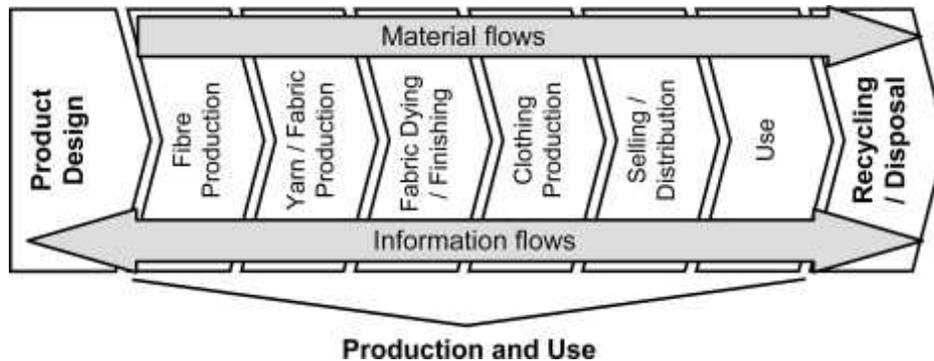
In the following chapter, the clothing chain and its characteristics are described. There are separate subchapters on the details of the current product chain phases for cotton and polyester, the actors in the chain and current end-of-life practices.

### **3.1 Product chain**

The textile product chain is described in order to understand the supplier-buyer relations and processes necessary to produce and offer clothing to consumers. The figure below (figure 1) represents the cotton textile chain. Material flows in one direction, from the raw material and fibre production phase to the recycling/disposal phase. Information is exchanged in both directions of the chain among all different business involved. Secondary inputs for production, such as chemicals and water, are not included in the phase description; these inputs are discussed in the environmental impact section. The recycling/disposal phase is strongly simplified, as the recycled material would flow back to the clothing production phase (Seuring, 2004, p.1063). These considerations on material flows and information flows also hold for the polyester chain, while the

figure below only represents the production phases for cotton. The specific phases for the cotton and polyester clothing chain are described in more detail in the following subchapters.

Figure 1. The textile chain (Seuring, 2004, p.1063)



### 3.1.1 Cotton

Product design is usually done by independent companies. In some cases, the design companies are integrated in other phases in the chain, for example in the distribution and retail of the clothing. These companies are directly connected to consumers and have influence on the rest of the production chain through the design. After product design, fibre production takes place. Here, cotton fibres are produced by growing and harvesting cotton, making fibres and the cleaning or ginning of these fibres. The next phase, yarn or fabric production involves spinning for the yarn and weaving or knitting to obtain fabric. Then, the fabric is dyed, which consists of colouring and bleaching. In this same phase the fabric is finished, which means that the fibres are treated for form stabilization or anti-wrinkle characteristics. After this phase, clothes are produced from the fabric, which consists of sewing and adding accessories like zippers and buttons. Then, the finished clothes are distributed and sold. In the after-use phase, the clothes are recycled or disposed (Goldbach & Seuring, 2004, p.66; Seuring, 2004, p.1064). In this thesis, this phase is called after-use, to include all available options such as landfill, recycling and re-use. In this way, not only specific after-use options such as 'recycling' or 'disposal' are seen as the single final phase.

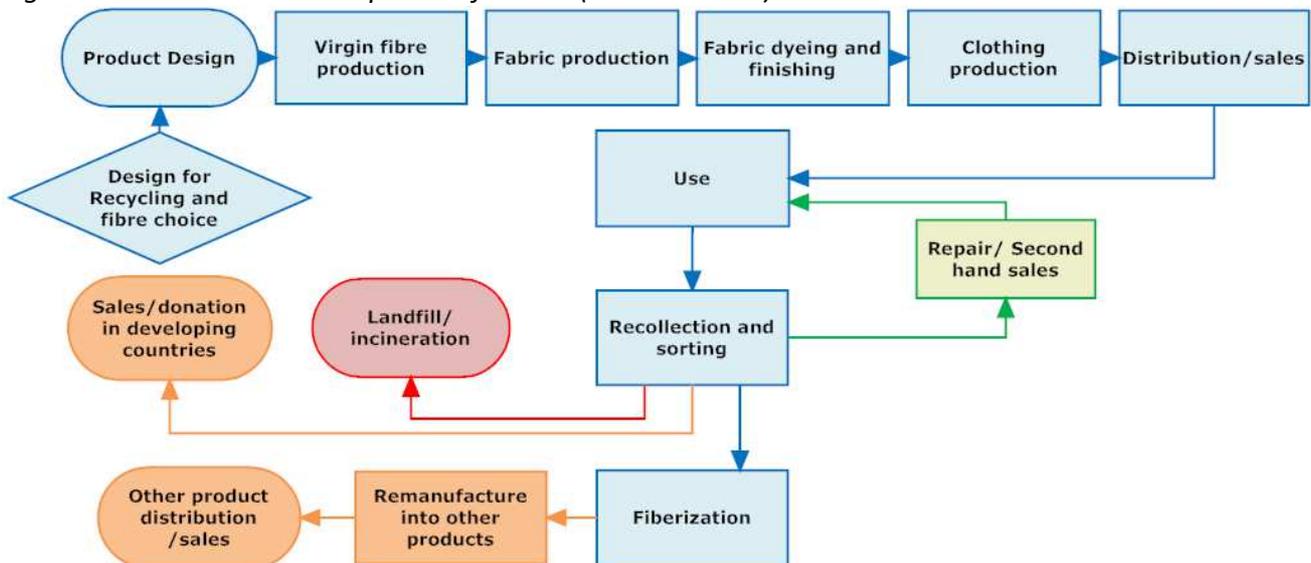
### 3.1.2 Polyester

Polyester is a man-made material. Thus, production involves different raw material inputs which, compared to cotton, need to be processed differently in the second and third production phase. The first phase is the design; as in the cotton chain, design influences the other phases in the chain, for instance the amount of material needed per garment or the number of applications to add. Polyester is made from crude oil, which applies to all product groups and is therefore not described in detail. In the second phase, the raw material is polymerised and cleaned. From this process, polyester chips are formed. The third phase involves melting the polyester chips and forcing them through spinneret holes, creating filaments. These filaments are collected into thread forms. These are stretched and drawn into polyester yarns. Then, these yarns are weaved or knitted to create fabrics. The fourth phase involves dyeing and finishing of these fabrics. As for cotton, this dyeing and finishing involves specifying colour and improving the characteristics of the fabric. Then, clothing is produced in the fifth phase, where applications are added to the fabric just as for cotton garments. The sixth phase is again similar to that of cotton, where distribution and retail takes place. Then, there are different options for after-use treatment, discussed in the following sections (Goldbach & Seuring, 2004; Seuring, 2004).

### 3.2 Conventional after-use options

After use, there are several options for handling the garments. The options depend if the clothes are rewearable or not. The following model shows the different options after use, with the associated processes and decisions.

Figure 2: business as usual options after use (own research)



In this model, the production chain is shown at the top. The chain starts at the top left with a decision for which design to use and which fibre to choose, made by designers. Then, after the conventional production chain and the use phase, there is a central decision to be made by either the consumer, or the charity or recycler to which the garment has been handed in: is the used garment still rewearable or not.

#### 3.2.1 Disposal

Currently, clothing holds a considerable amount of waste in the form of garments which are discarded after use. In Europe and North America alone, enormous quantities of clothing are being thrown away, ending up in landfills. This is estimated to be 15 million tonnes annually. Only 25% of clothing is currently collected in Europe. In the Netherlands, although 70 million kilos of garments are recollected yearly, still 135 million kilos of garments is discarded, of which 65% is still reusable (Fashion2, 2012). One cause for this large quantity is that consumers do not know that they can also hand in non-rewearable clothing at recollection bins (Rijkswaterstaat Leefomgeving, 2013). This discarded clothing is usually incinerated or landfilled, for no separation policy applies for textiles. Even when clothes are handed in to recyclers, after sorting it can appear that non-rewearable clothing is not suitable for any other reuse or recycling option, in which case the garments are incinerated as well, which is about 8% of recollected garments in the Netherlands (de Vries, 2013).

#### 3.2.2 Reuse

Clothing can be reused instead of discarded. Reuse of clothing can take place in different ways, locally or abroad. Consumers can re-sell their clothing on the domestic market locally, either through Internet or through second hand stores. Several recycling and charity organizations also provide options for handing in used garments. These take-back initiatives now take place on a voluntary basis and there are different options for returning used clothes. These items could be handed in at a second-hand store which makes profit from the reselling of these clothes locally in

the store. Another option is to place the items in charity bins. On set times, the content of these bins is collected and distributed to recycling agents or charity organizations with sorting centres. Here, the garments are sorted manually on colour, type of fabric and quality, distinguishing between rewearable and non-rewearable garments (Kici, 2012). The rewearable fraction of best quality is sold in local stores, little less quality garments are shipped to Eastern European countries and donated or re-sold there, the lesser quality to capital cities of Africa, and even lesser quality clothing ends up in the rural areas of Africa (Claudio, 2007; Bom, 2012b). When the garments are redistributed to other countries, it is technically and practically not possible yet to return these garments into a remanufacturing or third-hand cycle after a second wearing.

### 3.2.3 Remanufacturing to other products

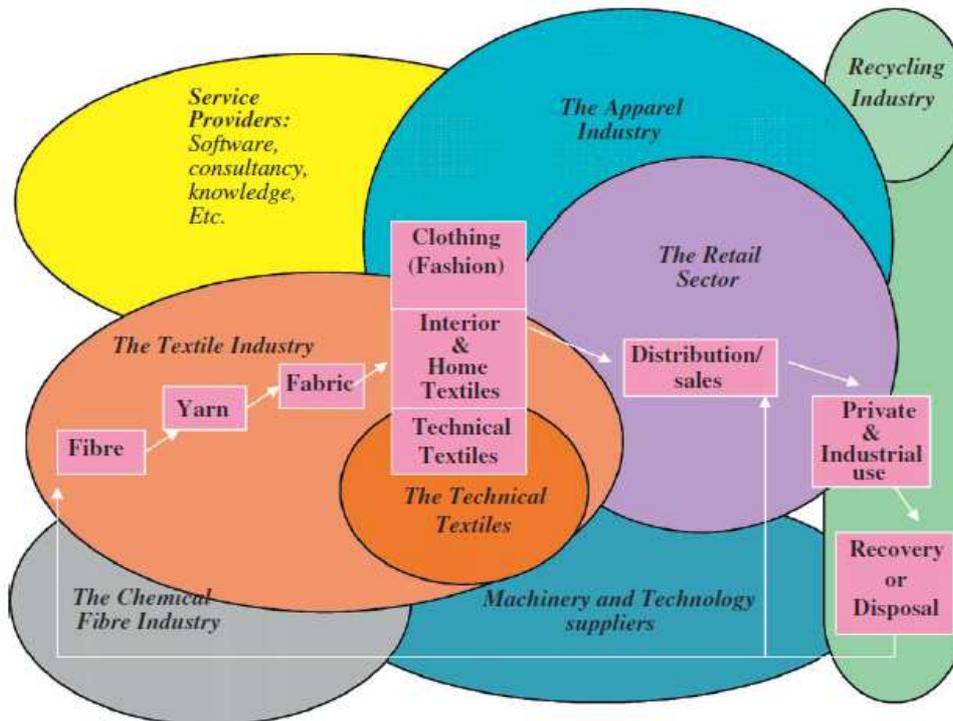
Currently, used garments which are not rewearable, are manufactured into other products in an open loop. Open-loop recycling means that products are recycled to produce different products. The way of recycling depends on the materials and products. (Graedel & Allenby, 2003, p.173). The possibilities for remanufacturing to other products are many; the easiest conversion to other products is to make cleaning rags out of strips of fabric. Other appliances are possible after sorting and shredding the garments, and the possibilities are nearly endless; currently, mainly lower quality products are made out of the shredded fibre, such as carpets, blankets, insulation, filling and lining for upholstery (VHT, 2012). The recycling of used garments into other products fills an economic niche and creates jobs and material for workers in developed or developing countries (Ayres&Ayres, 1996, p.13). However, the supply of these products sometimes transcends the demand, after which there is a leftover of products. From a materials recovery perspective, it would be optimal to remanufacture the used garments into new ones, to close the materials cycle (2Switch, 2013; DutchSpirit, 2013).

## **3.3 Actors**

There are many actors involved in the clothing sector. These can be categorized in three levels: the single actor or company level, the chain level, and the political or societal level. The chain level encompasses suppliers, retailers and recyclers. The political or societal level includes regulatory agents, interest groups and NGO's (Seuring, 2004, p.1061). In the clothing chain, several actors and industries are present, all being involved in several parts of the chain. Several different industries are taking part in the life cycle of clothing. The textile industry is involved in the production of fibre, yarn and fabric, where all kinds of textile are made. Then, the retail sector takes over for distribution and sales. The recycling industry is involved in the recovery or disposal of clothing after use, where the fibres could be returned in the textile industry. The apparel industry consists of textile manufacturers, retailers and recycling companies. Furthermore, many different service providers are present, for software, knowledge and other services (DeBrito et al, 2008).

The following map shows the connection between different sectors and the associated phases in the clothing chain.

Figure 3. Stakeholder map of the fashion supply chain (DeBrito et al, 2008, p.536).



In this figure, it is visible that the textile industry takes care of the whole production chain before the use phase. In this industry, the raw material providers, producers of several materials, and fashion companies operate. The technical textile industry is mentioned as well, but this type of textile is not discussed further in the thesis. Then the retail sector takes care of distribution and sales of the end product. After use, the recycling sector, including sorting agencies, recycling companies and remanufacturing companies, take care of recovery or disposal of the used garments. Then, the newly manufactured or reusable product may be sold again by the associated retailer, depending on the type of product being sold again (DeBrito et al, 2008).

Next to chain actors, there are also parties which are not directly involved in the production chain or recycling chain; the government, which stimulates and manages the textile industry within legislative boundaries; non-governmental knowledge institutions and NGO's, providing information and knowledge on the sustainability in the textile sector, and communicating and supporting innovative solutions for environmental problems associated with the textile industry (Texperium, 2013).

#### 4. Conceptual framework

In this chapter, the conceptual framework is discussed. This framework is a compilation of several concepts and some hypotheses on the topics of circular economy and aspects of circular business strategies and models. The basics of the circular economy and sustainable business models are discussed in the first two subchapters. Hereafter, the elements of a general sustainable business strategy are further elaborated. Then, general contextual factors, drivers and barriers for sustainable initiatives are given. This framework will be used as a basis for researching the specifics of the circular business strategies and models for the researched retailers.

## 4.1 Circular Economy

The circular economy is a new discourse on sustainable development, connected with and inspired by several longer existing principles such as cradle to cradle (C2C), life cycle thinking and bio mimicry (de Lange, 2012, p.1). As the Ellen McArthur Foundation defines it, “a circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models (Ellen McArthur Foundation, 2012, p.7).”

Several principles and business options to ensure circularity are connected to the CE practice:

1. A circular economy aims at eliminating the concept of waste. Waste is non-existent in this economy; all used products will be disassembled and re-used or will become a biologically degradable substance. This non-existence of waste will be realized in circular business models by (re-)designing a product with the intention to fit within a biological or technical nutrient cycle.
2. The distinction between durable products in a technical cycle and consumable products in a biological cycle is important. This distinction was initiated by the founders of the Cradle to Cradle concept. Consumable products, designed for biological degradability, become part of the biological cycle. Durable products are made of non-degradable substances, will be designed for reuse and disassembly. Furthermore, these products will not be sold and disposed like in the current economy. A new business-consumer relation will be the norm, built on product performance, lease, renting or share of durable products in a product-service system. If the product itself is sold, it could temporarily provide a service to customers. After use, a take- back scheme is imposed, and products are taken in for disassembly and recycling without loss of quality.
3. The required energy for an industry should be naturally renewable, in order to decrease dependence on fossil fuels and to increase resilience of the energy system. In this way, further pressure on the consuming nature of society and the economy is prevented.
4. A modular design, with versatile and adaptive characteristics is necessary for increasing resilience for a fast-evolving world with many uncertainties. Diverse systems with many connections and scales are better equipped against uncertainty, designed after successful natural systems.
5. System thinking is a basis for understanding how different parts are mutually influencing each other and the system as a whole. This principle in circular economy is used to see the different parts of a system as parts and not as separate entities, therefore keeping an overview of expected and unexpected interactions between parts of an industrial or economic system (Ellen McArthur Foundation, 2012, pp. 07, 22).

In the Netherlands, the need for a review of economic practices is gaining importance. At first hand, the government initiated change towards a circular economy, but seemed to draw back on regular economic practices. After this phase, several companies and societal actors took up the concept and have been spreading knowledge and initiatives since (Visser, 2012). Actors have started creating a circular method, in some large-scale Dutch sectors, such as the chemicals sector (Oegema & Wurpel, 2012).

## **4.2 Business models and strategies**

The concept of a business model, which is originated from the field of business management, encompasses all possible factors for successful market introduction. It specifies how value is created from the products and services, and how the product or service value is transformed into profit through interaction with consumers. Relations with suppliers and resource acquisition are included as well (Boons & Lüdeke-Freund, 2012). Money as a value is the most important asset to be exchanged between consumer and producer (Bom, 2012 a).

A new trend is the sustainable business model, where the concept of value is the main concept instead of money. Value is here translated into sharing, exchanging and creating. Entrepreneurs start to offer services with their products and take responsibility for the environmental and social desires of the consumers (Boons & Lüdeke-Freund, 2012; Bom, 2012 a). A traditional business model often does not work for creation of multiple values. The reason is that the value of sustainability cannot only be expressed by money. The actions of companies are not only important for direct stakeholders but also for other companies and society as a whole. Therefore, a cooperative way of working is needed. Another characteristic of a sustainable business model is that possession of products is not necessarily a central aspect; instead it is the access to the service that the product provides. Consumers pay for the use of the product and not for possession. A long term commitment is present, based on a trust relation between the consumers and the providers. Sustainable business models can be set up on a small scale, decentralized and bottom-up, creating new configurations of different actors (Bom, 2012a; Jonker et al, 2012).

One specific type of sustainable business model is the circular business model. This model has roughly the same aspects as a sustainable business model, with a specific focus on closing material cycles and rethinking the concept of waste. The circular business model is an implementation of circular economy values on a company scale (Ellen McArthur Foundation, 2013).

Literature research suggested that there is no certain method yet for distinguishing different circular business models. For this research however, it is the aim to explore these circular business models, for which a more detailed basis is needed. This basis is formed by stating that a circular business model can consist of several circular business strategies. A first step for analysis is to explore the different circular business strategies in the clothing industry in the Netherlands. Then, it can be determined which combinations can be seen and which combinations are absent. The elements of a strategy will be explained in the following subchapter.

## **4.3 Organisation of circular business strategies**

When looking at the organization of circular business strategies, there are four aspects which will be taken into account: the value creation, material flows, actors and technologies. Originally, the flow, actor and technology factors are designed as a triangle approach for industrial ecology purposes (van Koppen, 2004). Value creation has been discussed in the previous sub chapter. The final subchapter contains some general information on the management of a supply chain and the alterations needed for sustainable innovation.

### 4.3.1 Materials, flows and technology

The assessment of relevant material flows is important for determining the impact on environmental aspects, and the possibilities for decreasing this impact. The material flow assessment is important as well for analysing the possible destinations of the material, and where these materials could be combined with or replace raw materials. Technological developments are equally important to assess feasible options for improvement (van Koppen, 2004). As a technical development can create new possibilities for a circular business strategy, this factor is explored as well.

### 4.3.2 Actors

To account for the social aspects of a circular business strategy, it is important to analyse the involved actors. There are many perspectives possible on actor analysis. Several of these perspectives are used in this research: a discussion on which actor is central and actor characteristics for success.

#### 4.3.2.1 Central actors

According to van Koppen (2004), the main stakeholders involved are companies in the chain and consumers. The company should have sufficient dominance in the chain to force changes in relevant parts of the product chain. Depending on the product domain, this powerful actor could be the retailer, the manufacturer or the processing industry. When this central actor within the chain is missing, sometimes an actor outside the chain takes over this central role, for example a product association (van Koppen, 2004). Boons (2002) argues that recyclers and remanufacturing companies could be the key actor as well, as they play an important part in the handling, remanufacture and redistribution of clothing after the first use.

As Seuring (2004) argues, there is usually a focal company governing the supply chain. This company is often the one closest to the final consumers, which ensures the connection with the market. This company might be the most powerful one in the chain, so the objectives this company sets, are met by all involved firms down the chain. As there are two levels of analysis of supply chain management (the single actor level and the supply chain level), several viewpoints can be taken on which company is the most powerful one. When the single actor level is analysed, the direct relations with other actors in the chain are recognized and the position and function of this actor in the chain is determined. When analysing the supply chain level, it can be determined which actor actually sets the criteria for all chain members, and which actor arrangements are made.

#### 4.3.2.2 Actor characteristics and behaviour

As van Koppen observes, there are specific characteristics of key actors, stakeholders and networks which lead to successes in industrial ecology (IE) practices, and as argued, in circular business models as well. A first factor for success concerns the type of the actor network: often, an informal group of active entrepreneurs is found. Secondly, these entrepreneurs have a strong network through close and long-lasting relations internally and externally within the local government. These entrepreneurs together act to drive and facilitate change, becoming frontrunners in innovation. Other activities also shape these environmental improvements, and these activities are aimed at improving infrastructure, public image, and joining forces. The goal of these activities is thus to promote the interests of the industries involved, which could also hold for a smaller scale network of actors which cooperate along the chain (van Koppen, 2004).

A third success factor is a relationship of trust between the initiators of change. This trust usually develops over time and is the result of a longer period of cooperation. Fourthly, there needs to be a common understanding and acknowledgement of the common interests among the involved actors in the network; these interests go further than just an improvement in economic or environmental point of view and include a shared sense of responsibility for developing a region, municipality or industrial zone. It is also applicable for products and chains (van Koppen, 2004).

Boons (2002) describes a framework in which an explanation for the emergence of new initiatives in product chain management is given. The framework consists of three building blocks, of which one aspect is the assumption on resource choice, central to resource dependency theory. In this theory, organizations are seen as systems which are never in control of all the financial and cultural resources necessary for goal attainment. Some resources must be gathered from other organizations, and organizational behaviour will focus on reducing dependency on other organizations. This assumption is called 'dependency reduction' (Boons, 2002). Dependency can be reduced by producing the resource itself, or reduce the necessity of the resource. Therefore, when organizations try to shape product chain management, it is assumed that they will not increase dependency on other organizations but prefer options in which such dependency is reduced (Boons, 2002, p.496).

#### 4.3.3 Managing and redesigning product chains

The product chain is the total of material streams tied to production, consumption and disposal of a product, and its associated (inter)actions of social actors such as industries and consumers (Boons, 2002, p.496). A product and the steps of creation for this product is the central focus. Product chains can be complex, geographically and actor-relatedly, involving large distances and many actors. Companies extracting raw materials are connected through various steps to semi-finished and finished products, which are transported, consumed and recycled or in disposed, involving again other actors. For almost all known cases, limited steps to other levels in the product chain are taken; for example only one supplier back or the organization of recycling with domestic partners (Vermeulen & Ras, 2006, p.253).

The concept of supply chain is closely related but somewhat different, as the supply chain includes all activities which are related to the flow and transformation of goods from the raw material stage to the end user. Associated information flows are included as well, and material and information flow up and down the supply chain. In supply chain management (SCM), these flows are integrated through relations in the supply chains. There is a recognition that the flows need to be brought back from the customer. A different, more environmentally oriented way of supply chain management has risen, called environmental supply chain management (ESCM) (Seuring, 2004).

According to Seuring, there are three stages of a life cycle, which need to be reshaped when altering the management of a supply chain. In the product or network design, the central or focal companies need to acquire access to all partners and to form partnerships, which involves time and costs. In the phase where production and use takes place in the cycle, it takes time for the new supply chain to work at optimal level. New coordination modes have to be set into place. The recycling and disposal phase involves a crucial link to consumers, as the successful recycling is dependent on sufficient returns of used clothing. Concluding, the reshape of a life cycle involves time needed to design and operate new products and production networks, sufficient amounts of fibres and clothing need to circulate to allow the sector to develop, and the chain is more complex. This places a greater demand on the focal company and supply chain partners than with conventional textile chains (Seuring, 2004).

#### 4.4 Drivers

In the literature, several drivers for implementing sustainable business innovations have been identified. Runhaar et al (2008) have defined several drivers, and have given an overview of the most prevailing ones from other literature and empirical research. These drivers are put into different categories:

1. Financial incentives:

Financial support by governments

Savings on energy and resources

Synergy from cooperation with NGO's

Scrutinizing production processes for environmental improvement results in other (efficiency) gains (side-effects)

Savings because of cooperation

Economies of scope (synergy with other processes)

Synergy from cooperation with other companies (joint purchase, sharing knowledge, etc.)

Higher profit margin for green companies

2. Improving company image:

Higher brand consumer awareness

Good contacts with NGO's

Internal and external image improvement

Support from neighbouring households

3. Legitimacy

Environment is reason for existence

Prevent risk on reduced legitimacy in the future

Anticipate future legislation

Prevent negative publicity

4. Support from other actors

Support from media (attention, free publicity)

Support from consultants (knowledge provision)

Incentives of customers (social housing organizations)

Support from regional government (not subsidies, but positive attention, cooperation, knowledge etc.)

5. Market opportunity

Opportunity for niche market (different customers)

(Near) monopoly in ecological market

To distinguish from competitors in existing markets

6. Other incentives

Improved working climate (internal and in relations with customers) (Runhaar et al, 2008, p.170)

This list is very extensive, and considers several categories of drivers and specifies the different drivers. Therefore it seems a very useful theory for this thesis. However, there is no intention to

use this list as a 'check-box' for the interviewees in this thesis research. Rather, a selection of drivers is expected to be found as a reason for investing in circular business strategies.

A financial incentive is expected to be the main driver, because a retailer will not invest in innovation for moral reasons only, as the intention remains to make profit and grow as a company. Legitimacy reasons are also very likely to be mentioned by retailers and other interviewees, as it is imaginable that retailers try to prevent risk of running out of virgin materials by investing in recovery of used materials. Image improvement might be an important factor, if the innovation will be made public and promoted to customers. That might be a sign that retailers try to improve their image on recycling and related sustainability issues.

#### **4.5 Barriers**

Next to incentives, a set of barriers is defined. These are important to detect with different actors in the different initiatives, as then solutions to these barriers or alternative options could be defined. Runhaar et al (2008) define several barriers, categorized for the supply chain, governmental policy, economic origin, lack of knowledge, stakeholders, or other.

These barriers are categorized as follows:

##### **1. Barriers in supply chain**

Low availability of resources for green production

Lack of power in supply chain to force others to cooperate

Low cooperation within supply chain

Lack of good ecological production methods

Ecological product of inferior quality

Only one subcontractor (i.e. market power imbalance)

##### **2. Barriers caused by governmental policy**

Rigid rules obstruct innovation

Passive government

Too many rules

Inadequate enforcement of environmental regulations, favours trespasses and disadvantages environmental leaders

Inadequate subsidies, too low or too much focused on knowledge instead of production

Support by government ineffective due to lack of knowledge of green production/environmental leadership

##### **3. Economic barriers**

Modest demand for sustainable products

Increased costs

Customer not willing to pay for sustainability

Limited growth opportunities due to modest demand

Profit strains due to free riders

##### **4. Barriers by lack of knowledge**

Lack of knowledge by employees

Employees not eco minded

Knowledge available is not specific enough for company in question

General overview of opportunities to reduce environmental impact is lacking

Lack of knowledge by customers

## 5. Barriers by stakeholders

Sceptical approach to environmental leadership by NGO's

## 6. Other barriers

Negative image of sustainable products

Too many eco-labels

Reticent sector (Runhaar et al, 2008, p.172).

Vermeulen and Ras (2006) identify barriers in many fields as well, describing mostly the same ones. However, they mention anonymous markets as a barrier as well, meaning that when tracking down suppliers in a complicated product chain, the overview is easily lost. For in many product chains including clothing, wholesalers buy, store and mix with stocks of raw materials such as cotton, or half finished products such as fabric. Another barrier which is not mentioned by Runhaar et al is the motivation of key actors in the chain. They need to be motivated to take steps, and their motivation depends on several factors: The urgency of environmental issues, market opportunities and possibilities for investing money and labour in the innovation (Vermeulen & Ras, 2006, p.251). These barriers will be used when determining the background of the circular business model examples, however it is possible that new barriers will be found or that not all barriers are present in the case studies.

When describing specific barriers for the implementation of new business models, two practical barriers are described by Jonker et al (2012). Firstly, governments are not very supportive when it comes to a new form of economy. The current financial and juridical systems do not allow a positive feedback on sustainable business models. These systems do not recognize other values than monetary value, blocking innovation. The government could bring clarity and show support by stimulating and facilitating the shift to a circular economy and the associated sustainable business models. A second barrier is that a shift in paradigm must be set in motion in order to normalize the new business models. All actors in the life cycle of a product should think and act differently and embrace different values of a business. This is very hard as it encompasses the values of a whole society when all these actors and stakeholders are taken into account. All wait for next generations of technology, the right stimulations or a sufficient amount of certainty for success. But as these factors are currently changing, this barrier might be overcome by front runners and actors which see the potential of a new business model and dare to implement this (Jonker, 2012). For the clothing industry, the introduction of a new technology for separating and remanufacturing used garments has been a trigger to start trying to remanufacture clothing on a larger scale through a new business model (Bom, 2012a; Bom, 2012b).

## **5. Results I: Circular business strategies**

The findings from the research can be categorized in several parts. The first part, focusing on circular business strategies, is divided into four found strategies: recollection, fiberization and remanufacturing, selling remanufactured garments, and leasing. The last two strategies are combined in one subchapter. For each strategy, the following aspects were researched where applicable: value creation, chain actors and cooperation, material flows and technology.

## 5.1 Recollection

The first step of making efforts towards a circular clothing cycle is to take back used clothes. This is the first phase after the use phase, when consumers decide what to do with the garments which they no longer wish to possess. Providing a take back option prevents for the clothes being thrown away.

### 5.1.1 Value creation

All investigated retailers provide a hand-in option for consumers, whether the garments are rewearable or broken. However, retailers can implement several measures to add value for consumers to hand in their used garments. Firstly, the garments can be sent back to the retailer for free, where the retailer takes account of the shipping costs. This does not impose any costs for the consumer. The effort of sending the clothes back can be decreased by including a retour envelope with a new purchase, which is done in one case in the Netherlands (Witte Boorden b, 2013). Secondly, the retailer can offer the consumer a discount in currency or percentage, on a new garment when the consumer hands in the old garments. This discount differs per retailer; at H&M, consumers receive 15% discount on a new garment when a full bag of used clothes is handed in. At WE Fashion, a discount of 5% is given on a new garment (van Rossum, 2013). At C&A, a discount of five euros is given (de Vries, 2012). Thirdly, the garments can be handed in and the consumer receives the deposit which was paid when purchasing the garment. This deposit differs from a discount, because in the deposit case, the consumer is not obliged to buy a new garment to profit from handing in old garments (Mud Jeans, 2013). In addition, the consumer paid a higher amount for the new garment for which the deposit is being returned after hand-in, for the retailer not to lose profit on the deposit service. This creates an extra intention for consumers to hand in used garments, as they paid an extra tax when purchasing it (DutchSpirit b, 2013). For all three options holds that the clothes could be rewearable or broken, the condition of the clothing does not matter for the availability for handing it in.

For retailers, recollecting garments creates extra value as well. In the found cases in which consumers go to the retailer and get a discount on new garments, it is expected that the discount generates extra traffic in the store, creating extra profit for the retailer when consumers buy new garments (DutchSpirit b, 2013; 2Switch, 2013; CREM, 2013). However, the actual results of current tests with recollection and a reward discount are not made public yet. It is unsure in what other way value is added for retailers in the cases where recollected garments are handed in to recycling partners, for no direct contact could be established with these retailers. However, according to a source from H&M, the cooperation with I:Collect for recollection of garments does not generate profit for H&M; the generated revenue is used 'to reward our customers, to make donations to local charity organisations and to invest in recycling innovation' (H&M, 2013b).

### 5.1.2 Chain actors and cooperation

Several actors are involved in pursuing the practice of clothing recollection. Compared with the business-as-usual practice, a moderately different actor configuration is in place, as the retailer does not undertake any measures to recollect used clothing in that case. For the recollection strategy, the main initiator is the retailer, as this party takes initiative and responsibility to recollect worn clothing as a separate task next to selling clothes. This recollection takes place in a 'passive' way, in which consumers are informed about the take-back possibility of the retailer and the associated benefits for the consumers. There are recollection facilities at the store (de Vries, 2012). Retailers do not recollect used garments at the door, in contrast to some clothing recycling organizations (Leger des Heils, 2013).

The involvement of other parties partly depends on the presence of follow-up circular business strategies initiated by the retailer. Where no other circular business strategy is undertaken, as is the case for H&M and C&A, the business-as-usual actor configuration is in place after the retailer has recollected the clothing and transfers it to recycling agents. From there on, the retailer has no influence over the further destination of the used clothing. (2Switch, 2013). WE Fashion does implement a second circular business strategy: selling recycled garments (van Rossum, 2013). However, this strategy is not connected to an active involvement in fiberization and recycling processes; the retailer itself does not demand the recycled garments to be made from used garments which are recollected in the WE Fashion stores. In this case, the set of actors operating the phases between recollection and reselling is unknown. For the remaining four retailers, other circular business practices are undertaken, which will be further explored in chapters 7 to 9.

There is currently no evidence of cooperation between the large retailers which operate recollection practices, as every large retailer has separate recollection facilities. Cooperation between retailers and other parties is seen in the cases of H&M and C&A, both cooperating with recycling agent I:CO (de Vries, 2013; van Rossum, 2013).

### 5.1.3 Flows and materials

After the handing in of clothing, there are many options for the further treatment. Three of the seven exemplary retailers are not involved in the other circular business strategy of fiberization and reproduction; these retailers sell or donate the garments to recycling agents, which in turn send the clothes to third world countries or remanufacture clothes to other products. A small fraction is being remanufactured into new clothing (Nuon, 2013). Compared to the business-as-usual model, the take-back strategy only adds the retailer as an extra recollection agent, situated after the use phase. After this phase, no different practices from business-as-usual take place (RE-5, 2013).

After recollection, which is undertaken by retailers, the clothing is distributed to recycling agents. There, the clothing is sorted by type and quality. After sorting, there are several destinations for the clothing, depending on quality of the fabric.

1. In general, rewearable garments with good quality are distributed to, and sold in second hand stores in the Netherlands.
2. Lesser quality wearable garments are being distributed to Eastern Europe and developing countries. There they are sold by local merchants, or distributed for free by charity and emergency aid organizations (Nuon, 2013).
3. Non-rewearable but recyclable clothing is processed into other products.

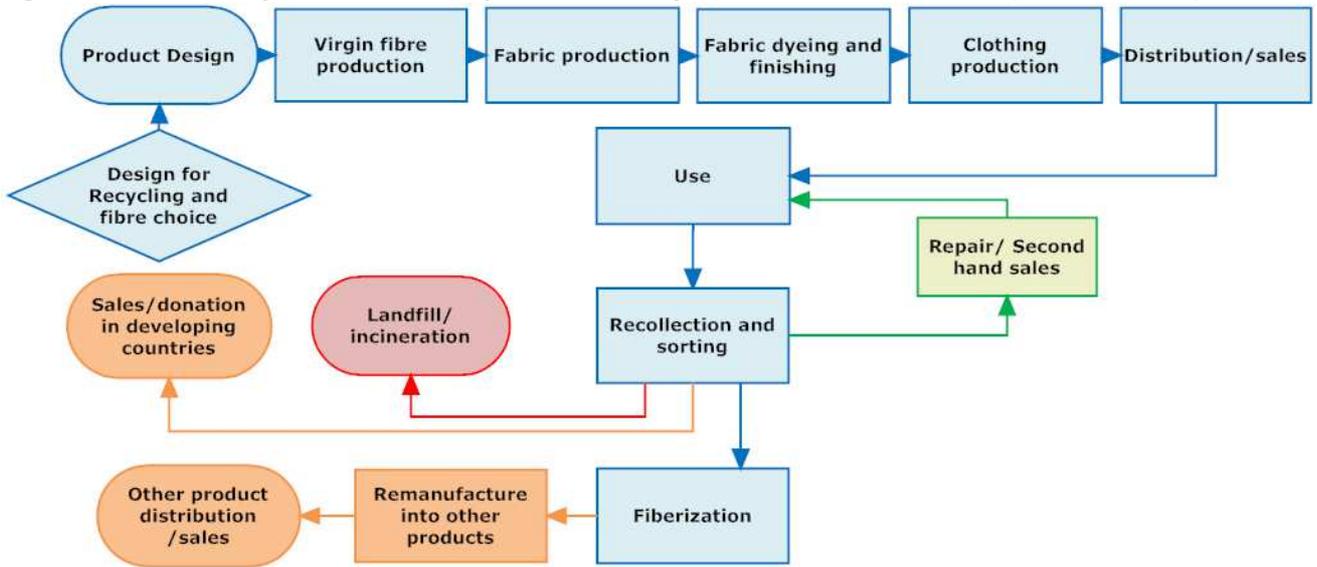
There is a broad range of products made out of used clothing. The actual output of other products depends on market demand and choices by the sorting or recycling agency. Synthetic fibres can be fiberized and used for isolation material or emergency blankets. When this material is compressed under high temperature, it can be processed into office desks or furniture (2Switch, 2013; Texperium, 2013).

4. When clothing is very dirty beyond recovery or not reusable in any other way, it is transported for incineration or landfilling (DutchSpirit, 2013b).

These options are listed according to the quality of used garments. As every involved party has its own strategies for earning profit from used clothing, there is less significant opinion on what is deemed a most preferable option (2Switch, 2013; DutchSpirit, 2013a). However, from a circular economy perspective, the rate to which materials can be recovered or upgraded is a key determinant for favourability. In this perspective, not all previously listed options are equally

favorable. The model below shows the clothing flows for a retailer providing take-back options without implementing further circular business strategies, such as C&A and H&M.

Figure 4: Flow chart for recollection by retailers and further business-as-usual (own research)



In this model, the starting point is situated in the diamond-shaped field on the top left. From there, the conventional clothing production flow is shown in blue. The red path and oval shape shows the most unfavourable end of the flow, namely landfill or incineration. For in this case, there are no known possibilities for re-use of clothing or recovery of any material.

The orange paths, rectangle and oval show the moderately favorable options for the ending of the clothing chain; Sales or donation in developing countries and remanufacturing, distribution and sales of other products made from used garments. Theoretically, there are possibilities for recovery of materials after a second wearing of clothes in developing countries. However, such a practice is not known to be undertaken currently, and this issue is beyond the scope of this research. From a circular economy perspective, remanufacture into other products is deemed less favorable than recycling clothing into new clothing. This practice is regarded as downcycling, which is suboptimal to total material recovery (Ellen McArthur Foundation, 2012; Texperium, 2013). Still, remanufacture into other products or re-wearing in developing countries is deemed more favorable than landfilling or incineration.

The green path and rectangle shows the most favorable option, namely the direct second-hand reselling of used garments (and repair if needed). Second hand sales is shown as a separate process, because the retailer is not the same company as the one selling second hand clothing; in second hand clothing stores, no first-hand selling of new clothes occurs. In the stores in which clothes are handed in and where no other circular business strategy is used, no second-hand clothing is sold at all. Repair and second-hand sale of returned clothing is the most favorable option, for it does not demand any extra technology or infrastructure other than the existing infrastructure in the Netherlands. Additionally, the materials are not modified or transformed; the material is kept in the original state and is thus recovered locally without a large effort.

#### 5.1.4 Technology

Different collection facilities are present for the recollection of used garments. The larger retailers with physical stores (WE Fashion, C&A and H&M) possess recollection bins in the stores where consumers can hand in the clothing (de Vries, 2012). These recollection bins are placed by the recycling agency with which the retailer has a contract. After recollection, the clothing is transferred by conventional recycling companies and transported to sorting locations. From there on, the conventional infrastructure and technology for the handling of used clothing is operated. This business-as-usual process is described in paragraph 3.3.

### **5.2 Fiberization and reproduction**

After recollection, a follow-up circular business strategy is the fiberization and reproduction of used garments into new clothes. With this strategy, retailers take active effort to get their recollected garments to be fiberized (cut into small pieces with specialized machinery) and reproduced (woven with new yarn to create recycled garments).

#### 5.2.1 Value creation

AS there is no direct contact with consumers in this business strategy, the value creation focuses on the retailers and suppliers. In the fiberization and production strategy, retailers add monetary value by contracting fiberization and spinning companies for processing the used garments from the retailers. When the garments are fiberized and reproduced, this value increases. Then in a next step of the chain, the clothes are meant to be sold again on the Dutch market. However, it is not sure how high the added value will be in these steps, because the reproduced clothing is not sold on the Dutch market yet, and therefore the price of recycled garments cannot be compared to conventionally produced ones.

Value creation for retailers occurs by several other means rather than direct monetary income. Firstly, retailers recognize that the production of virgin cotton and other natural resources poses increasing strains on the environment. Due to these and other more unpredictable factors, the availability of virgin cotton is expected to decrease and the price to rise. This development sparks a search for ways to use less virgin cotton, such as recovering fibres from used garments. In this way, retailers are less dependent the production of virgin raw material and its associated price increase (DutchSpirit, 2013; NRVD, 2013;). Another consideration is that of avoiding possible negative publicity, which is associated with harvesting and using conventional cotton on a large scale. Retailers tend to refuse being associated with this kind of environmentally damaging raw material production (DutchSpirit, 2013; 2Switch, 2013).

#### 5.2.2 Chain actors and cooperation

In contrast to clothing recollection and conventional recycling systems, there is no nation-wide operating system yet for large-scale fiberization and reproduction of garments. The development of this system and associated actor partnerships is still in the experimental phase (KICI, 2012). WE Fashion is the only retailer which has set out an actor network for the supply of reproduced garments: the used ones are recollected in the WE Fashion stores. Then these are sorted and fiberized in the Netherlands. After manual sorting, the clothes were fiberized in the Netherlands, and the fibres were shipped to Prato, Italy. In close cooperation with RE-MO, a clothing recycling company, the fibre producers in Prato developed garments from the fiberized yarn (Landré, 2013). The following schedule represents the process and actor network of recycled clothing from WE Fashion.

Figure 5: Actors in the reproduction process for WE Fashion garments (RE-MO, 2013).



For the other retailers with ambitions to have their recollected garments reproduced, the actor configurations are currently developing. Retailers are trying to connect to other actors along the chain. Some of the other actors are in cooperation with WE Fashion as well. One of the other actors is Texperium, a knowledge institute involved in the development of a fiberization and reproduction infrastructure for used garments, and a central information point for parties interested in the reproduction of clothing. Kici, a recycling agent involved in the initiative and the development of the automatic sorting system, is a second actor along with Wieland Textiles, a recycling company which owns the only automatic sorting machine in the Netherlands (Kici, 2012). A fourth actor and a central connection in the technical fiberization process is the recycling company Frankenhuis, the only one in the Netherlands with fiberization technology (Texperium, 2013). Then when the material has been sorted and fiberized, new yarn needs to be spun from this material. As there are no yarn production companies in the Netherlands, retailers are currently setting out connections with foreign fibre production companies which are willing to spin fiberized yarn along with yarn from virgin material. The companies with the most advanced experience in this field are currently situated in Prato, a city the north of Italy, a region with many yarn producers who possess the skills of mixing recycled yarn with virgin yarn (Landré, 2013). One final actor which is less directly involved but nevertheless supports the developments is Agentschap NL. This actor has cooperated in setting up the connection between RE-MO and WE Fashion on the reproduced clothes (RE-MO, 2013). In addition, this agency supports the proceedings of Texperium (Texperium, 2013).

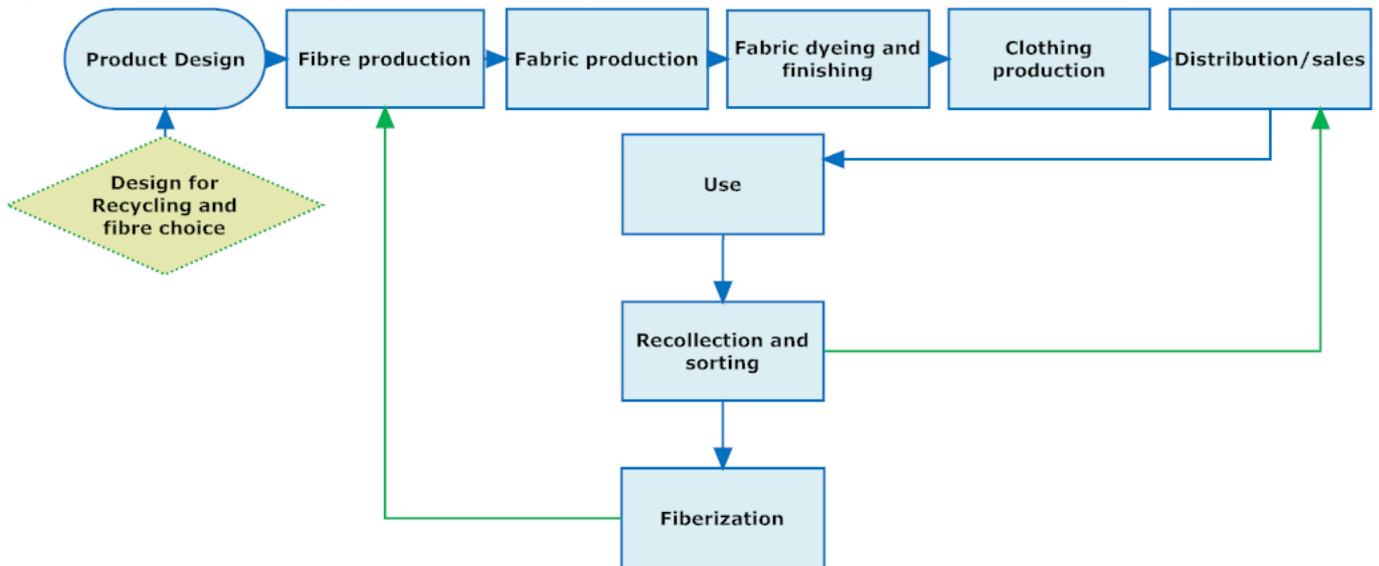
Despite efforts from these actors, there are some complicating factors concerning the configuration and cooperation for smaller retailers which are still developing their actor network. Firstly, as larger retailers have more financial possibilities and a more developed production system, these companies can compete on sustainable innovation. There is a chance that a smaller retailer with a circular innovation, such as DutchSpirit with the leasing of suits, will not be able to take a frontrunner position if a larger and more noted retailer takes over the concept (DutchSpirit, 2013). A second barrier is that larger charity companies and recycling agents pursue their activities with a goal for a highest possible profit as well; recycling agents usually sell the highest possible volume of garments to third parties, after which the volume is sent to developing countries or manufactured into lesser quality products. Most conventional actors are not very willing to cooperate because they find a change of company profile and system time and money consuming (2Switch, 2013; DutchSpirit, 2013).

### 5.2.3 Flows and materials

Regarding the flows and materials for the reproduction process, several options exist. On the process step of sorting there are two possibilities: sorting by hand and mechanical sorting. The mechanical sorting has several advantages, as it is faster and less labour-intensive. For fiberization there are also two possibilities: for the first option, the clothes can be collected regardless of the type or colour of material or garment, and have to be separated first before being reproduced effectively. In the second option, the clothes are collected separately, based on material and type of garment. Currently, three of the four retailers which (have an intention to) sell fiberized and reproduced garments use this separate collection method. The clothing stream is focused on one type, fabric and colour of garment, simplifying the sorting step and not needing the sorting machine before the stream entering the fiberization machine. This separate sorting of clothing is less complicated for the three retailers which are involved in this type of sorting, for these retailers only offer collections on one type of garment (such as Mud Jeans only sells jeans), sometimes even on one colour or material (such as Witte Boorden, only selling white men's t-shirts) (Witte Boorden, 2013b). The only retailer involved in clothing fiberization and remanufacture which does not sort the garments internally is Re-5. This company offers all kinds of garments in different colours and materials; therefore, the whole batch is being separated by a sorting machine and then distributed to a fiberization company (RE-5, 2013).

In the following model, the business strategy of fiberization and reproduction is shown with the subsequent processes.

Figure 6: Material flows of fiberization and reproduction (own research)



As shown in the model, the chain starts with design for recycling and fibre choice. This process step is important for determining the complexity of the fiberization and fibre production process, as non-textile parts such as zippers and buttons complicate the fiberization process. The green design for recycling and fibre choice decision is based on the statement from interviewees, that the clothing for remanufacture has been designed to fit a fiberization and reproduction process. Thus, design for recycling and fibre choice is favorable for this circular business strategy. After production and use, the recollection (and sorting in one case) takes place. Then in the fiberization process, the garments are threshed out until only fibres are left, after which the fibres are mixed with new fibre in the production process. In this way, the materials cycle is closed.

There are several issues regarding the fiberization and reproduction of garments from the investigated retailers. Firstly, with an exception of WE Fashion, the smaller retailers have not recollected a sufficient amount of used garments yet, to produce one batch of fiberized yarn. With the current recollected volume, it is not profitable yet for fiberization. However, it is estimated that the volume will be sufficient within a few years (Witte Boorden, 2013b). A second drawback is the low availability of high quality garments which are fit for fiberization; the largest fraction of garments on the Dutch market is low-quality garments which wear out or break quickly, and which are replaced in new sale seasons every three months. This fraction is less suitable for successful reproduction (2Switch, 2013). Thirdly, the conventional clothing industry and large retailers are set to have up to five clothing seasons per year, in which the supply in the store is renewed. However, it takes much longer to reproduce garments, even if it is unknown what the actual reproduction time is. Currently, the reproduction rate cannot keep up with the time of conventional fashion seasons from large retailers. This means that reproduction is currently not suitable for the conventional clothing industry, unless the fashion seasons become longer or the retailer sells basic garments which are not sensitive to trends (2Switch, 2013).

#### 5.2.4 Technology

Two innovations are central when considering the remanufacturing process: the mechanic sorting of garments and the mechanic fiberization. The mechanic sorting machine has been developed over several years. In 1999, a European project named Identitex started with searching for technologies for recycling post-consumer textiles. The project focused on two processed steps: recognizing the type and colour of the material and the actual sorting of these materials. The outcome was a prototype which puts the textile preparation, identification and sorting processes together. The technology used to recognize different materials and colours is Near Infra-Red (NIR) spectroscopy. Then, the garments are blown into the right bin by an automated air flow. The prototype sorts clothes with a speed of over ten garments per second (Cordis, 2002). After the initial research ended in 2001, no further applications for the sorting prototype were sought. In 2009, a consortium called Textiles for Textiles was established, commissioned by the European Union for the Eco-innovation programme. This project can be seen as a follow-up for Identitex, making the sorting prototype feasible for industrial application. The Textiles4Textiles project ended in 2012 (Textiles4Textiles, 2012). Because Wieland Textiles was the only sorting agency in the consortium, this company installed the automated sorting installation at their sorting facility (Dekkers, 2013).

A main issue for the sorting machine is the input of garments with different materials combined which is called a blend. One example of a blend is a winter coat, with polyester lining inside, polyester and wool mix filling and an outer layer of woven cotton, all materials having different colours. This kind of blend cannot be sorted efficiently yet, delaying the sorting time and making it necessary to sort garments by hand in a first sorting round, in which pure materials are separated from blends. It is expected that the installation will be feasible for recognizing different materials, but no clear prediction of this technological advancement can be given (Texperium, 2013). There is no technical reason why the recycling or re-use rates for most material types should not be dramatically increased; there will certainly be a growth in more efficient separating technologies. When material prices better reflect the true environmental costs of production and use, this increase in technologies will be accelerated (Ayres & Ayres, 1996, p.14).

Another technological innovation, needed to make the reproduction process possible, is automated fiberization. This process has been developed by Texperium and Frankenhuis, and it creates an economic incentive and market opportunities for remanufacturing used garments which were initially not rewearable. The fiberization machine is currently in operation at Frankenhuis. However, as discussed in the previous subsection, the practical application of this installation is not proven for the smaller retailers which do not have a sufficient amount of recollected clothing yet.

In the Netherlands there are no companies which produce yarn or reproduced clothing. Currently, no such technology is being developed in the Netherlands either. For the fiberized garments to be reproduced successfully, the fibres have to be transported to foreign companies which are willing and able to reproduce clothing from this specific type of yarn. In Prato, region in north Italy, there are companies with advanced experience in clothing reproduction. As the unravelled fibres are too short and therefore not sufficient in quality to be spun into yarn, other raw materials have to be blended in as well. Currently, the percentage of fiberized yarn in reproduced clothes can reach 50 to 60% (Nuon, 2013). Still, it is technologically not possible yet to increase the percentage of recycled yarn to 100% (Texperium, 2013). This boundary complicates the further reproduction of garments for some retailers which experiment with reproduced clothing, because they have other demands on sustainability as well: the garments sold by these retailers are certified for being made of 100% biological cotton. This means that the virgin cotton that is mixed in the remanufacturing

process needs to be 100% biological as well. Otherwise, the retailer is not allowed to carry the biological clothing label and provide the desired guarantee for sustainability (Witte Boorden, 2013b; Re-5, 2013). This condition makes it harder for these retailers to find a clothing manufacturer which produces 100% biological yarn and is willing to invest in facilities for blending in fiberized yarn.

### **5.3. Leasing and sale of reproduced clothing**

For the circle to close, fiberized and reproduced garments need to be sold. Leasing is a different strategy compared to the sale of reproduced clothing, as leasing creates a different form of transaction between consumer and retailer. By leasing, the consumer pays a fixed amount per month for a predefined time period, after which the garment can be returned to the retailer for recycling, or the lease can be extended. As such, the material stays in ownership of the retailer (Mud Jeans, 2013). Thus, the terms 'purchase', 'sale' or related terms do not fit the description of leasing, as these imply a definite transaction with a change of ownership. Currently, DutchSpirit, Witte Boorden and Mud Jeans provide a possibility for leasing garments, although the concept is named 'subscription' in the Witte Boorden branding.

#### **5.3.1 Value creation**

As for leasing, the different relation provides extra value for the consumer in several ways. Firstly, an economic added value stems from the spread payment of garments. Instead of paying an exclusive garment at once (such as a tailor-made suit from DutchSpirit), a lease system with spread payment is more affordable for consumers (Awearness Fashion, 2013). Secondly, when a lease period ends, there are several advantageous options for consumers: they receive back a deposit when returning the garments, whether rewearable or broken, or they can extend the lease period with a discount on the monthly payment. A third added value is intrinsic, for the lease construction adds to a sustainable lifestyle by changing the focus on using the garment instead of owning it (Mud Jeans, 2013).

By selling reproduced clothing, added value for retailers is created in a non-monetary way; remanufactured clothing is a new niche market and a novelty in the Dutch fashion industry, for which retailers can become a frontrunner if they introduce the leasing concept. Consumers have increasingly become aware of the life cycle of clothing, and where it ends. Some consumers wish for an option to hand in their worn garments to the same retailer as where they bought it, to be sure the material is recovered correctly. Some consumers buy the same type of garments after handing in the old ones. Retailers recognize this new trend as a market opportunity and innovate for this reason (Re-5, 2013; Witte Boorden, 2013b). Consumers wish to connect a sustainable lifestyle to the purchase of more sustainably produced clothing, to which this new niche market might fit. WE Fashion launches the first pilot with reproduced clothing in August 2013. The WE Recycle collection will consist of sweaters and vests for men (van Rossum, 2013). The case of leasing implies a more long-term and personal relation between the consumer and retailer, with a larger probability that a consumer extends the leasing period. This mechanism provides for constant and solid customer relations and a higher possibility of constant revenue for the retailer (2Switch, 2013).

### 5.3.2 Chain actors and cooperation

The retailer is the actor which performs the actual selling of reproduced garments. The retailer has to perform a contract with a supplier of reproduced garments. Of the investigated retailers, only WE Fashion actually sells reproduced clothes in the Netherlands. The other retailers have an intention to sell these, but the process of reproduction has not yet been completed due to practical limitations (see sections 7.3 and 7.4). As such, it is not known how the actual sale of reproduced clothes by these retailers will develop. It is estimated that within five years, the materials cycle of these retailers can be closed (Witte Boorden, 2013a; RE-5, 2013).

There is little information on cooperation between retailers, as retailers individually (will) sell their own collection of remanufactured clothes.

For realizing a lease concept, the retailers change the type of interaction with consumers from short-term and unique purchasing moments to a more long term, subscription-shaped relation (DutchSpirit, 2013). The leasing of garments therefore involves more commitment from consumers compared to the conventional sale of clothing. As the lease of garments is a new concept, actor relations and alliances are not yet fully established and are currently being formed (NVRD, 2013). An example of cooperation is one between Mud Jeans and DutchSpirit, exchanging knowledge and experience on leasing (DutchSpirit, 2013). Other actors are exploring the possibilities and limitations of leasing garments on a more individual basis (Texperium, 2013). It is currently unknown if larger retailers are considering leasing garments as a new value creation for consumers (NVRD, 2013). Neither are there any known examples of retailers which lease reproduced garments; WE Fashion does sell reproduced garments but does not operate a leasing concept, and the retailers who do offer a leasing option cannot sell reproduced clothes yet.

### 5.3.3 Materials and flows

Selling reproduced clothes does not involve any advanced or innovative flow or process, as the only change is the type of product and the processes prior to sale. Therefore, the same flow as for any other type of garment applies. However, as the selling of reproduced clothes is in all cases combined with a fiberization and reproduction process, the same model applies as the one for fiberization and reproduction.

Several remarks can be made regarding the materials and material flows associated with leasing garments. Firstly, leased garments remain in ownership of the retailer, as is stated before. For garments with a longer lifespan and a higher quality, such as jeans and suits, the lease period needs to be adapted to the lifespan of the leased garments. One disadvantage of leasing is that there is a timespan between the garments being purchased for use, and the return of the used garments. This leasing period can vary from several months (in the case of the Witte Boorden t-shirts) to several years (in the cases of Mud Jeans and DutchSpirit). On the other hand, this aspect could also be an advantage, because there is a larger assurance that the garments will return to the retailer within a specific time period, and that the recollection moments can be predicted (DutchSpirit, 2013). However, the actual leasing period depends on several factors, such as consumer satisfaction, quality of leased garments and fashion trend development. Because all examples of leasing are inherently connected to fiberization and reproduction, there is a possibility that the demand of new garments is larger than the amount of clothes being recollected with the ending of the lease contract. This drawback can be overcome by calculating and trying to anticipate on the leasing period and the timespan needed for remanufacturing the used garments (2Switch, 2013). For leasing garments, the same model applies as for remanufacturing garments (figure 6), for the actual flows do not change, only the type of agreement between retailer and consumer changes.

## 6. Results II: Circular Business Models

The second set of findings concentrates on combining the strategies from the previous chapter. The several combinations are explained in subchapter one. Then, the added values for each business model are explained. In a third subchapter, the central actors for developing circular business models are discussed.

### 6.1 Combining strategies

Specific combinations of circular business strategies form circular business models. However, not all combinations are seen in the example retailers in the Netherlands. For example, there is no case in which a retailer sells reproduced clothing without recollecting it first. Neither is there any example of a retailer being involved in recollection and sale of reproduced clothing without involving in a fiberization and reproduction system. Other combinations are seen for the majority of the investigated retailers. Some of them adopted more than one, or all found circular business strategies. The schedule below shows the involvement of the retailers in the four business strategies:

*Table 2: Overview of retailers and involvement in circular business strategies (own research)*

| Retailer      | Recollection | Fiberization and reproduction | Leasing or subscription | Sale of reproduced clothing |
|---------------|--------------|-------------------------------|-------------------------|-----------------------------|
| C&A           | X            |                               |                         |                             |
| H&M           | X            |                               |                         |                             |
| WE Fashion    | X            | X                             |                         | X                           |
| Re-5          | X            | X                             |                         | X                           |
| Witte Boorden | X            | X                             |                         | X                           |
| Mud Jeans     | X            | X                             | X                       | X                           |
| DutchSpirit   | X            | X                             | X                       | X                           |

There are several combinations of business strategies found. These combinations are shaded in different colours to show which retailers are involved in which strategies. The orange shading indicates the business model of C&A and H&M, called 'recollection only', in which only recollection as a circular business strategy is implemented, with the further chain being similar to business as usual. The blue shading distinguishes WE Fashion, Re-5 and Witte Boorden for recollecting garments, being actively involved in the set-up of a fiberization and reproduction system, and (intending to) selling these reproduced garments again. However no leasing construction applies, therefore this model is called 'all except lease'. For Mud Jeans and DutchSpirit, indicated with green shading, all four circular business strategies apply, shaping the third circular business model, named 'all strategies combined'.

It becomes visible here that the two largest retailers do not undertake any action to influence the processes after the recollection and distribution to sorting and recycling agencies. As a consequence, it is likely that the recollected clothes from this origin are still manufactured into other products or shipped to other countries, where the material cannot be returned into the cycle. From this perspective, it cannot be ensured that these retailers indeed perform a circular business model, although it is true that the garments are recollecting to prevent waste.

## 6.2 Added values

At first, the research focused on the value creation for the individual strategies. It became apparent that there are several added values which apply to a certain business model which are not applicable in another model. In this chapter, discussion focuses on incentives for the specific business models.

### 6.2.1 Recollection only

When garments are recollected, the retailer which performs recollection will create added value in some way. When retailers give a recollection option with a discount on a new product as a reward, it is expected that the discount generates extra traffic in the store, creating extra profit for the retailer when consumers buy new garments (DutchSpirit b, 2013; 2Switch, 2013; CREM, 2013). However, there are no results found yet on the success of this supposed mechanism. The direct economic benefit is therefore uncertain, also because no direct contact has taken place with the retailers performing only recollection. In the H&M case, it is said that no profit is made from recollection of used garments; the generated revenue (supposedly from selling recollected garments to the recycling partner) is used 'to reward our customers, to make donations to local charity organisations and to invest in recycling innovation' (H&M, 2013b).

Avoiding negative publicity might also be a driver to get involved in recollection. As there is a perceived fear for negative publicity on the waste associated with fast fashion and mass produced garments, a recollection option might show a more positive view to retailers (DutchSpirit, 2013; 2Switch, 2013). For recollection to be successful, consumers need to be informed about the option for recollection in the store. When promoting the recollection option, the issue of waste is discussed, and the recollection option is shown as a way to avoid waste from clothing with a moral ground (H&M, 2013b). By communication recollection in this way, although not directly confirmed, it is possible that the retailer does so to improve the image of the company on sustainability and environmental care issues.

### 6.2.2 All except lease

For retailers which put all circular business strategies into practice except for leasing the garments, the moral argument holds as well, however it goes further with this model: the incentive to invest in setting up a remanufacturing system shows a willingness to adjust a whole company's strategy and infrastructure, which goes beyond setting up a recollection facility only. Retailers become aware that production of virgin cotton and other natural resources poses increasing strains on the environment. Retailers recognize their role in reducing these strains by recycling the fabric and replacing virgin fibres by re-used or recycled ones. Following this trend, fabric is increasingly seen as a useful resource instead of waste which needs to be discarded as easy as possible (DutchSpirit, 2013; NRVD, 2013). Another moral argument is that there is a necessity for closing the materials cycle from a sustainability point of view, that it is 'the only right way to do it' (RE-5, 2013). Then, fiberization, remanufacture and reselling of used clothing are necessary steps to take when a retailer has the ambition to be totally sustainable. This moral discussion applies especially for the smaller retailers, all of which have been taking steps towards a totally sustainable and zero impact product range and company setup (Witte Boorden, 2013b; RE-5, 2013).

Next to moral reasons, there are also motivations based on a security and independence issue. Among some retailers, there is possible fear for negative publicity on the environmental side-effects of virgin cotton production for garments. A conversion to yarn from fiberized clothing shows the willingness for a conversion to more sustainable materials (2Switch, 2013). Other security reasons are based on economic factors. Due to increased strains on the environment and other more unpredictable factors, the availability of virgin cotton is expected to decrease and the price to rise. This development sparks a search for ways to use less virgin cotton, such as recovering fibres from used garments. In this way, retailers are less dependent the production of virgin raw material and its associated price increase (CREM, 2013; 2Switch, 2013).

An economic added value could originate from fulfilling the niche market which is created with selling reproduced garments. As this niche market is currently developing, no economic data could be added to this statement. However, consumers have increasingly become aware of the life cycle of clothing, some consumers wish for an option to hand in their worn garments to the same retailer as where they bought it, to be sure the material is recovered correctly. Some consumers buy the same type of garments after handing in the old ones. Retailers recognize this new trend as a market opportunity and innovate for this reason (Re-5, 2013; Witte Boorden, 2013b). The niche market gives opportunities to become a frontrunner in this market, and to promote the selling of remanufactured garments as something quite unique, sustainable and innovative. Connecting to the advantages of becoming a frontrunner in the sustainable garment market, there is a drive to 'lead the way' for shaping a closed system of fiberizing and reproducing used garments. (2Switch, 2013).

### 6.2.3 All strategies combined

Adding leasing as a fourth circular business strategy, several motivations apply to this circular business model as well. The niche market and front-runner advantages apply in particular, as leasing certainly is a novelty in the clothing industry in the Netherlands. Secondly, retailers which lease garments have a high chance of a unique setting for building a sustainable image. Additionally, there is a possibility for showing the willingness to close the materials cycle by changing the ownership conditions with a lease contract.

There are some added values and motives for retailers which are only seen for this circular business model. Firstly, the case of leasing implies a more long-term and personal relation between the consumer and retailer, with a higher chance for a consumer to return the worn garment and start a new lease period. This mechanism increases the chance of constant and solid customer relations and constant revenue for the retailer (2Switch, 2013). Secondly, there is a higher chance that all leased garments are being returned to the retailer, which gives more possible volume for fiberization and remanufacturing.

### 6.3 Central actors

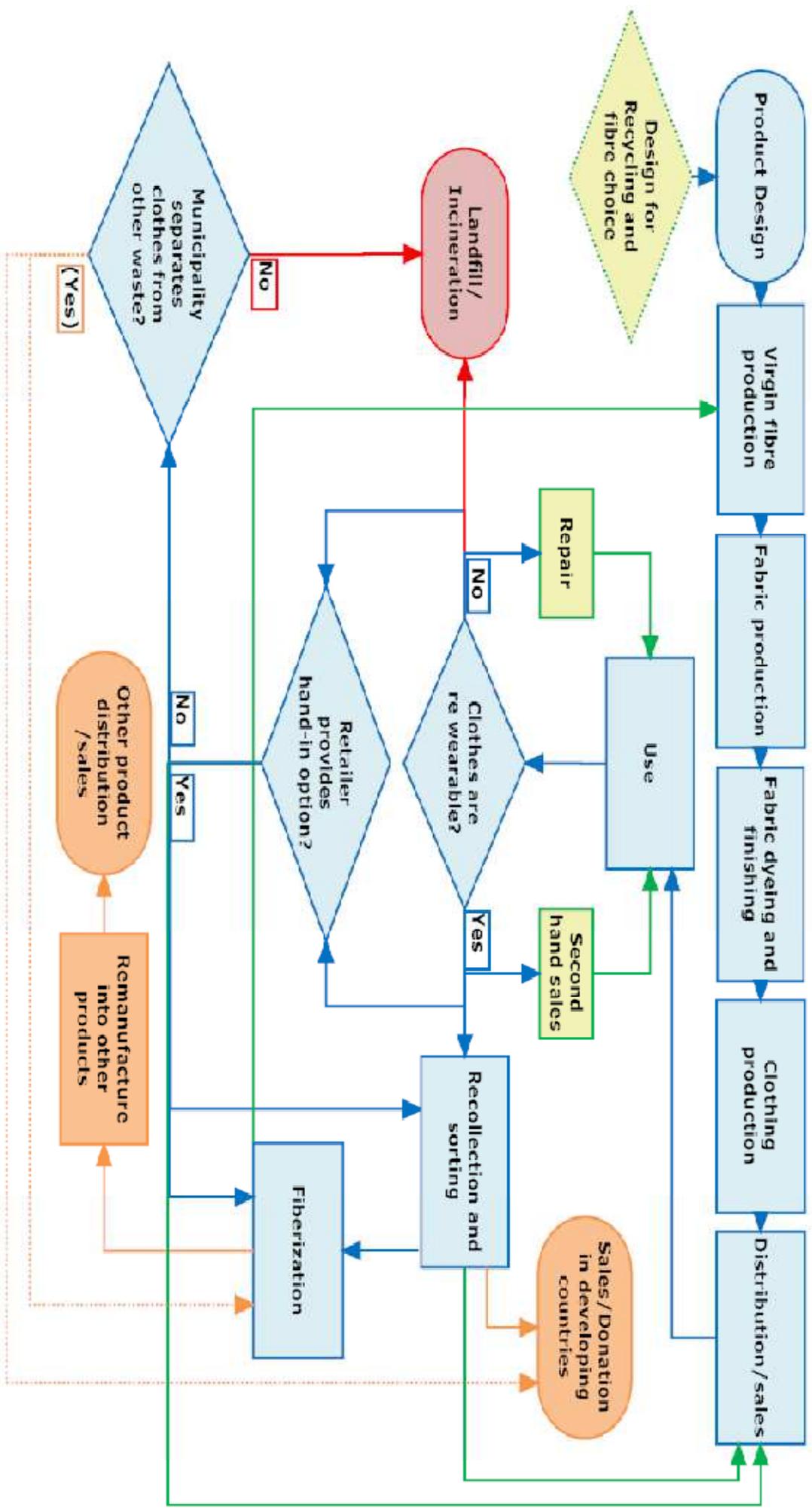
In this section, it is discussed which actors are initiators of circular business models in the clothing industry in the Netherlands. In the literature, discussed in the conceptual framework, there are several viewpoints on central actors. A first remark is that the companies in the chain and consumers are main stakeholders, and that a central company is seen to initiate and realize changes in relevant parts of the product chain. It depends on the product domain which actor is the initiating and central one (van Koppen, 2004). Boons (2002) places more importance on recyclers and remanufacturing companies, as they play an important part in the handling, remanufacture and redistribution of clothing after the first use. Seuring (2004) argues that the focal company governing the supply chain is often the one closest to the final consumers, for this company ensures the connection with the market. This company might be the most powerful one in the chain, so the objectives this company sets, are met by all involved firms down the chain. On supply chain level, an important factor is which actor actually sets the criteria for all chain members.

Interviewees shared competing views on which actor is central; not all interviewees had a clear view on the issue. They stated that they were not able to tell which actors actually set criteria for circular business model innovations, which shows that there is uncertainty among the different actors on their perceived role and the role of other actors. The views of remaining interviewees can be categorized into several perspectives. A first perspective on which some interviewees agree is that all actors involved are equally important for realizing circular business models, the circular business model will not develop successfully if one of the actors is overlooked. Designers and product developers are important, designing garments in such a way that recycling becomes less complicated; consumers are important for handing in used garments and consuming reproduced garments or leasing them; the government has an important stimulating role by subsidizing innovations; researchers determine the feasibility of the circular economy movement and define boundaries; finally, knowledge organizations are crucial for connecting all other actors and spreading knowledge on the closing of material cycles and circular economy solutions (Awareness Fashion, 2013; CREM, 2013). The role of all these actors is important because for circular business models, all processes in the chain must be adapted towards closing the materials cycle. This process involves efforts from all directly involved chain companies, as well as consumers, the government and knowledge institutes. This view is moderately reflected in literature, where the discussion focuses on a certain central actor.

However, some interviewees argue for a central actor as well. Some smaller retailers state that the retailers themselves are the largest change makers when it comes to innovation for closing the materials cycle. As these companies shape the assortment of garments and determine the eventual supply and what will be the product range, they have considerable influence on the process of introducing remanufactured garments and leasing in the market. Theoretically, these innovations can be supported by consumers through purchase and handing in used garments, providing a basis for the retailer to grow and become a frontrunner in the new development (RE-5, 2013; Witte Boorden, 2013b). However, there is also an argument that retailers try to keep up with the changing demand and trends by developing new concepts and products, and that they adapt to the demand of consumers (2Switch, 2013).

In another perspective, the consumer is seen as a central actor, for consumers shape the demand for new garments, new trends and innovative niches. It is up to recycling agents and knowledge institutes to connect other parties and stimulate cooperation. Retailers try to keep up with the

changing demand and trends by developing new concepts and products, such as the leasing system and remanufactured clothing (2Switch, 2013). An argument against the central actor status of consumers is that consumers only react to the available assortment, and they are nudged in a certain direction by marketing mechanisms such as price and position in the store. Also, retailers do not stop innovating when there is no current demand for a certain new product; if the new product is predicted to become successful, it will be introduced and promoted through marketing (CREM, 2013).



As seen, there is some discussion on the roles of the consumer and retailers as main actors, which is also reflected in literature. Besides this discussion, the government is specifically mentioned as being the most influential actor, which is not actively defended in the found literature. One interviewee states that the role of the government is central, for the government supports innovations towards closing the materials cycle and facilitates this innovation through subsidies, programs and cooperation with other actors (Texperium, 2013). In the whole discussion on central actors, it becomes visible that the views are in line with the type of organization which holds the specific view; in some cases, the actor sees its own kind of organization as the key actor and as the most influential actor.

## **7. Results III: Connecting circular business models**

In this third result chapter, the three found circular business models are connected to the conventional clothing recycling options from chapter 3. This combination will be visualised by a figure representing all possible material recycling options, including the ones which close the materials cycle. Then, found success factors and barriers for implementation of the circular business models are compared with the conventional recycling infrastructure.

### **7.1 Overview and favourability of options**

In this chapter, the previously described flows of the circular business models will be gathered and connected to the business-as-usual practices in one diagram, to show the different options for clothing after the use phase and the environmental favourability of each option. Then, this connection will serve as a basis for finding a ranking of how favorable each option is, in terms of possibilities for material recovery with minimal effort. In the diagram, it is important to note that there are several paths to take, depending on the decisions made by the involved parties. The involved parties for the shown decisions are designers, retailers and brand owners, and in one case the municipality or government.

*Figure 7: Overall material flow chart of all described business models and business as usual options (own research)*

The diagram shows the combination of different strategies, and the associated models are an outcome of taking a certain route through the model. The circular business strategy of leasing is not specified in the model, however it can belong to several paths: leasing can be attached to the path from the decision if the clothes are rewearable to the distribution/sales phase. It can also be connected to the path which follows the fiberization and reproduction step in the model, with the associated decision if the clothes are rewearable and if the retailer offers a recollection option.

When taking the different paths, there is a distinction between short cycles and longer cycles, and between favorable and less favorable options in terms of material recovery. The combination of these two factors shows the favourability of the possible options. As seen in the model, the least favorable options are coloured red; of these options, landfill and incineration is the least favorable. As there are several re-use or remanufacturing options for even non rewearable garments, the incineration is only favorable when no other option can apply. This can be the case for very heavily polluted garments. However, many Dutch households still throw away potentially reusable garments, and the local government does not separate garments once they are thrown away with normal household trash. As a result, the incinerated fraction is larger than necessary (de Vries, 2013).

A more favorable option is that of fiberization and production into other products, such as chair upholstery, isolation materials and related products. In this way, the material serves a new purpose in another product, but this product is generally of lesser material quality than clothing. In this sense, reproducing other materials from clothing is seen as downcycling. Another more favorable option is when rewearable garments are sent to developing countries to be sold there, despite the fact that materials from the used clothes in these countries cannot be recovered after a second round of wearing. The shortest and most favorable option from a materials perspective is the reuse after the first round of wearing, when clothes are rewearable, or repair and reuse if clothes are not rewearable.

## **7.2 Success factors and barriers**

Research revealed that there are some promising aspects for the development of circular business models. However, there are some restraints which are apparent for all strategies and for the development as a whole. In the initial research, it was expected that the role of consumers and the government would be different for each CBS or CBM. It turned out that the involvement of the government is aimed at closing the materials cycle for garments in general, and it is not specifically different for a certain CBS. The role of consumers is perceived to be similar for the different circular business models as well. Therefore, the influence of these two actors is discussed in same chapter.

### 7.2.1 Consumers

In general, consumer awareness on sustainability is increasing. People realize that products which are broken are not necessarily useless. Consumers in the Netherlands are usually willing to commit to sustainability (2Switch, 2013; RE-5, 2013). Research showed that Dutch citizens would like to see their recollected clothing being recycled or upcycled or that it is donated to charity (Fashion2, 2012). In addition, the group of consumers that connects sustainable consumption with a trendy personal lifestyle and identity is growing (DutchSpirit, 2013b). However, interviewees point out some doubts regarding the mindset of consumers on closing the materials cycle for garments in general:

1. Consumers still do not buy garments on the basis of sustainability issues alone. For the majority of consumers priority aspects are price, style and quality, not sustainability (CREM, 2013).
2. Consumers are prejudiced regarding sustainable clothing and pricing, for example that leasing garments is always more expensive or that sustainable garments are less fashionable (CREM, 2013).
3. There is ignorance among consumers on several aspects; they cannot distinguish different innovations from conventional clothing, and therefore do not make well informed choices (DutchSpirit, 2013b). Neither do they know about how the conventional fashion system works, how much waste is associated with clothing consumption, and how to contribute to a less wasteful clothing industry (Awareness Fashion, 2013). For example, many consumers do not know that also broken or worn out clothing can be handed in at retail stores (de Vries, 2013).
4. Possibly, the efforts needed for leasing garments and handing in used clothes at the retailer are too high for consumers, and they will not comply with these requirements (MVO Nederland, 2013; NVRD, 2013). However, this effort should be compared with the added value for consumers, and in that respect, it depends on the specific added value for the consumer to make the effort or not. For example, for returning clothes to a retailer, one has to go to the store with the used garments, which might be a bigger distance than the recollection bin on the street. At the retailer, the consumer gets a discount for handing in used clothes, while there is no reward if it is delivered at the recollection bin.
5. For leasing, it is deemed that it does not matter for the consumer if they pay for the product at

once or in monthly amounts. For it does not matter for what reason the clothing is handed in, as long as there is a personal gain for the consumer (RE-5, 2013). On the other hand, for high quality and expensive garments such as jeans and suits, the spread payment in the leasing system can be an advantage (Awareness Fashion, 2013).

6. Consumers may be emotionally attached to garments, and may be reluctant to hand them in or return them after the lease period has ended (2Switch, 2013). The idea of wanting to own a garment is associated with this emotional attachment, that there is a notion of ownership and control over the treatment of the products (DutchSpirit, 2013b).

There are several possible measures for helping reduce the different doubts. These measures focus on improving consumer awareness on the after-use options of non-rewearable clothing on the one hand and taking away prejudices about price and image of sustainable clothing on the other hand (Awareness Fashion, 2013). This has been done through a nation-wide campaign called Fashion2, in cooperation with several chain actors and the national government (Fashion2, 2012). Apparently, the campaign did not prove to the interviewees that the consumer prejudices or ignorance is taken away, although this assumption has not been directly tested. However, enlarging the publicity about retailers with innovative concepts such as leasing or selling reproduced clothing might increase the basis for consumption of these garments. This is mainly a marketing and branding aspect, which involved retailers need to perform (DutchSpirit, 2013b). NGOs should play a larger role in spreading information about the options for handing in used garments and buying sustainable garments.

A way to counter the preference of consumers to price and style of garments instead of sustainability efforts alone is to connect these factors. The remanufactures, leased or otherwise more sustainable garments must not be significantly higher priced, and the garments should fit current trends or be timeless basics which every consumer might appeal to (DutchSpirit, 2013b; Mud Jeans, 2013). Again, this is a task for the textile industry and retailers with a circular business model.

### 7.2.2 Government

Policymakers increasingly treat clothing as a separate waste stream within waste management policy. Apart from improvements for the production process and a shift to other fibers, the reuse and innovative recycling of fibers is an important aspect (Leijendekker, 2013).

The Dutch national government takes several measures to stimulate and support the development of circular innovations in the clothing industry. Firstly, it funds several projects such as the projects for developing the sorting machine (Textiles4Textiles, 2012). Secondly, Agentschap NL, being part of the Ministry of Economic Affairs, Agriculture and Innovation, supports the activities of Texperium and the cooperation between RE-MO and WE Fashion (RE-MO, 2013; TExperium, 2013). A third, large effort is the development of a consultation group on sustainability in the fashion and textile industry, the so called 'ketenoverleg verduurzaming mode en textiel'. With other parties in the chain and within the consultation group, Rijkswaterstaat coordinates a working group on textile recycling, aimed at optimizing the recycling possibilities for textile, and stimulating reuse (Dekkers, 2013).

The working group organizes several initiatives. Firstly, the consumer awareness and chain cooperation was stimulated through performing research and advice for municipalities, with workshops about textile recycling. A second effort from the working group was to demonstrate the innovative possibilities for recycling, together with Texperium. The demonstration showed what

can be produced out of used uniforms from KLM (Rijkswaterstaat Leefomgeving, 2013). A third effort was that the ministries of Infrastructure and Environment and Economic Affairs, Agriculture and Innovation set up the Green Deal on Textile Collection in 2012, together with thirteen other parties. The goal of this Green Deal is to diminish the part of textiles in household waste with 50% for 2015, compared to 2011. This 50% decrease equals 4,2 kilos of used textile per inhabitant per year, based on the current amount of 135.000 tons of textile waste per year. A part of this Green Deal was the Fashion2 project, in which several parties organized activities to increase consumer awareness on separating textile waste. In this project, the retailer as a recollection agent was mentioned, but there was no specific attention for the rewards for the consumer (Fashion2, 2012). One negative aspect of the national government activities is that the focus lies on innovations which can be profitable or converted to successful business. Therefore, other interesting innovations which are not directly marketable, will not be stimulated further (DutchSpirit, 2013b).

Municipalities have a very different role compared to the national government. Apart from a nation-wide imposed benchmark on clothing recycling and sustainability, which is not communicated openly, there is no control from the national government. Because the local recollection bins are managed by the municipalities, they have the possibility to pose a price on donated textiles. The second hand clothing companies and recyclers bid for the clothing, and the company with the highest bid is able to buy the batch. In this way, municipalities gain extra income (2Switch, 2013).

There are some negative aspects connected to the activities of the local government. Firstly, because local governments have a financial incentive for clothing recycling, smaller innovative companies with a weaker financial position cannot get hold of second hand clothing easily, for the commercial second hand and recycling companies can pay a higher price for the second hand batch. Secondly, as there is no incentive for municipalities to become involved in other processes of textile recycling, there is no attention for the further destination, circular innovation or optimal recycling of the clothing. Thirdly, the difference in perspective from the national and local government creates a missing link between the two governmental levels (2Switch, 2013).

### 7.2.3 Actor networks and cooperation

A first positive factor pointed out in the literature (van Koppen, 2004), is that there is an actor network which can influence the development positively: an informal network of active entrepreneurs starts experimenting with circular business strategies. As this research shows, such networks are indeed visible in the Netherlands to date. As van Koppen (2004) points out, a second success factor is the existence of close and long-lasting relations between chain actors and with governmental actors. For the larger retailers, cooperation between their organization and recycling agents is well established, and WE Fashion has set up a cooperation network for the remanufacturing and reselling of garments which were previously recollected in the store. The national government stimulates developments towards clothing recycling, as discussed in chapter 7.2.2. However, the local government does not actively facilitate innovation towards closing the cycle because of an interest in the revenue made from trade in recollected garments. The conventional recycling organizations are not affected, for they are often well established and powerful enough to pay a higher price for the batch of recollected garments, to donate or sell them in developing countries or remanufacture them into other products.

Another complicating factor for building strong networks for smaller retailers is that there are not many spinning companies willing and able to cooperate with retailers on mixing fiberized yarn for new garments. The smaller retailers are still in discussion with other actors along the chain to

cooperate on setting up a recollection and remanufacturing system. The knowledge institutes do not reach all smaller retailers and are not known among each other. Despite some starting initiative on cooperation between some retailers, they generally do not know of each other's experiments and ambitions. However, as the smaller retailers all serve different product ranges, there are possibilities for cooperation or knowledge exchange without a high risk on direct competition: Mud jeans offers mostly jeans for the Lease a Jeans concept, Witte Boorden offers white t-shirts only, Re-5 sells a large range of garments, and DutchSpirit sells tailor made suits as a main product. As the fiberization, remanufacture and reselling or leasing of garments is a joint ambition; there are possibilities for further contact.

Two other factors of success are not yet visible for any retailer or network, namely a relationship of trust between the initiators of change, and a common understanding of the common interest among the involved actors (van Koppen, 2004). As trust needs to develop over time and the smaller retailers are experimenting and starting new developments internally without being fully aware of each other's ambitions, there is no trust relationship yet. There have been some attempts to cooperate with larger retailers or larger recycling agents, but as they pursue their own goals towards generating revenue, these organizations are not trusted by smaller retailers (see chapter 5.2.2 on actors in remanufacturing). Common understanding and a shared sense of responsibility have not been established yet either, for the same reasons which are previously discussed.

#### 7.2.4 Materials, flows and technology

On the aspects of material flows and technology, one large promising development is the technology which makes it realistic to sort and fiberize use garments. This technology, discussed in chapter 5.2.4 can be applied on a larger scale, depending on the success of the current pilots. The fiberization and remanufacturing system operated with WE Fashion is the main example of a current pilot with selling remanufactured garments. Although the sorting machine and fiberization and remanufacturing system have been realized on a smaller scale, there are still technical and material related issues. The specific barriers for the aspects of each circular business strategy have been mentioned in the corresponding chapters, while some of these barriers are visible throughout the whole circular business model development. For materials and flows, the most influential barrier is the complexity of material combinations, which the sorting machine cannot recognize yet with the current technology. If these combinations cannot be sorted automatically, manual sorting has to be done, making the whole system less efficient and more costly. The fashion industry does not focus yet on the material complexity and there are no large scale initiatives to design garments out of one or two materials.

### **7.3 Recommendations**

For successful implementation of circular business models, some important aspects need to be taken into account. On the level of actors within the chain, it is important that knowledge on new technology and innovations is distributed in a more effective way, and that more cooperation is set up between the smaller retailers, and the other actors in the chain. Joint knowledge creation and exchange can be realized by setting up a platform specifically for redesigning the clothing sector for closing the materials cycle. This platform can connect knowledge institutes like Texperium, retailers with interest in circular business practices like the examples from the research, recyclers with ambition towards remanufacturing like 2Switch, branch organizations, and a governmental body such as Agentschap NL. Common goals need to be discussed and the common interest needs to be defined, which can be the development of a closed materials cycle for clothing in the Netherlands. The government needs to coordinate the municipalities and regulate conventional recycling

agents, to improve circumstances for garment fiberization and remanufacture, next to continuing the current activities such as Fashion2 and the Green Deals on material recovery.

Knowledge institutes, governmental organizations and retailers need to inform the consumer better about recollection of used garments and the purposes for remanufacturing, and the possibilities of selling remanufactured garments and leasing must be communicated better. A continuation of projects like Fashion2 can be suitable, together with campaigns from retailers, focusing on the advantages and environmental benefits of handing in used garments at the store, leasing, and buying remanufactured garments.

From a materials perspective, there is a need to design clothing to fit a purpose of fiberization and remanufacturing. This means that the design for recycling principles needs to be applied on a larger scale, especially for the retailers which are currently experimenting with the sale of remanufactured garments. As for technology, it is important that the current technological developments continue, and that there will be enough incentive and financial support from the organizations and companies involved.

## **8. Discussion**

### **8.1 Theory applicability and future research**

Because of the recent developments on circular economy and sustainable business models, few academic sources were available on these topics and the main sources on circular economy and circular business strategies were derived from documents from NGOs, businesses, and interviews. The circular economy and associated attempts towards achieving a closed materials cycle are a novelty and need to become more widespread and understood. This research is a first attempt to do so, however more knowledge is needed on the consumer perspective, the ambitions and actions from large retailers, and the possible cooperation and knowledge exchange on the level of the whole clothing production chain. For following research, a suggestion is to explore the vision of consumers on concepts such as remanufactured garments and leasing. In this way, better predictions on the success of these concepts can be given, considering the small visibility of the innovations in the current clothing market.

When combined with a value creation aspect, the used triangle approach from van Koppen (2004), using flows, technologies and actors, was proven to be useful as a framework. As the main aspects of an innovation are discussed separately, and social as well as technical aspects are combined, the triangle approach takes all large factors into account. The value creation aspect was particularly important to reflect the business perspective and the ambition of private companies such as retailers to create extra value for their own organization as well as for consumers. The research suggests that this framework can be applicable for analyzing business strategies and models in other industries as well, with the remark that for some business models, the technology factor must be omitted, which has been the case for leasing and selling remanufactured garments. Despite the usefulness of the applied framework, there are some remarks on the completeness of the analysis. As stated in the introductory chapter, a materials perspective was taken, with material recovery as a main criterion for determining the most favorable options for used clothing. Energy use was not taken into account, neither were the costs associated with implementing a circular business strategy or model. A cost benefit analysis could be useful for determining the economic feasibility of such a strategy, with a possibly different outcome.

Useful observations on actor characteristics for success are provided by van Koppen (2004). These observations are useful as well for this thesis as there is a large system with several actors involved in the reshaping of a clothing industry through specific sustainable business models. The observations are thought to be transferrable from industrial parks to product chains, shifting the focus on a geographical area to a less geographically defined field of sustainable innovations, among which circular business strategies are categorized. The other observations on central actors proved to be useful as well, the discussion in the literature being reflected by the interviewees.

The dependency reduction theory from Boons (2002) states that organizations reduce dependency on other organizations by producing raw materials themselves or reducing necessity of the resource. This can be seen in a modified version in the business strategy of fiberization and reproduction; the necessity of virgin raw materials is reduced. However, retailers do not gain control over the production of fibres from used garments; other companies are in charge of this process. Here, dependency is not reduced but it is shifted to other organizations. The theory on the alteration of a supply chain, as given by Seuring (2004), seems to be applicable to the business models involving remanufacturing and leasing of garments. The alteration of the supply chain is not needed when only recollection takes place. Drivers and barriers vary along the different circular business strategies and models. Both barriers from Jonker et al (2012) are partly confirmed; as the national government does facilitate material recovery innovations and the local government does not, it cannot be stated that the government in general is not supportive. The second barrier from Jonker et al is that a shift in paradigm must be set in motion in order to normalize the new business models, which is hard as it encompasses the values of a whole society when all these actors and stakeholders are taken into account. However, as this barrier is countered by promising examples and developments from the clothing industry, the barrier is present but can be overcome by front runners and actors which are currently committed to closing the materials cycle.

## **8.2 Limitations of the empirical research**

When performing the actual research, it appeared that only one third of approached interviewees were willing and able to take time for an interview. This appears to be a sufficient number for gathering data for the results, but it would generate more useable data if it was possible to also interview more of the investigated retailers or to interview other retailers with a circular business incentive. In general, a larger number of respondents would have generated more useable information on the drivers and barriers for circular business models and the (expected) cooperation with other actors in the chain. Especially an NGO or a branch organization could add information on their role in the development of circular business models. The availability of data other than interviews was less than expected, probably due to the uncertainties related to the actual development of a circular economy, and the novelty of circular business models in the clothing industry in the Netherlands. This problem also occurred with interviewees; not all of them were familiar with the concept of circular economy and the associated technology and actor relations.

## 9. Conclusion

The main question for the research was the following: *What are the characteristics of, and possibilities for circular business model incentives in the clothing industry in the Netherlands?*

Four distinctive sustainable business strategies were found: recollection by retailers, remanufacturing into new garments, reselling and lease. As for recollection of garments, it depends on the retailer, which follow-up measures are taken to further close the materials cycle, if any active follow-up measures are desired. H&M and C&A are not involved in any other efforts other than recollecting the garments, after which the conventional after-use options apply. This creates doubt on the final contribution to a totally closed materials cycle, as these two retailers do not put any effort into preventing the recollected garments to be sent to developing countries or recycled into other products, while these options are less favorable in terms of material recovery. As for the other five retailers, more extensive measures are taken, which are accompanied by changing into a different value transfer, actor configuration, material flow and technological input. Two main technological innovations accelerate possibilities for remanufacturing into new garments and the associated leasing and selling of these garments; the automated sorting process and the advanced fiberization techniques. Despite some technological barriers, these technologies are perceived to be promising and a solid basis for further exploration of circular business models.

The four circular business strategies can be combined into three models: recollection only, all strategies except leasing, and all four strategies combined. The added value for retailers differs for each model. The ethical motivation is mentioned for all models, as well as the ambition to become a frontrunner and fill a new niche market. The retailers only performing recollection state that there is no direct profit generated from the recollection. However, findings suggest that image improvement and sustainable branding are underlying motives. An added value of remanufacturing and selling remanufactured garments is possibly to decrease dependency on raw materials.

Barriers mainly arise from the interaction with other actors along the chain in the after use phases, mainly because of profit intentions and a fashion industry which focuses on fast fashion and the large scale choice for hardly workable materials. As for interaction with and the role of consumers, it is unsure what the success of the circular business initiatives will be. It is likely that the effort needed to hand in garments at the retailer, or buy or lease remanufactured clothing is outweighed by the associated benefits for the consumer, such as a discount on new clothes or a spread payment in the case of leasing. However, the possibilities for consumers to hand in garments and to buy or lease remanufactured clothes need to be communicated better to consumers.

As interviewees show competing views on central actors, it is not certain which of the main actors is perceived to accelerate change the most. It seems that the most weight is put on the efforts of retailers for starting new initiatives, supported by innovative recycling agents, the government and knowledge institutions for creating actor networks and providing knowledge and technical innovation. Then, the eventual success of a circular business model depends on the market, the spreading of information from knowledge NGOs and the influence of consumers which need to put effort into taking back used garments and buying or leasing remanufactured garments.

When comparing conventional after-use options with circular business initiatives, there are some interesting remarks regarding favourability of each option. It appears that direct reuse by other consumers is the most efficient for material recovery, followed by a second hand store as a step

between the first and second round of rewearable garments. For more expensive and durable garments, leasing can be a good alternative for buying, if the rewearable garments return to consumers in the Netherlands. If garments are not rewearable anymore, the most favorable option for material recovery is to fiberize and reproduce the fibres in to new yarn for garments.

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