AALBORG UNIVERSITY
STUDENT REPORT

PRODUCT AND MATERIAL REVALORIZATION
in the circular economy

LESSONS LEARNED

EDWARD VINGWE

Supervised by Prof. Arne Remmen
Aalborg University

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ABSTRACT

This thesis explores how circular business models aimed at product and material recovery for revalorization are approached within the fashion and furnishing sectors. Two of the companies operate within the fashion sector and the other two, within the furnishing sector. The exploration focuses on first and foremost, how these companies deal with the interconnectedness of the economic, social and environmental aspects in terms of sustainability in their pursuit of the triple bottom line as an *entirety*. Secondly, the goal of this exploration aims at collecting experiences and lessons learned by the four investigated companies. Since companies are indulged to go beyond their boundaries when approaching circular business concepts, issues related to networking and partnerships have been explored as well.

Primary data has been collected through semi-structured interviews with persons responsible for sustainability in the four investigated companies. Data analysis has been used for the introduction and conceptual framework. Data from the companies' official websites have been used for cross references as well. Grounded theory has been applied as an iterative process to gain a deeper understanding of the investigated phenomena.

Currently, there is growing need to shift from the current linear economic system due to resource depletion, environmental and social impacts associated with the current make-use-discard linear way we create value nowadays. Climate change, toxic chemical substances that are hazardous to society and environment and loss of biodiversity are among the major concerns of linear economy. Moreover, scientific studies forecast that resource prices will increase within this 21st century. Currently, policy makers, societies and businesses are striving to find and implement possible solutions to the aforementioned concerns. In December, 2015, circular economy was proposed by the European Commission as an optimal substitute of linear economy. Currently, there is a growing interest towards circular business models aimed at product and material recovery for revalorization most especially, among companies. However, although there is such a growing interest for circular economy, circular business concepts are still emerging, therefore new. Additionally, based on my experiences from working with companies on transition to circular business models, there is also a growing need to share experiences within circular economy.

This thesis has focused on collecting experience and lessons learned within product-service and take-back systems as emerging circular business models for product and material recovery for revalorization. The finding of this thesis are not be generalized because each of the investigated companies are unique and should perceived likewise. However, the findings of this thesis may benefit some of the companies I work with and probably, may also point out some of the prerequisites for circular economy for other interested stakeholders such as policy makers and etc.

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1 INTRODUCTION

Success in doing business has been measured entirely upon sales volumes i.e. the single bottom line in other words, financial profitability. Aimed at boosting economic growth, planned obsolescence has ever since the Great Depression become the way of designing services and products (Fitzpatrick, 2011). The core of planned obsolescence promotes techniques that aim at calculated design for obsolete products that don't last (ibid). Companies have therefore, strived to designing for planned obsolescence, which has become the most predominant and well-established way of designing services and products (Braungart & McDonough, 2009). However, the make-use-discard due to design for planned obsolescence has had two direct drawbacks. Such drawbacks as the depletion of finite resources and generation of significant volumes of valuable but not revalorized waste (Braungart & McDonough, 2009).

Further, scientific research has for long, consistently warned of both short and long term, direct and indirect negative impacts on ecology due to the current linear economy, the use of non-renewable resources and toxic chemical substances (Carson, 1962); (World Commission On Environment and Development, 1987). Climate change and ecotoxicology are among major impact categories experienced today. Societies are moderately reaching a consensus with science that the current linear economy bears significant negative impacts on the environment and society (European Commission, 2015c). 195 countries adopted the Paris Agreement aimed at combatting climate change by acting on environmental and social impacts (ibid). Moderately, sustainability discourses nowadays deal with finding ways of achieving the triple bottom line in the way we create value.

The triple bottom line strives to optimize the financial, environmental and social profitability as an *entirety*- a new measure of success in doing businesses today. Thus, companies have to strive to be the best at continuously optimizing the triple bottom line as an entirety. However, the three elements of the triple bottom line are interlinked and interconnected thus, making sustainability a complex system that should be approached likewise. Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce desired effects (Arnold & Wade, 2015). According to Arnold & Wade, (2015), these skills work together as a system.

Therefore, systems thinking towards sustainability from a company viewpoint, demands a whole new set of skills. Such as disruptive business model innovations that seek to interlink and interconnect the financial, environmental and social profitability for a new economic growth. The status quo by 2012 showed that 70% sustainable practices concentrated within factory while 28% on product and 0% on systemic sustainability (Adams, Jeanrenaud, Bessant, Overy, & Denyer, 2012). Since then however, there have been new developments towards circular economy.

Circular economy displaces the cradle to grave with cradle to cradle, a lifecycle thinking towards sustainability. Cradle to grave is when services and products are designed without pre-calculating material recovery for revalorization at end of use. On the contrary, cradle to cradle strives to design services and products for their efficient recovery and revalorization at the end of use (Braungart & McDonough, 2009). Ensuring the elimination of eco-toxic chemical substances and optimized product and material circulation, principles of circular economy are built upon the principle of biological metabolism (Sempels & Hoffmann, 2013). Through biomimicry- mimicking the biological processes, services and products are intentionally designed to suit either the biological or industrial metabolic principle (ibid).

As a regenerative economy, services and products in circular economy are therefore, designed either to return to the biological nutrient cycle or technical nutrient cycle. Biological nutrient cycle deals with 100% biodegradable resources while the technical cycle deals with optimizing recovery and revalorization of resources that cannot fully and easily biodegrade. Business concepts developed out of circular economy thinking include repair, reuse, remanufacture/refurbish and recycling.

While creating 580,000 jobs, reducing 450 million tons of CO_2 emissions by year 2030, the EU new circular economy package is estimated to generate €600 billion savings from material recovery for reuse, repair, refurbish/remanufacture among others (European Commission, 2015a). Although a resuscitated concept, product and material recovery for remanufacturing are increasingly becoming a significant aspect within the EU manufacturing industry. With supportive governmental policies and industry investments, remanufacturing has potential to generate €90 billion within the EU market and create 600 000 jobs by 2030 (Parker, et al., 2015). In Denmark, remanufacturing within the fashion and furnishing sectors together with three other sectors, is estimated to generate DKK 2.3 billion i.e. 0.15% of the national GDP (Incentive, 2015).

I have worked with three Danish fashion and furnishing companies. During the last semester, I worked on finding possible approaches and strategies for Mogens Hansen's furniture take-back system. Currently, I am assisting with conceptualizing business models for product and material recovery for EverRest ApS - a memory foam mattress manufacturer based in Aarhus. However, as the central case study, also representing best practice, I have worked with Better World Fashion, a start-up company that has recently launched its disruptive circular models. Better World Fashion manufactures a sustainable leather jackets brand from old leather, recycled plastic and aluminium that had otherwise become waste. The direction of this master thesis is based on experiences noted from these business cases.

This master thesis explores circular business models that aim for both the inner and the outer circles within the fashion and furnishing companies. The exploration will focus on systems thinking approaches, experiences and lessons learned by four companies that have implemented product- service systems and take back systems. Their business models will be presented in order to have an understanding of, how the triple bottom line is achieved throughout the value creating activities. Business models describe the rationale of how organizations or companies create, deliver, and capture value (Osterwalder & Pigneur, 2010).

Product-service systems (PSS), take- back systems (TBS) are business models of interest in this research. However, industry symbiosis is another field of interest. As part of industrial ecology, industrial symbiosis is based on feasible sustainability principle that waste for one company may become valuable material for another (Jacobsen, 2006). According to Jacobsen, (2006), industrial symbiosis is a collective sustainability approach that optimizes resources among co-located companies. The collective incentives of industrial symbiosis from a company viewpoint, has to be understood in terms of the economic and environmental performance of an individual company (Jacobsen, 2006). Initially however, industrial symbiosis has mainly focused on material exchanges among companies (Posch, Agarwal, & Strachan, 2011). Discussions within the field of industrial symbiosis have often ignored the initial social interrelations aspects that build the trust between companies which most often, is an initial step to mutual partnerships (ibid). One of the outcomes from the last semester project which investigated take back systems for Mogens Hansen initiated a mini industrial symbiosis. Leather cuttings that would otherwise, become waste at Mogens Hansen are now shared between Better World Fashion and Strunk. Therefore, as a build-up, this master thesis also seeks to observe what kinds of partnerships exist and what aspects of industrial symbiosis play roles in circular business concepts development.

Primary data has been collected from a study tour in Denmark and The Netherlands. Experiences by Better World Fashion, MUD Jeans, Royal Auping and Royal Ahrend has been collected. Secondary data from official homepages of these organizations also served as points of departure and thereafter were used as for cross-references and supplements.

Aware of that circular economy is a new paradigm shift, the main goal of this master thesis is to explore experiences and lessons learned by the aforementioned companies. This master thesis is not a comparison of these companies. For the reasons to be discussed, each of these companies is unique and therefore, the findings are not to be generalized.

2 BACKGROUND

This master thesis is inspired by Sustainable Production (SP) 3.0 research program at Aalborg University and the participating companies. SP 3.0 has provided a platform from which close collaborations with companies such as Mogens Hansen Moebler, Better World Fashion an EverRest ApS were depicted. All three companies are aiming at the circular business concepts for product and material recovery for revalorization. Collaborations with these companies have supported and specified the work related to this master thesis. For the benefit of the three companies, this master thesis has focused on approaches and lessons learned within the fashion and furnishing industries.

2.1 MOGENS HANSEN

Based in Aarhus, Mogens Hansen specializes in manufacturing durable Scandinavian handmade furniture. The main research question for Mogens Hansen aimed at exploring possible strategies for a take-back system suitable for its furniture. However, the primary goal for Mogens Hansen was to recover its wooden frame for remanufacturing. Notwithstanding the primary goal, finding potential users for the rest of the materials recovered became an inevitable question. Cushion foams, textile and leather upholsteries were among the prospective recovered materials that the company was incapable of reusing at that moment. The idea behind this master thesis was thus conceived from an attempt to finding organizations that could upcycle some leftover materials from Mogens Hansen. Unlike the traditional recycling or down-cycling, upcycling refers to remanufacturing products/services of a higher value from the reuse of materials that would otherwise, become waste.

Findings that indicated symbiotic material revalorization possibilities for Mogens Hansen's take-back system pointed towards Lifestyle and Design Cluster's Tekstilmølle, Advance Nonwoven, LIND DNA, Strunk and Better World Fashion all co-located in Denmark. Although this cluster seemed ideal, its exploration remained outside the perimeters of the goals of this thesis. However, new developments towards sharing materials have been initiated among Mogens Hansen, Strunk and Better World Fashion.

2.2 BETTER WORLD FASHION

Towards the end of the last semester project, Better World Fashion, one of the participating companies in SP 3.0, was about to launch its start-up campaign on Kickstarter. Based in Aalborg, Better World Fashion manufactures sustainable leather jackets of high value in terms of slow but high quality fashion. The company manufactures its leather jackets by upcycling old leather that would otherwise, become waste. The company offers its clients both leasing and buy-back scheme.

The primary tasks initially involved highlighting, scaling and communicating sustainability issues associated with leather and fashion industry. However, later tasks involved start-up fund applications, further conceptualization and optimization of the company's circular business concepts. These latter tasks sought to spar and prepare the company for clearer, simpler but tighter systems-thinking. After a 104% successful launch on Kickstarter, I was offered further tasks by SP 3.0, to assist yet another company, EverRest.

2.3 EVERREST

Based in Aarhus, EverRest manufactures polyurethane (PUR) based memory foam mattresses and pillows. The company is currently aiming at cascading use through either TBS /or PSS or both. Therefore, the primary task for EverRest has in the first run been to define the sustainability aspects associated with PUR memory foam mattresses with focus on raw materials and environmental chemistry. Secondary tasks have involved conceptualizations of TBS and PSS business models.

From close collaborations with these three companies, three consistent questions have indicated the need for sharing both technical and material resources in the development of circular business concepts. Generally, discourses within the Danish Industry indicate the need for more collaborations:

» […] In Sweden producers are very good at collaborating; we still have a lot to learn from that in Denmark. We need to be more involved in networking and be less afraid of opening up the bag. « (Morten Lind, Director at Innovation Randers A/S, 2016).

Source of quotation: (Lifestyle & Design Cluster, 2016)

3 PROBLEM FORMULATION

This master thesis seeks to explore state of the art of how companies are approaching systems thinking and circular business models aimed at product and material recovery for revalorization within fashion and furnishings companies. The exploration will focus on systems thinking approaches, experiences and lessons learned by companies that have implemented product-service systems (leasing) and take back systems. This master thesis therefore seeks to explore the following questions:

- How are systems thinking and circular business models aiming at product and material revalorization with the fashion and furnishing companies approached? In order to understand the companies' experiences, the following sub-question will be explored
    - What are the lessons learned?
- Additionally, partnerships established out of the circular business concepts will be observed. The observation will seek to answer the following sub-question:
    - If any, what kinds of partnerships and potentials exist within the investigated companies

4 METHODS AND THEORIES

Primary data through interviews to answer the aforementioned questions have been collected through a grand tour in Denmark, Sweden and The Netherlands. Additionally, secondary data through official homepages of the targeted companies have served as points of departure and cross references. In order to get first-hand understanding of the experiences and lessons learned, primary data has been the predominant method. Primary data has been preferred because it known as the richest, most reliable, valid and credible sources in qualitative research (Bryman, 2012). Primary data has been collected from the following persons holding a relevant position in each of the investigated companies.

Semi-structured interviews were conducted. Unlike structured, the open questions in semi-structured interviews create a more flexible atmosphere and interaction between the interviewer and interviewee (Bryman, 2012). Open questions allow space for storytelling which in turn, may provide a deeper insight of the subject being studied(ibid). Additionally, by meeting the relevant interviewees in person has initiated an atmosphere, where follow-up questions have been responded quicker. This process is inspired by Grounded theory. As an iterative process, grounded theory enables analysts to get more and more grounded in the data thereby increasingly develop richer concepts and models of how the case being studied really works (Charmaz, 2000). That being said, document analysis has been used in the introduction and conceptual framework.
Further, this exploration is a collection of state of the art systems-thinking, business models and lessons learned during the current paradigm shift from linear to circular economy. The case studies have been selected for this purpose and therefore, not generalized. Since circular economy and circular business models are new concepts, the knowledge generated may be useful to some companies and policymakers, especially in these preliminary stages of the paradigm shift. Additionally, this master thesis is also inspired by Bent Flyvberg viewpoint:

» Within a given context, a detailed examination of a single a case study cannot provide reliable information about the broader class. However, it may be useful in the preliminary stages of an investigation since it provides hypotheses which may be tested systematically with a larger number of cases. « (Flyvberg, 1991).

5 CONCEPTUAL FRAMEWORK

This chapter briefly presents the principles and sources of value creation in circular economy. Sustainable business model archetypes of sustainable business models reciprocal to the sources of value creation in circular economy will also be presented.

5.1 CIRCULAR ECONOMY, PRINCIPLES, SOURCES OF VALUE CREATION AND SUSTAINABLE BUSINESS MODEL ARCHETYPES

Circular economy displaces cradle to grave with cradle to cradle conception of sustainability. Cradle to grave is when services and products are designed without considering revalorization at the end of use. To the contrary, cradle to cradle strives to design products with the intention of maximizing the utility capacity of products and materials during and after end of use (Braungart & McDonough, 2009). Ensuring the elimination of eco-toxic chemical substances and iterative product and material circulation, principles of circular economy are built upon the principle of biological metabolism (Sempels & Hoffmann, 2013). Through biomimicry, services and products are purposely designed to suit either the biological or industrial metabolic principle (ibid).

1. The Biological metabolic principle: aims at designing products that are 100% biodegradable (Sempels & Hoffmann, 2013). The primary intention is that materials return to the biological nutrients at end of life (ibid). A T-shirt made from organic cotton can be designed in such a way that it is 100% biodegradable and therefore, return to the biological nutrient cycle (Sempels & Hoffmann, 2013). Best examples include Rohner Textil AG (Hartman & Werhane, 2009) and Radium Foam (Starmans, 2016) .

   Rohner Textil is a Swiss company that manufactures a biodegradable textile brand known as Climatex Lifecycle (Hartman & Werhane, 2009). For many years, Climatex Lifecycle has gained popularity within sustainable furniture upholstery (Hartman & Werhane, 2009) pp.360-376. Climatex Lifecycle which is also C2C certified, is extensively used by among others, Steelcase, a cradle to cradle certified US based furniture company (ibid). Still within the furnishing sector, based in The Netherlands, Radium Foam is a company that uses the design for biological metabolic principle. With its Vita Talalay sustainable mattress brand, the company uses 100% biodegradable natural latex which is C2C Gold Certified (Starmans, 2016); (Radium Foam, n.d.).

2. The Industrial metabolic principle: Also referred to as the technical metabolism, aims at ensuring optimum product and material recovery for the revalorization of resources that are not 100% biodegradable (Sempels & Hoffmann, 2013). In order to ensure resource efficiency, the industrial metabolic principle strives to prolong use of products and materials through for instance, eco-design, design for durability and design for easy disassembly and assembly (ibid). Design for easy disassembly and assembly enables optimal product reuse and repair thereby prolonging the products' lifetime within the inner circles (see figure 1 below) (McDonough & Braungart , 2013); (Sempels & Hoffmann, 2013) . Additionally, and also related to the outer circles, design for easy disassembly enables efficient material recovery for remanufacturing/refurbishing, upcycling and proper recycling (ibid). According to Sempels and Hoffmann, (2013), enabling these possibilities increases resource efficiency, as these optimize recovery and utility capacity of products and materials.

   A good example is Steelcase (Sempels & Hoffmann, 2013). Through material recovery, Steelcase's take-back system has enabled 99% reusability and recyclability of its ground-breaking chair, The Think Chair (ibid). Some bed and mattresses companies such as Royal Auping has followed. In the Danish fashion

industry, Better World Fashion collects old leather, recycled aluminium and plastic bottles in the remanufacturing of its brand of sustainable leather jackets (BWF, 2016).
That being said, the principles of circular economy can be understood illustratively as summarized in the following "butterfly" diagram in figure 1 below

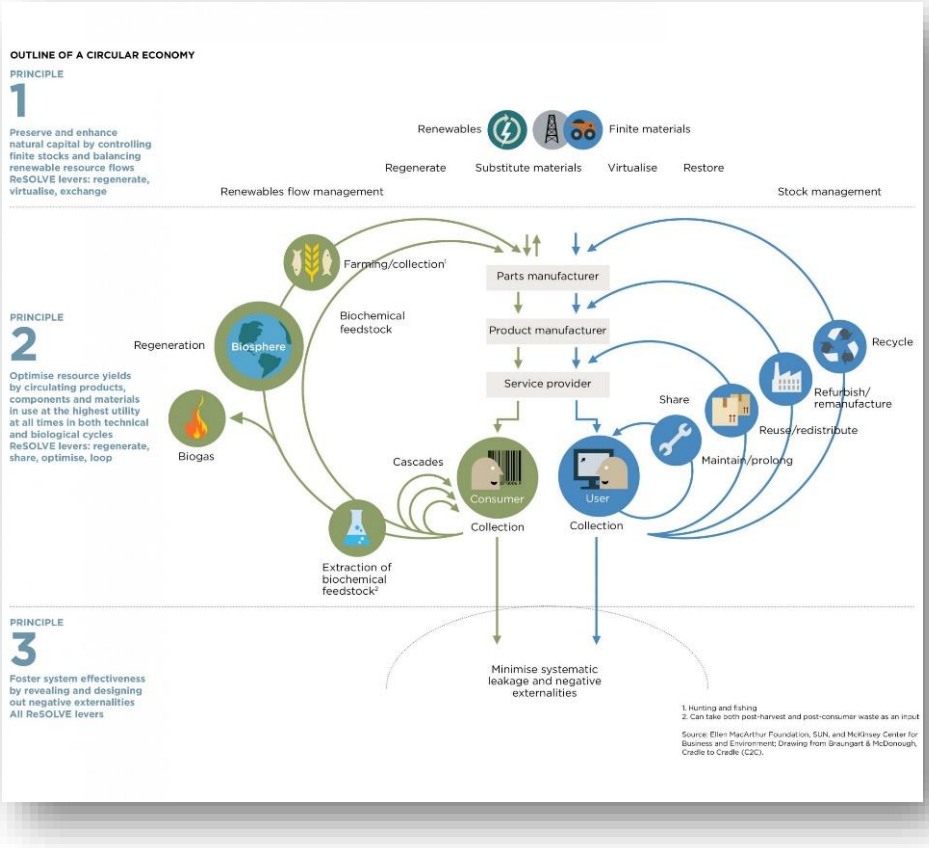

Figure 1. Modified after (Ellen MacArthur Foundation, 2015b)

From a business perspective, circular economy offers four sources of value creation:

- Power of the inner circle: Aims at designing products so that they can be easily maintained and repaired either by user or repair shops (Sempels & Hoffmann, 2013). The easier the maintenance and repair processes, the faster the product returns to into reuse i.e. the tighter inner circle (ibid). The tighter inner circles represent significant savings in relation to intensive labour, energy, material and logistics requirements if the product has go all the way to outermost circles for repairs, refurbishments and remanufacturing (Sempels & Hoffmann, 2013). Further, according to Sempels and Hoffman (2013), the tighter inner circle reduces product's externalities costs such as greenhouse gas emissions, water consumptions and toxicity. From a business and sustainability perspective, studies have shown that business innovations aiming at designing for the power of the inner circle are often more profitable. According to Walter Stahel, this is due to a profit maximization axiom- an unwritten law which says that

»… the smaller the loop, the more profitable and resource efficient it is. In other words, don't repair what is not broken, don't remanufacture what can be repaired, don't recycle what can be remanufactured. « (Walter Stahel)

Source of citation: (Ellen MacArthur Foundation, 2015a)

Stahel's observation is based on that the further the product goes further out of the inner circles the costlier the revalorization becomes. In simple terms, there are costs involved in repairing and the costs increases as products move out of the inner circles for refurbishment or remanufacturing, for example.

- The power of circling longer: Aims at increasing the number of consecutive cycles of reuse, repair, refurbish/remanufacturing, recycling and/or increasing the time in each cycle (Ellen MacArthur Foundation, 2014). This has been studied to be more suitable for durables - products and materials that last. Through for example, design for easy disassembly, materials from durables can be used interchangeably as spare parts (Guldmann, 2016). Additionally, the power of circling longer also applies to consumables- products with high rates of disposal, such as packaging materials, aluminium cans and glass bottles. Unlike glass bottles, aluminium cans are used only once before recycling. Notwithstanding that at the rate of 50% recycling, all aluminium is lost after 17 recycling loops (Guldmann, 2016). However, aluminium cans have greater potential to be more sustainable than bottles if hypothetically, the recycling rate is increased to 90% (ibid). At this rate according to Guldmann, (2016), aluminium will be lost after 35 recycling loops. Note that glass bottles are used 27 times before recycling (Stahel, 2010). Further interchangeable components in durables can be used as spare parts for defect products or used as upcycling materials in other industries; industrial symbiosis.

- The power of cascading use: aims at design for optimum product and material recovery for either refurbish, remanufacture or upcycle in the outermost circle (Sempels & Hoffmann, 2013). As illustrated in figure 1 above, the power of cascading use aims at remanufacturers- producers (Sempels & Hoffmann, 2013); (Ellen MacArthur Foundation, 2015b).

- The power of pure circles: aims at optimizing the collection and redistribution of uncontaminated material streams, most especially, those in the technical cycle (Sempels & Hoffmann, 2013). In contrast to biological material streams, technical materials have greater potential of maintaining quality over a long period of time (ibid). Design for durability and easy disassembly may enable and optimize the collection of technical materials which in turn, may be redistributed either within the same economic cycle or across (Sempels & Hoffmann, 2013). This prolongs the product/material lifetime thereby increasing material productivity (ibid).

  That being said, remanufacturing costs 40-60% less than the primary manufacturing (Knowledge Transfer Network, 2014). Additionally, the selling prices of remanufactured products are reported to be within the range of 30 and 40% less than those of primary manufactured products (ibid). Moreover, while offsetting 800000 tonnes CO_2 emissions annually, remanufacturing saves 85% in contrast to energy consumptions incurred in primary manufacturing (Steinhilper, 2006).

Derived from its principles, circular economy can be viewed as a regenerative concept of sustainable business development that aims at systematically achieving the financial, environmental and social profitability as an entirety by improving resource efficiency and by rethinking the traditional business model. Circular economy can be understood as an economic system that encompasses resource efficiency and optimized resource circularity within two interconnected levels as follows:

1. *SOCIETAL* Level: how society organises *ECONOMY* also in terms of good housekeeping of resources in society and;
2. *BUSINESS* Level: how businesses organise themselves to recapture value during and after end of product use as part of the transitional societal change in terms of sustainable value proposition. Such sustainable value proposition through which companies perceive themselves as part of the societal change through for instances, a shift from selling windmills to selling sustainable energy systems or from merely selling clothing to selling services such as slow fashion through leasing or take-back systems. This is the level that this thesis focuses on. At this level, this thesis focuses on circular business models aimed at recapturing value either during use (inner circles) or at end of use (outer circles) or both as a point of departure. However, other interconnected business activities such as partnerships and networks established to support these circular business models are also focussed on. In terms of circular business models aimed at product

and material revalorization, inspirations have been derived from the sustainable business model archetypes summarized by (Bocken, Short, Rana, & Evans, 2014). See figure 2 below

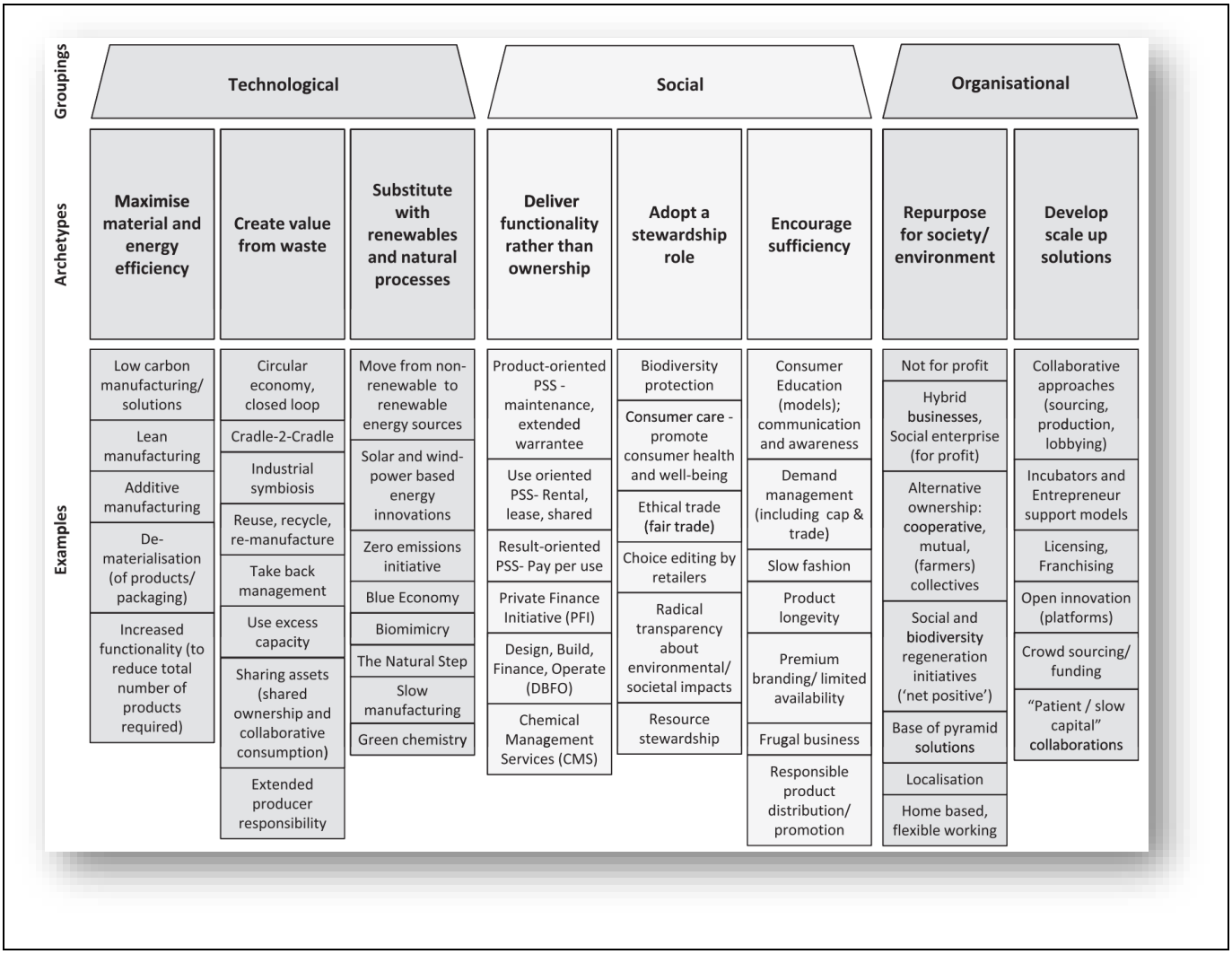

Figure 2: Sustainable business model archetypes. After (Bocken, Short, Rana, & Evans, 2014) p. 48.

As shown above, classified into technological, social and organisation, there are eight different sustainable business model archetypes. However, two sustainable business model archetypes have been of great interest for the purpose of this thesis and these are:

- Create value from waste: as the name implies, this sustainable business model archetype aims at one hand, turning waste streams into useful and valuable input to other production thereby optimizing the utility capacity of materials and on the hand, eliminating waste (Bocken, Short, Rana, & Evans, 2014). While assimilating the natural metabolic principle where waste does not exist, this business model archetype is sustainable in terms of increasing resource efficiency, reduction of waste and emissions associated with the productions of virgin materials (ibid). By closing the material loop, creating value from waste aims at reducing the industrial environmental impacts by disrupting the continuous demand of virgin materials (Bocken, Short, Rana, & Evans, 2014). Cradle to Cradle, industrial symbiosis and take-back management are among the examples within this archetype (ibid). Also defined in the early stage of this chapter, cradle to Cradle aims at incorporating the idea of the closed loop technical nutrient cycle with that of a biological open loop (Bocken, Short, Rana, & Evans, 2014). As a solution oriented process, industrial symbiosis also

defined in Chapter aims at turning waste outputs from one process into inputs for another process or product (ibid). In terms of take-back management as the name implies, is a sustainable business through companies intentionally re-organise their value creating activities with an aim to recover and recapture its products/materials' value at end of products' use (Sempels & Hoffmann, 2013). The other archetype of main focus in this thesis is the delivering value rather than ownership.

- Deliver functionality rather than ownership: this sustainable business model archetype aims at shifting product ownership from the user to the producer (Bocken, Short, Rana, & Evans, 2014). Through this archetype, the producer delivers functionality of the product on pay-per use- basis rather than selling ownership of the product (ibid). The producer therefore, remains the owner of the product thereby ensuring product and material recovery for product reuse or material revalorization (Bocken, Short, Rana, & Evans, 2014). The producer takes the responsibilities of ensuring consistence in the product's performance whereas, the user benefits from not bearing the costs associated with product ownership such repairs, etc. (ibid). In better alignment of the needs of the customers (societies) with that of the producer, this archetype is studied to have the following potential benefits:
    - It breaks the link between profit and volume of production (Bocken, Short, Rana, & Evans, 2014);
    - It can result into reduction of resource consumption (ibid);
    - It can motivate by offering manufacturers opportunities to deal with issues associated during and after use of the products (Bocken, Short, Rana, & Evans, 2014)
    - It optimizes use efficiency (ibid)
    - It optimizes product longevity and durability (Bocken, Short, Rana, & Evans, 2014) and;
    - It encourages product reuse (ibid).

  Examples of within this archetype as showing in figure 2 above include user oriented product-service service system such as leasing (Bocken, Short, Rana, & Evans, 2014).

That being said, this thesis has focussed on user oriented product-service and take- back systems. The following companies have selected as case studies because first and foremost, they implement either both or one of the aforementioned business models. Secondly, these case studies represent a suitable combination suitable for the purpose of this thesis. Thirdly, most of these case studies have been featured as best practices by significant circular economy platforms such as the Ellen MacArthur Foundation and Cradle to Cradle Institute among others.

6 BEST PRACTICES- THE STUDY TOUR TO THE NETHERLANDS

6.1 MUD JEANS

This chapter presents a brief history and company description of Mud Jeans. System-thinking, state of the art experiences and lessons learned from its product-service and take-back systems will also be presented. Primary source is an interview with Bert van Son, CEO and owner of Mud Jeans

6.1.1 Brief history and company description

Mud Jeans is a Dutch fashion brand with its headquarters in Almere in The Netherlands (Bert van Son, 2016a):

» We are new founders […] the company started in 2008, actually not so far away from here. They (the previous owner) did something within sustainable practices such as responsible factories and organic cotton […] « (Bert van Son, 2016a).

However, the company became insolvent and Bert bought the company, inventory and stocks from the curator in 2012 (Bert van Son, 2016a).

Mud Jeans now uses and upcycles organic cotton into denim jeans, shirts and T-shirts, jumpers, vintage, cardigans, bags and beanies of higher triple bottom line value for men and women (Mud Jeans, 2016a). See figure 3 below for some of Mud Jeans denim brands

Figure 3. Mud Jeans sustainable brands. Modified after (Mud Jeans, 2016a)

Mud Jeans is renowned for its disruptive business model innovation (Bert van Son, 2016a). Uniquely differentiating itself on the global market, Mud Jeans offers both product-service and take-back systems for all its denim jeans (ibid).

Prior to buying the company, Mud Jeans was already a sustainable brand working with organic and eco-certified factories only (Bert van Son, 2016a). For Bert however, the roots of the now renowned disruptive brand go long way back to 1983 (Bert van Son, 2016b). At the age 23 Bert van Son moved to China to work within the textile industry (ibid). After 13 years of experience within the industry in Asia and Turkey, Bert van Son founded two successful textile companies in France and Spain: Sahinler France AS in France from 1996 – 2004 and Leomil Fashion S.A.S. in Spain from year 2004 – 2009 (Bert van Son, 2016b) . However, Bert still felt the need to do things differently. Buying Mud Jeans presented him with an opportunity to do so (ibid). In 2013, a year after buying the company, he induced the ‘’lease a jeans concept’’ that’s what has gained the company popularity and set it apart from the mainstream fashion brands on the global market (Bert van Son, 2016a). Lease a jeans became Bert’s innovative initiative to dealing with the first-hand experiences of the sustainability challenges associated with the fashion industry (ibid).

Challenging and disrupting the traditional make-use-discard linear business models dominating the fast fashion industry today, Mud Jeans embarked on a continuously improved product-service system and take-back systems since 2013 (Bert van Son, 2016a).

6.1.2 Systems-thinking at Mud Jeans

6.1.2.1 Raw materials, types and suppliers

»Did you know that fashion is the third most polluting industry in the world? « (Mud Jeans, 2016b)

Mud Jeans uses cotton as a major raw material. The company is conscious about the key sustainability issues associated with fashion industry today. For instance, the fashion industry today is confronted with the accumulation of waste, that's usually burned at end use (Bert van Son, 2016a). Also the company is aware that the production of cotton and processing is associated with bad working conditions and low wages (Mud Jeans, 2016b). Also in terms of the raw material itself, conventional cotton production involves intensive use of irrigation, non-renewable energy and eco-toxic agrochemicals (ibid). Cotton production accounts for up to 24% of insecticides and 11% of pesticides on the global market and yet cotton farms constitute only about 2.4% of the global cultivated arable land (Mud Jeans, 2016b). Therefore, evolving, the company started with making some feasible decisions on the what type of cotton it uses in its value creating activities.

By 2014, the company predominantly used organic and recycled cotton in the manufacturing of its denim jeans and all the other products (Mud Jeans, 2016b). Recycled cotton further reduces its products' water footprint by 40% (ibid). 70-80% of organic cotton productions are dependent on rainfall, not irrigation (Mud Jeans, 2016b). Additionally, no agrochemicals and genetically modified seeds are used in the production of organic cotton Therefore, quote:

» The only raw materials we use are GOTS and BCI certified. I would like to go for more GOTS certified cotton so that we know that people have been treated well and that we don't disturb the earth with all kinds of pesticides... « (Bert van Son, 2016a)

GOTS stands for Global Organic Textile Standard and as an independent certification, it ensures textile processing sustainable standard for organic fibres (GOTS, 2014). GOTS also provides ecological and social criteria within the organic fibres. See figure 4 below for an overview regarding types of cotton used by Mud Jeans between 2014 and 2015.

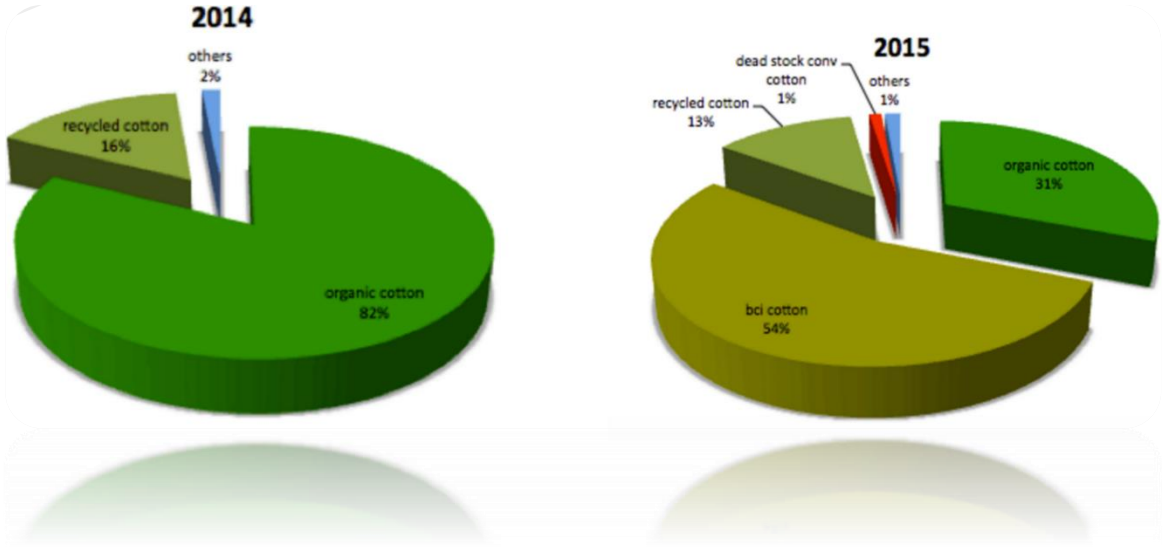

Figure 4. Types of cotton used by Mud Jeans. Modified after (Mud Jeans, 2016b)

As shown in figure 4, the company diversified by using more conventional cotton than organic, but only from suppliers approved by Better Cotton Initiative (BCI) (Bert van Son, 2016a). Better Cotton Initiative has standards set to ensure that global cotton production is better for cotton growers, environment and the future (BCI, n.d.). The other advantages associated with BCI are that it is a bigger initiative and that it diversifies by closely helping farmers to reduce the use of agrochemicals and teach them sustainable farming practices (Bert van Son, 2016a). At the moment, Mud Jeans is working with The Sustainable Apparel Coalition (SAC) to ensure measurability and transparency in sustainability performance of the company (Bert van Son, 2016a). The Sustainable Apparel Coalition focusses on measuring the environmental performances of the apparel, footwear and home textile industry by use of its standardized supply chain measurement tool called the HIGG index (SAC, n.d.). The HIGG Index

measures the environmental, social and labor impacts of the making and selling of apparels and demands transparent reporting (ibid). For Mud Jeans, such tools are important. Quote:

» […] Certifications are going to be important because one of the things that people ask is that, ''how can we see that the clothing is sustainable and then who is doing the right things and everybody is saying something […] « (Bert van Son, 2016a)

Mud Jeans experiences that giving numbers to the company's sustainability performance is increasingly becoming important because customers are confused that the majority of fashion brands nowadays claim to be sustainable (Bert van Son, 2016a).

6.1.2.2 Production

See figure 5 below shows Mud Jeans production roadmap in relation to the production factories

Figure 5. Roadmap of Mud Jeans production factories. Modified after (Mud Jeans, 2016c)

Dealing with quality, logistics, social and environmental issues associated with manufacturing of its products, Mud Jeans keeps its circles closer by keeping its production factories closer, most preferably in Europe (Mud Jeans, 2016c). The only outside Europe factory is however rather close and FLOCERT certified, include DNM Mill factory in Egypt that mills its denim fibres and Yousstex International that has best available sustainable technique in stitching and laundering denim jeans (ibid). Mud Jeans has entered into partnerships with Yousstex that has many years of experience in sustainable stitching and laundering techniques- a sustainable value also shared by Mud Jeans. Yousstex specializes in laser and ozone technologies (Mud Jeans, 2016b).

The laser technique replaces the predominant conventional use of sandpaper and potassium permanganate (Mud Jeans, 2016b). According to Mud Jeans, the conventional process uses sandpaper to brush the surface of the fabric through which the yarn is opened up to make its white base visible. The visibility however, becomes transparent only when potassium permanganate, a bleaching agent chemical substance is applied. Potassium permanganate ($KMnO_4$) is a strong oxidizing agent very toxic to aquatic life with persistent effects (ECHA, 2016). $KMnO_4$ as a strong oxidizing agent, also intensifies fire (ibid).
The use of Potassium permanganate within the European Union is regulated in accordance with Regulation (EC) No 1907/2006, Annex II, as amended by Regulation (EU) No 453/2010 (ECHA, 2016). In the aforementioned regulation, potassium permanganate has been regulated as a toxic chemical substance to humans when swallowed or inhaled over a long period of time (ibid). Additionally, potassium causes severe skin burns, eye damage and may cause organ damage if exposed over a long period of time (ECHA, 2016).
Therefore, by using Yousstex laser along with the ozone best available techniques that enhances the white worn effect visibility, toxic chemical substances and high costs due manual labor involved in the conventional washing and bleaching techniques are avoided (Mud Jeans, 2016b). Through ozone washing technique according to Mud

Jeans, 2016b, oxygen is converted to ozone gas which then damps and rinses. Due to its reversible process possibility, this technology reconverts ozone gas into oxygen and then sustainably emitted into the atmosphere.

That being said, the rest of production factories are located in Europe predominantly, in Italy. The spinning, dying, weaving and finishing of Mud Jeans organic denim fabrics takes place at Calik Denim in Turkey. The stitching of jeans, knitting of sweaters and recycling of yarns from worn out jeans for manufacturing Mud Jeans jumpers is done by Italian factories as shown in figure 5 above.

Establishing close and trustful relationship is an important sustainability aspect for the company (Mud Jeans, 2016c). By keeping its production facilities close also helps to establish shared values by keeping closer relationships with almost every single worker at the production factories (Mud Jeans, 2016c). Additionally, keeping its production factories closer also plays an important element of sustainability for Mud Jeans (ibid). Outsourcing is a predominant practice in the mainstream fashion industry however, it bears a number of other significant impacts in terms of sustainability (Shishoo, 2012). One of which Bert van Son elaborates:

»...like for instance, now you know that (X jeans company), is talking about recycling plastic from the ocean and ''may be'' they will make 500 pieces out of that and yet the manufacture up 20 million pairs unsustainably […] « (Bert van Son, 2016a).

Bert van Son elaborates that such a brand is greenwashing consumers because the 20 million pairs of jeans the brand manufactures involves unstainable productions also in terms of logistics. All sent by airplane for instance, the fibres are flown to Pakistan for spinning, then yarn to Bangladesh, the textile is the flown to India for tailoring and finally to shops in Holland (Bert van Son, 2016a). Therefore, the company does its productions in Europe, Tunisia and Egypt (ibid).

Additionally, to ensure resource efficiency and reduce waste, Mud Jeans produces its products only on demand and its distributors are only allowed to keep its prototypes (Bert van Son, 2016a).

6.1.2.3 Capturing and recapturing value: Sustainable business models at Mud Jeans

6.1.2.3.1 Product-service and take-back systems

»…there is a third problem in the whole garment industry and that's the waste. And we asked ourselves: ''How are we going to solve that? « (Bert van Son, 2016a).

Therefore, Mud Jeans came up with the leasing and take-back system for its pair of jeans (ibid). Figure 6 below illustrates fundamental principles of the circular business concepts at Mud Jeans

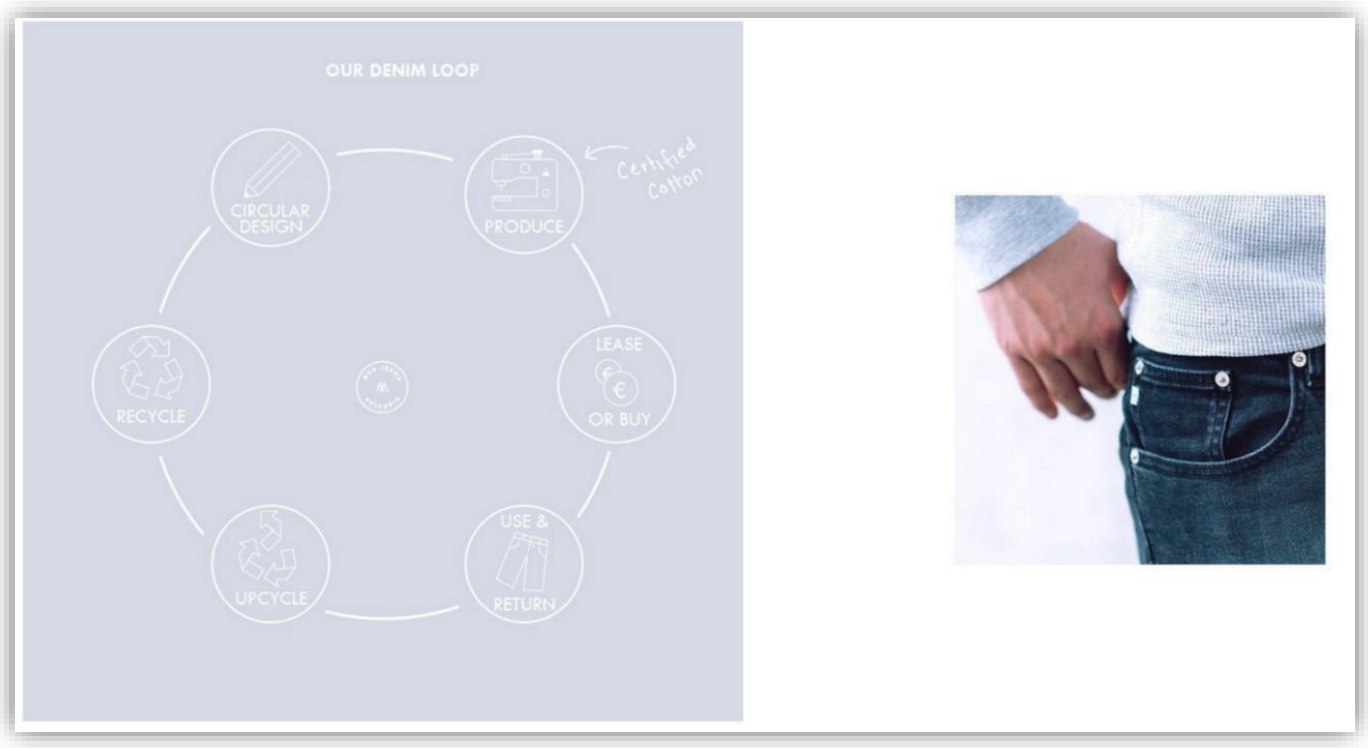

Figure 6. Principles of PSS and TBS at Mud Jeans. Modified after (Mud Jeans, 2016a)

Mud Jeans implements these circular business concepts in order to ensure product reuse and material recovery for remanufacture (Bert van Son, 2016a). See figure 7 below on how product-service and take-back systems work at Mud Jeans

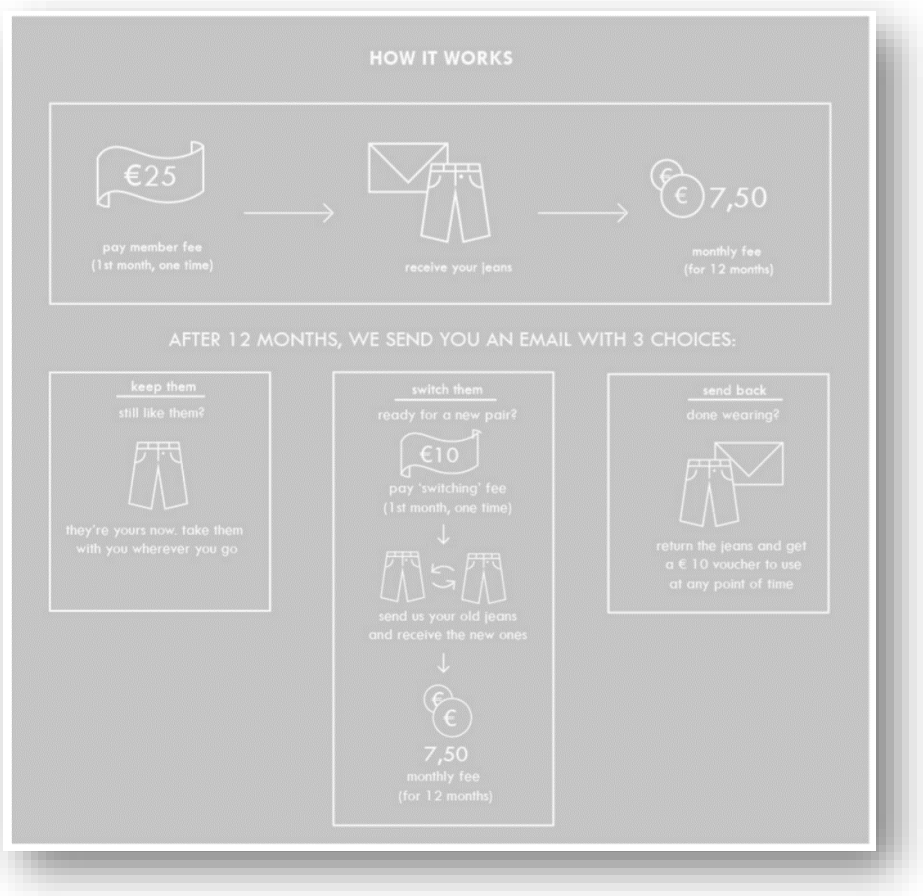

Figure 7. How PSS and TBS works at Mud Jeans. Modified after (Mud Jeans, 2016e)

Since its implementation, ‘’Lease a jeans’’ is the initial product-service system that gained Mud Jeans popularity. This disruptive business model innovation is organized in such a way that, at first, a customer pays a one-time membership fee of €25 (Bert van Son, 2016a). A customer receives a pair of denim jeans of their choice and thereafter, pays € 7,50 per month for using the pair of jeans (ibid). The €7.50 monthly instalment ceases after 12 months where the customer is offered three options:

- The customer resumes total ownership of the pair of jeans without further monthly instalments or;
- Switch the old pair of jeans with a new pair. With this after-sale service provision, he customer pays a one-time switching fee of €10 Euros for the first month, send the old pair back to Mud Jeans and receive a new pair of own choice. Thereafter, the customer pays €7,50 monthly instalments for 12months. However, if a customer decides neither to own the pair of jeans nor switch them, they can choose the following option;
- Send their pair of jeans back to Mud Jeans regardless of its conditions, and get a €10 voucher which they can use at any time (Bert van Son, 2016a).

That being said, the minimum 12 months leasing period is devised to ensure financial feasibility for both parties i.e. the lessee (the customer or the user) and the lessor- Mud Jeans (Bert van Son, 2016a). According to Bert, the minimum leasing period does not whatsoever, reflect the durability of the denim jeans brand. Therefore, depending upon the conditions of the pair of jeans upon return Mud Jeans revalorizes either by:

- Cleaning the recovered denim jeans using laser and Ozone best available techniques and lease it again (Mud Jeans, 2016b).

- Making necessary repairs, lease it again and repeat. However, if the pair of jeans is extremely worn out, Mud Jeans ensures sustainable recycling of the materials
- Recycling: Mud Jeans recollects its denim jeans recovered through leasing or take back and send it to Sagarli Srl. In Italy for recycling (Mud Jeans, 2016c). Sagarli Srl. recycles the materials into yarn that in turn, is used by Mud Jeans in the manufacturing of its jumpers (ibid). Going beyond its recovering its own products, the company has embarked on collecting worn-out jeans that would otherwise, become waste from anyone. Through ''THE RECYCLE TOUR'', the company aims at collecting any worn-out jeans, recycle them and use them as materials for remanufacturing its products. To achieve this enhanced remanufacturing journey, Mud Jeans is entered into yet a closely shared value relationship with Tejidos Royo factory in Valencia, Spain (Bert van Son, 2016a); (Mud Jeans, 2016f). Tejidos Royo has many years of experiencing in milling and spinning waste textile materials using sustainable techniques (Bert van Son, 2016a).

6.1.3 State of the art experiences: Lessons learned by Mud Jeans

This sub-topic present lessons learned by Mud Jeans. In order to present a simple structured overview that clearly demonstrate different levels of engagement, the lessons learned have been categorized in terms of:

- Selection of materials, suppliers and their location in relation to investigated companies' production activities;
- Production in terms of location to suppliers, cleaner productions and design concepts reciprocity to implemented circular business models;
- Circular business models aiming at product and material revalorization;

Note that the same structured will be maintained and used in all the investigated case studies. That being said the following is a summary of experiences and lessons learned by Mud Jeans (summarized after Bert van Son)

1. Related to raw materials

It is necessary to use types of raw materials that are more reciprocal to the circular business concepts and models (Bert van Son, 2016a). Closely collaborate with suppliers as a way to ensure shared values that enhance circularity (ibid). According to Bert, it is also necessary to collaborate with nearby suppliers as this also increases resource efficiency as well as shared values of business concepts. The use of certified raw materials is encouraged as this also ensures sustainable practices in their production (Bert van Son, 2016a). The use of certified raw materials also serves as a sustainability communication medium between producers and consumers (ibid). It is also necessary for producers to innovate ways of furthering waste reductions (Bert van Son, 2016a). Such ways as engaging consumers in the collection of waste and thereafter, working with best available upcycling techniques that enhances revalorization of second generation materials (ibid). Additionally, always search for alternative sustainable raw materials that are more suitable for circularity (Bert van Son, 2016a).

2. Related to production

Mud Jeans does not own the production facilities and therefore, the company is entirely dependent on other factories (Bert van Son, 2016a). As a way of ensuring sustainability within productions, Mud Jeans collaborates with factories that live up to the circular business concepts of the company (ibid). Furthering resource efficiency, first of all, the company opts to closely collaborate with nearby facilities mainly in Italy, Spain, Tunisia and Egypt (Bert van Son, 2016a); (Mud Jeans, 2016c). Secondly, Mud Jeans collaborates with factories that have best available production techniques and best practices in relation to its circular business concepts (ibid). As a way of ensuring sustainable practices, the factories that Mud Jeans work with are certified by organizations that seek to ensure sustainable productions practices within the industry (Bert van Son, 2016a). Additionally, the company has close relations with these facilities (Mud Jeans, 2016c).
Additionally, Mud Jeans has chosen to produce only on demand (Bert van Son, 2016a). This is a way of reducing waste and passive stocks. Distributors are only allowed to keep prototypes/models in their stores (ibid).

3. *Related to circular business models*

There are many business prospects in circular economy today however, telling a good sustainability story by itself and alone is insufficient (Bert van Son, 2016a). First and foremost, according to Bert, circular business models operating within the currently ever-changing fashion need to continuously innovate. However, not necessarily by adapting to the mainstream practices within the industry but by evolving along with fashion and sustainability issues associated with the current practices (Bert van Son, 2016a). With such an approach from a business viewpoint, the circular brand will innovate inspired by the challenges associated with the mainstream practices today and offer sustainable however, fashionable value proposition of today and tomorrow (ibid).

The company initially started with only one model prototype of its sustainable pair of jeans and told a good story of its circular business concept (Bert van Son, 2016a). That was not enough, not that it wasn't a true good story but it lacked just a few different models appealing enough for the sustainably conscious but diverse market audience (ibid). That along with introducing a whole new and disruptive business concept, was sufficient enough to slow down an active start-up (Bert van Son, 2016a). The company has now designed more models for both its ''Mud men and women'', an alias term Mud Jeans and its supporters seem to get along well with as they interact on social media platforms (Bert van Son, 2016a). The company has also diversified into designing other products and accessories as listed earlier on. That being said:

»…. Financing is one of the challenges but I think you've heard about all that already, in the guardian…« (Bert van Son, 2016a).

Referring me to his interview with the Guardian (The Guardian, 2016), through which Bert listed five key lessons as follows:

- The standard banking system is yet to evolve along with circular business concepts (Bert van Son, 2016a); (The Guardian, 2016); (ING, 2015). The changing nature of cash flows, legal issues such collateral and increased capital needs associated with circular business concepts challenge the current banking system (ING, 2015); (The Guardian, 2016). ING suggests the following, among other changes to the current banking system:
    - A change from collateral to cash flow based approach (ING, 2015); (The Guardian, 2016);
    - The development of new valuation and risk model that for instance, captures instead of writes off the value of second hand assets (ibid).

- Sustainable value proposition and its circularity concepts have to be so clear that the consumer can easily understand the concepts (Bert van Son, 2016a); (The Guardian, 2016);. Also focus on what sets the company's value proposition and concept apart from the rest on the market (ibid);

- Go ahead and use viral marketing (Bert van Son, 2016a); (The Guardian, 2016). According to Bert, such viral marketing as blogging are a cheaper but effective means of gaining the essential insight in relation to the customers and market prescience. (Bert van Son, 2016a); (The Guardian, 2016). The company encourages its customers to make short statements about their experiences with the products by the brand (Bert van Son, 2016a). See figure 8 below

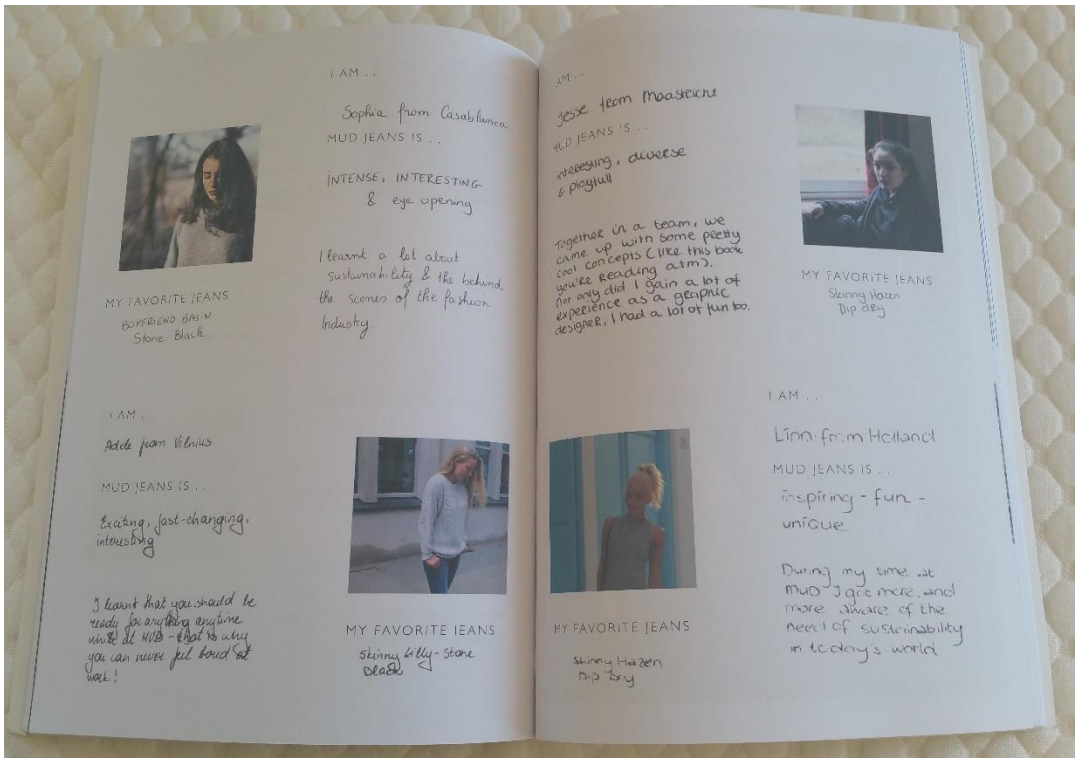

Figure 8. Collection of stories from Mud Jeans customers. Modified after (Mud Jeans, 2016a)

- Continuously interact with customers and educate them about the company's circular business concepts (Bert van Son, 2016a); (The Guardian, 2016). Some circular business concepts are literally disruptive and therefore, need adoption time. For instance, although the leasing business concept is appealing and that it in particular, has differentiated the brand from the most, it accounts only for 40% of the company's turnover (The Guardian, 2016). The rest comes from purchased goods. However, by interacting with its customers and communicating with them about all the possibilities and benefits, Mud Jeans experiences that 80% of leasers choose to keep their leasing contract. Mud Jeans uses social media platforms such as Facebook, twitter and also LinkedIn. Additionally, the company has developed its own ''App'' in order to simplify and engage its customers thereby enhance its sustainable value proposition. Moreover, Mud Jeans engages its customers by inviting them in their journey. Taking storytelling to a higher fun level, the company has recently taken its customers on what it calls the RECYCLE Tour from The Netherlands to Tejidos Royo, Spain via Belgium and France (Bert van Son, 2016a). See figure 9 below for Mud Jeans Recycle Tour

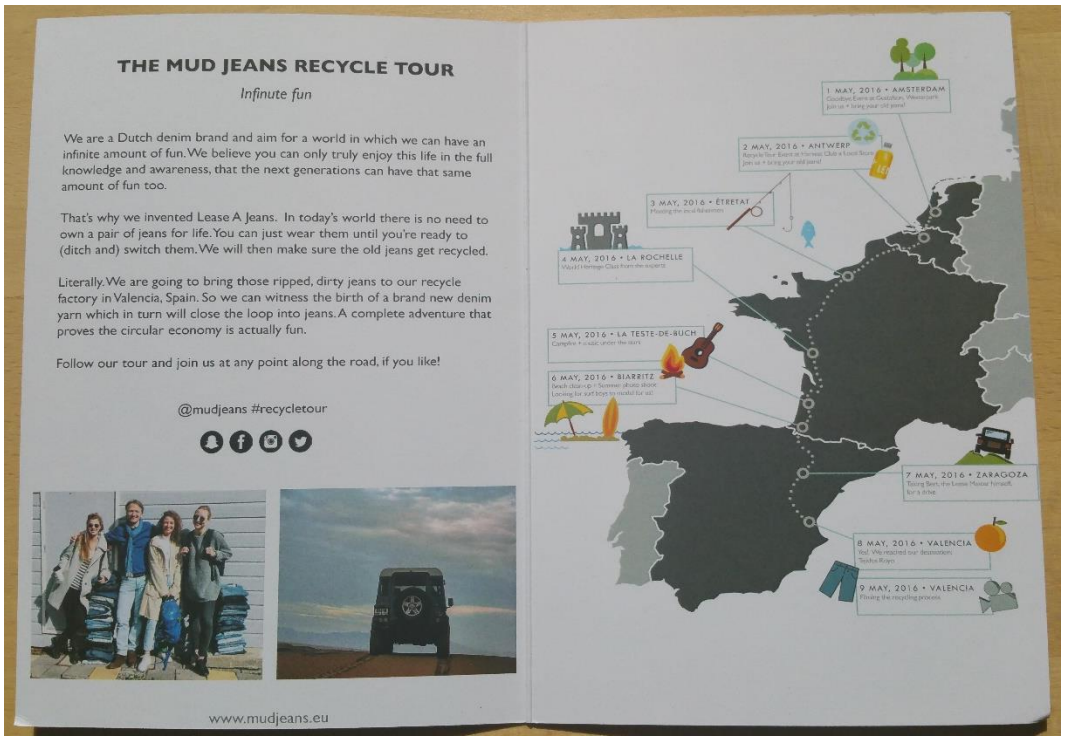

Figure 9. Mud Jeans Recycle Tour roadmap. Picture modified after (Mud Jeans, 2016f)

Achieving its goal Mud Jeans has taken its customers for a fun journey and collected 3000 jeans for recycling at Tejidos Royo factory in Spain (Mud Jeans, 2016f);

- Storytelling is a fun and essential way of engaging, educating and gaining customer insights thereby promoting the brand and its circular business concepts (Mud Jeans, 2016a). These stories are also used for viral marketing;
- Additionally, circular business models such as leasing require legal and financial advisory services (Bert van Son, 2016a). Acquiring legal advice ensures that the leasing contract functions with legislative framework for the benefit and fairness of both parties (the lessor and lessee) (ibid). The financial advice ensures the financial feasibility for both the lessor and lessee (Bert van Son, 2016a).
- That being said, Bert added that certifications that measure sustainability best practices based on the triple bottom line will be inevitable (Bert van Son, 2016a). According to Bert, customers are continuously demanding to know who is doing the right thing that's coherent to the triple bottom. Further, majority of companies nowadays claim to be sustainable after executing one slight stunt that deals with one element of the triple bottom (Bert van Son, 2016a).

6.2 ROYAL AUPING

Primary source: Geert Doorlag, Product Developer at Royal Auping Headquarters in Deventer

Picture modified after (Doorlag, 2016)

6.2.1 Brief history and company description

Royal Auping is a Dutch high quality brand manufacturer of beds, mattresses and accessories. See figure 10 below

Figure 10. Auping bed and mattress. Picture modified after (Royal Auping, n.d.-a)

Royal Auping was founded in 1870 by Johannes Auping. See figure 11 below for an overview of development and important milestones

Figure 11. Historic development and milestones. Picture taken by Edward Vingwe, taken on April 15, 2016

Currently, the company has its headquarters in Deventer, in The Netherlands (Royal Auping, n.d.-a)., Royal Auping now has its market mainly in Europe, Asia and South America with target on both households and hotels. See figure 12 below for locations of the company's marketing and distribution operations

Figure 12. Market locations of Royal Auping. Modified after (Royal Auping, n.d.-a)

Royal Auping as an innovative quality brand that lasts, stems all the way back from the founder Johannes Auping in 1888 (Royal Auping, n.d.-b). Already since 1898, by then, Auping delivered beds to the Place on the Dam- the Dutch Royal palace (Royal Auping, n.d.-a). However, the designation term ''Royal'' came as a special award for a 100 years of continuous consistence as a business. See figure 13 below

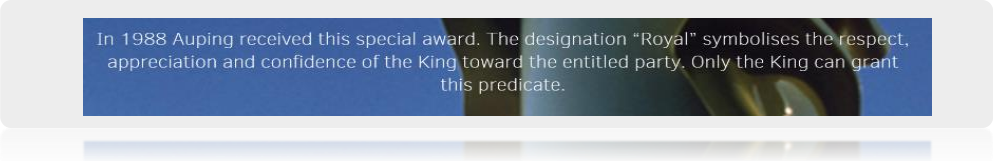

Figure 13. Modified after (Royal Auping, n.d.-a)

Reserving its more than a century sustainability tradition of quality and durability, Royal Auping continuously evolves along with sustainability challenges of today.

»We are not a start-up business…so we need to be very good at incremental developments. We cannot be revolutionary. « (Doorlag, 2016).

However, circular economy thinking is not a stranger in the company. The company continuously improves its systems thinking approach towards material recovery and revalorization through C2C design principles implemented since 2011 (Doorlag, 2016).

6.2.2 Systems thinking at Royal Auping

6.2.2.1 Raw materials

With a cradle to cradle design approach, selection of types of raw materials and suppliers are some of the fundamental strategies towards creating sustainable value at Royal Auping (Doorlag, 2016). According to Doorlag, the major raw materials used at the company include steel, wood, textiles and mattress foams mainly polyether and latex based. So far 60-80% polyether and 20% latex foams are used within the mattress industry today (Doorlag, 2016). However, the selection of its types of raw materials aligns with cradle to cradle design principles. In order to maintain its values in terms of cradle to cradle concepts, quality and durability the company works with suppliers within its production proximity. Therefore, the major raw materials suppliers are located mainly in The Netherlands, Germany, Belgium and Denmark. Having suppliers nearby has many benefits. Some of which, quote:

»[...] We are producing in Holland and we are choosing our partners nearby and make sure we have the same set of shared values. All this makes communication very easy when you work with continuous improvements […] « (Doorlag, 2016).

Also as a way of optimizing resource efficiency, having suppliers closer is the company's strategy of enhancing mutual partnerships based on company values but also business concepts (Doorlag, 2016). According to Doorlag, such mutual partnerships are enhancing the company's cradle to cradle values of material circularity. Emphasizing on the inevitability of creating mutual partnerships in such a line of circular business concepts for example, showing me the mattress base materials:

» […] leftovers are sent back to the supplier and then they rework and put them into new material streams. We have a perfect closed loop for this material [...]this is a symbolic way of how we think in all the things that we do here. « (Doorlag, 2016).

Also among other mutual partners, Royal Auping has established a mutual partnership with a Danish supplier, Kvadrat not only based on material circularity but also based on sharing knowledge and business concepts (Doorlag, 2016). Holding a number of significant European eco-labels, Kvadrat is a Danish manufacturer that specializes in innovating a wide range of high quality textile fabrics for both industrial and domestic use (Kvadrat, n.d.).

6.2.2.2 Production, social responsibility and product design

Figure 14. Royal Auping steel factory. Picture modified after (Doorlag, 2016)

Ten years ago, Royal Auping made a research to find out whether it was still sensible to keep all its productions in The Netherland or move to for instance, Turkey or Poland or China (Doorlag, 2016):

» […] we found out that if we go there, we couldn't live up to the quality that we expected from ourselves and then we decided to stay here but we needed to be more efficient. « (Doorlag, 2016).

All productions take place at its headquarters in Deventer where the company has its own steel and wood factory (ibid). However, to further optimize resource efficiency, Royal Auping implemented a ''Lean'' management program throughout its production systems (Doorlag, 2016). Lean management practices are a systematic means of eliminating all waste in production systems (ibid). According to Doorlag, lean management practices recognize by analysing resource inefficiencies in all manufacturing processes. Ten years ago, prior to implementing lean management practices, Royal Auping kept a lot of stock to make sure that the company lived up to its six weeks' delivery time (Doorlag, 2016). However, since implementation of Lean program, delivery time has been reduced to three weeks (ibid). According to Doorlag, Lean management practices have not only reduced resources in terms of time but also material resources since before, some of the stocks became idle, outdated and eventually, waste. Ever since, the company only produces upon order (Doorlag, 2016).

Further, Royal Auping uses a lot of energy and therefore, it made a number of change in terms of its energy consumptions. Related to technological improvements, the company moved all its productions from a 100-year-old facility to what used to be its logistic centre (Doorlag, 2016). However, Royal Auping still had to invest in smart technologies such as LED lamps, daylight sensors, geothermal heat pumps and smart ''robotic'' welding machines in its new facility (ibid). All this according to Doorlag, has resulted in 90% thermal and 50% electric energy savings. Also willing to invest in necessary technology, the company intended to use its wood biomass leftovers for energy but due to regulatory issues, it was prohibited (ibid). The wood biomass contains a bit of glue and paints although the prohibition was also associated with the existing monopoly within energy suppliers (Doorlag, 2016). Thereafter, the company looked into investing in wind energy however, this turned out to be financially infeasible at that

moment (ibid). Nevertheless, lean program has so far proved coherent to a resource efficiency aspect of sustainability (Doorlag, 2016).

Related to working conditions and social responsibility, workers used masks before but not anymore because the company invested in a water-vapour technique that improves air quality in its steel and wood factory (ibid). See figure 15 below

Figure 15. Wood factory with water-vapour sprayers set up along wood cutting operations. Modified after Doorlag, (2016)

Further, keeping all productions in the Netherlands adds a social sustainability value in terms of securing local competencies and employment (Doorlag, 2016). Coming from an industrial design engineering background, Geert recalls wondering why Royal Auping employed so many people when all the machines could be easily automated:

» […] I wondered but I gained an experience and lost that illusion because this is really something that is done by hand. If you need to achieve quality products like we make, it's all handmade […] « (Doorlag, 2016).

Also related to social sustainability, Royal Auping is a signatory of the UN Global Compact (Royal Auping, n.d.-a). The UN Global Compact seeks to align company operations and strategies with universal principles related to human rights, labor, environment and anti-corruption (UN Global Compact, n.d.).

Further, in relation to product design, Royal Auping has a cradle to cradle (C2C) design approach. All mattresses manufactured by the company are C2C certified (Doorlag, 2016). See figure 16 below showing one of Royal Auping C2C design principles

Figure 16. C2C design concepts. Modified after (Royal Auping, n.d.-b)

As shown in figure XX above, along with reciprocal selection of materials, the cradle design concept was implemented in order to ensure easy and efficient material recovery for revalorization. With design for easy disassembly, all components are assembled in a way that allows easy maintenance, efficient reparability and upgradability. Also see figure 17 below

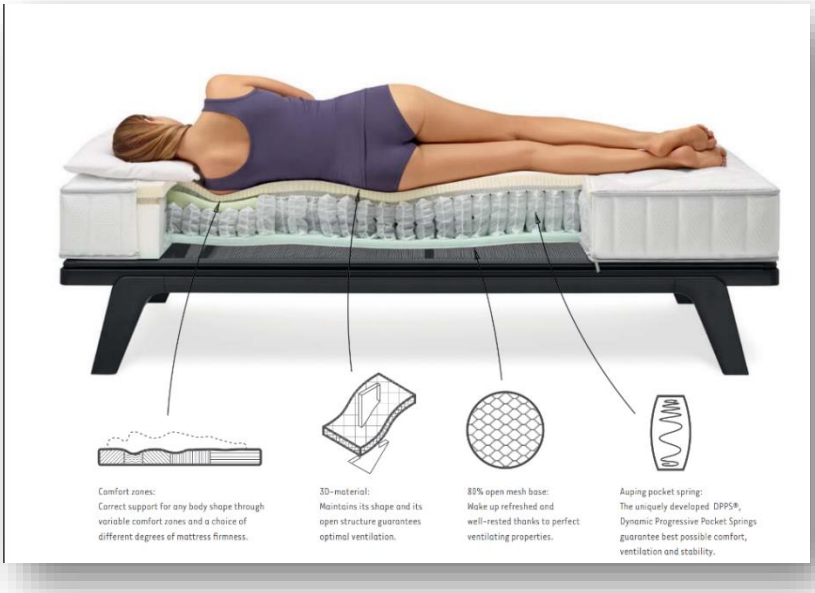

Figure 17. Ergonomic cradle to cradle design concepts. Modified after (Royal Auping, n.d.-b)

Also shown in figure 17 above just to mention a few advantages, the mattress covers washable, replaceable/ upgradable and all materials traceable, recoverable and etc. (Royal Auping, n.d.-a). All Auping mattresses are cradle to cradle certified (Doorlag, 2016). According to Doorlag, the company is continuously searching for new materials that are required by C2C certifications. That being said, the cradle to cradle design concept as mentioned earlier on, was implemented upon introducing its disruptive take-back business concept that up to date, seeks to recapture value of all its mattresses at end of use.

6.2.2.3 Recapturing value: Take-back system at Royal Auping

Royal Auping offers a take back system as one of the company's after sale service provisions (Doorlag, 2016). The take-back system is made clear and simple. The customers buy the mattresses, use them for as long as they want and at end of use, Royal Auping collects the mattresses and the customer gets €10 as an incentive (Doorlag, 2016). All Royal Auping mattress distributors are part of this take-back system service provision. According to Doorlag, the service has been organized in such a way that the old mattresses are collected upon delivery of new mattresses/products. In this way, logistic financial costs along with environmental impacts such as greenhouse gas emissions associated with transportation are reduced (Doorlag, 2016).

Other after-sale service provision included in the take-back system of mattresses at Royal Auping is the five-year warranty (Royal Auping, n.d.-a). The first two years the customer is guaranteed a full warranty thereafter; well-calculated depreciation values count (ibid). Additionally, the company offers through its homepage, maintenance tips to ensure consistent product functionality (Royal Auping, n.d.-a).

As of now however, between 25-30% of all customers actively participate in this take back system (Doorlag, 2016). Doorlag assumes that this also reflects customer satisfaction in terms of products' quality. He also adds, quote:

» […] also some customers opt out and reuse the mattresses themselves […] « (Doorlag, 2016).

Collected mattress are however, used for remanufacturing (Doorlag, 2016). The springs are melted into steel and reused, latex and polyether are remanufactured by RetourMatras (partner of Royal Auping) which in turn, remanufactures the materials into yoga mats and carpets (ibid). In this way, 90% of the materials are used for remanufacturing (Royal Auping- DK, n.d.-c).

6.2.3 State of the art experiences: Lessons learned

Summarized after Doorlag, (2016), the following is a summary of experiences and lessons learned by Royal Auping

1. Related to raw materials

In terms of material selection, circular business concepts aiming at product recovery, reuse and material revalorization can benefit a lot from cradle to cradle design concepts (Doorlag, 2016). Royal Auping carefully selects its raw materials so that it can live up to its quality and cradle to cradle design expectations (ibid). In order to ensure sustainable practices in the upstream, the company opt for certified raw materials. Among other certifications, the company uses materials that are certified by EU eco-label and Cradle to Cradle (Doorlag, 2016); (Royal Auping, n.d.-d)
However, there is need for producers to continuously look out for new sustainable alternative materials that are more responsive and reciprocal to circularity and circular business concepts (Doorlag, 2016). Doorlag adds that there is need for both producers and consumers to be realistic and transparent in terms of sustainable value propositions. State of the art in terms of material selection and consumption within the mattress producers for instance, polyether and latex foams are roughly the two foams that are being used by mattress manufacturers up to date (Doorlag, 2016). These materials count for about 60-80% polyether and 20% latex (ibid). Note that latex is currently associated with a competitive notion of selling natural mattresses (Doorlag, 2016). However, the predominantly used type of latex that dominates the current market is no way compostable or biologically cycle-able (ibid). Doorlag adds that both producers and consumers should be aware of such greenwashing concepts. On one hand the use of natural latex is a possible alternative:

» If you would have natural latex and made a mattress out of it that could be compostable, that's conceivable. « (Doorlag, 2016).

On the other hand, however, the use of natural latex requires well-thought design concepts because the designer has to be aware that composting environments work with moist and temperature levels equivalent to 60-70% moisture and 30-35% degrees Celsius:

» [...] that is actually the same climate that you have under your blankets. Therefore, in my opinion, it's not good to have bio-compostable materials in your mattress […] « (Doorlag, 2016).

Further, Royal Auping works with raw material suppliers in the Netherlands and other nearby European countries that are closely located to its production facility (Doorlag, 2016). This is a way for the company to increase resource efficiency as well as ensuring shared values (ibid). Shared values at Royal Auping aim at enhancing material circularity, improving quality and sustainability expectations and sharing circular business concepts (Doorlag, 2016). Therefore, the company closely collaborate with its raw material suppliers by developing partnerships aimed at developing innovative sustainable solutions around these aforementioned values (ibid). Overall, creating close partnerships throughout the value chain plays a vital role in circular business concepts in terms of communications issues that in turn, establish these shared values (Doorlag, 2016). As easy as creating close partnerships may sound, sometimes it takes time, experience and other resources, most especially for companies with suppliers far from where productions take place (ibid). It takes time to develop trust within these values (Doorlag, 2016).

2. *Related to production*

The company has continuously optimized its production systems and facility through smart technologies and lean management practices (Doorlag, 2016). These continuous optimizations in turn, are significantly saving the company resources such as energy, raw materials and water as well as reducing air and water pollutions (ibid). However, there exist some regulatory barriers impeding innovative initiatives. In the case of Royal Auping, although the company had access to best available techniques that enable generation of thermal energy from its wood biomass, the company was prohibited to do so (Doorlag, 2016). There were concerns that the paint used in its wood productions had potential of air pollution (ibid). Although the prohibition was for the right reason, Doorlag contemplates that the prohibition may also have been associated with the existing monopoly within the energy suppliers (Doorlag, 2016).

Further, keeping its productions still in The Netherlands has served as a way of ensuring quality expectations associated with its brand as well increasing resource efficiency (Doorlag, 2016). Additionally, this decision has had positive rebound effects that promote local sustainability in relation to preserving local competencies as well securing employment (ibid).

In terms of design concepts, for companies aiming at circular business concepts cradle to cradle design concepts are unavoidable (Doorlag, 2016). On the other hand, cradle to cradle design concepts can be used as sources of inspiration for companies that are not aiming for its certification (ibid).

In relation to companies that have worked with sustainable concepts for many years and have already made significant improvements within sustainability, incremental improvements are highly recommended (Doorlag, 2016).

3. *Related to circular business model*

In relation to take-back system at Royal Auping, the company has learned that circular business concepts require adoption time (Doorlag, 2016). Since implementing a take-back system for its mattresses, about 25-30% of the mattresses have been returned to Royal Auping so far (ibid). Although it is said that some of the consumers choose to reuse the mattresses themselves, there is however, need to allow customers to adapt to such disruptive circular business concepts as take-back systems (Doorlag, 2016). The customers are yet to learn the core benefits behind such kinds of after-sale service provisions however (ibid). However, if the assumption that the mattresses are being reused by consumers themselves is right, that would indicate quality satisfaction as well as sustainability (Doorlag, 2016).

In the meanwhile, prices of raw materials are lower than second generation materials (Doorlag, 2016). In other words, according to Doorlag, the costs involved in retrieving and processing second generation materials are higher than virgin resources. Therefore, from a business perspective, a stand-alone take -back system is financially

infeasible. However, Royal Auping is closely collaborating with RetourMatras, a company that upcycles the taken back mattresses into yoga mats, carpets and etc. (Doorlag, 2016). According to Doorlag, in spite of material circularity, take-back system at Royal Auping also is increasing consumer awareness in terms of sustainability issues. Moreover, such circular and sustainable value propositions as take-back systems provide good stories in terms of marketing (Doorlag, 2016).

6.3 ROYAL AHREND

Primary source: Diana Seijs, Sustainability Officer at Royal Ahrend

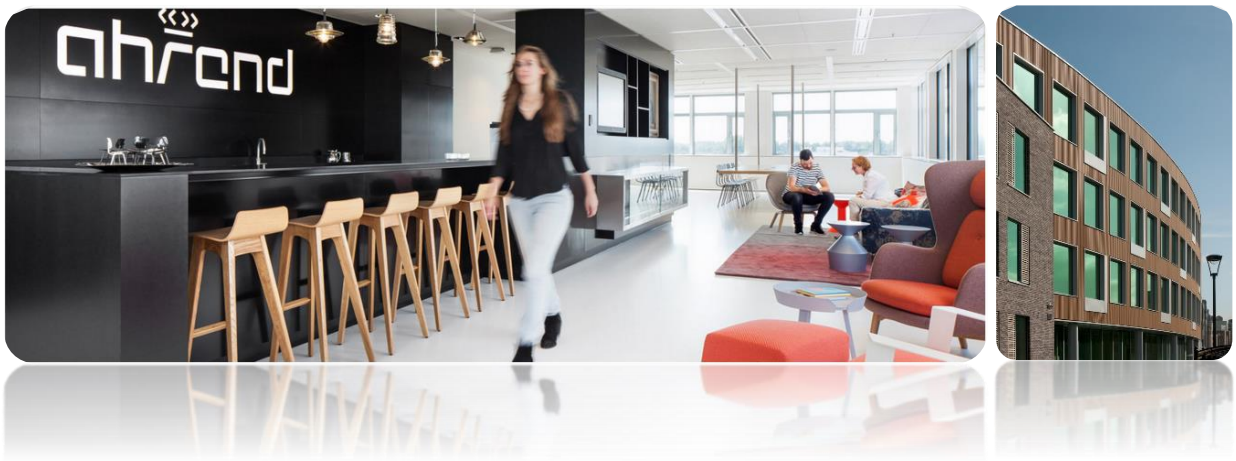

Figure 18. Royal Ahrend. Modified after (Royal Ahrend, n.d.-a)

6.3.1 Brief history and company descriptions

Ahrend is a company that has for more than 100 years played a leading role in Dutch design furniture (Royal Ahrend, n.d.-a). Founded in 1896 by Jacobus Ahrend, Ahrend is well-established brand in high quality office furniture (ibid). As a market leader in Europe, Ahrend has operations in over 25 countries including United Arab Emirates, China and Russia, operating on over five continents (Royal Ahrend, n.d.-a). However, most of the company's operations abroad are related to marketing and distribution (ibid). All furniture productions take place at Royal Ahrend's own facility in The Netherlands.

6.3.2 Systems thinking at Ahrend

6.3.2.1 Raw materials

The company's major raw materials include steel, wood, textiles and cushion materials (Royal Ahrend, n.d.-a). However, to ensure best available sustainable practices also within its suppliers, materials used at Ahrend are cradle to cradle certified (Royal Ahrend, n.d.-b). Cradle to cradle certifications standards provide criteria that require continuous improvements in terms of the elimination of toxic chemical substances, design for materials traceability, recoverability, reusability and recyclability while ensuring social sustainability throughout the value creating chain (The Cradle to Cradle Products Innovation Institute, 2014). For Royal Ahrend, working with suppliers who are also cradle to cradle helps to ensure continuous circulation of materials (Seijs, 2016). For example, Ahrend gets help in the recycling of steel and lacquer from its suppliers (ibid). Some of its suppliers are obliged to take back some materials for recycling (Seijs, 2016). Its suppliers are located in Europe e.g. in The Netherlands, Germany, Belgium and Denmark.

That being said, Ahrend has established partnerships with suppliers aiming at continuous material innovations based on the aforementioned principles/standards (Royal Ahrend, n.d.-b). For instance, based on material share-ability for further circularity, Royal Ahrend collaborates with Gabriel, its Danish supplier of textiles (Seijs, 2016). Additionally, based on shared value and business concepts, Royal Ahrend has also established partnerships with

TECHO, CSR Netherlands (Royal Ahrend, n.d.-b). TECHO is also an office furniture company that is part of the Royal Ahrend group (ibid). Also working with circular economy, CSR Netherlands provides expertise within corporate social responsibility (CSR Netherlands, n.d.). Creating partnerships throughout the value chain is a vital element most especially in circular business concepts, quote:

» […] Creating mutual partnerships is the key especially when you are thinking about circular business models because you are going outside your own boundaries and you always need partners [...]. « (Seijs, 2016).

However according to Diana Seijs, how to get the right partners at the right time that are reciprocally beneficial is difficult:

» […] You need to have some kind of trust, the thing you need to focus on the most because if you don't trust the other side of the table, no partnership will exist […] but it also demands piloting and testing […] « (Seijs, 2016).

6.3.2.2 Production and product design

Royal Ahrend uses 100% renewable energy resources in all its production processes (Seijs, 2016). See figure 19 below for an overview of sustainable production processes and concepts at Ahrend

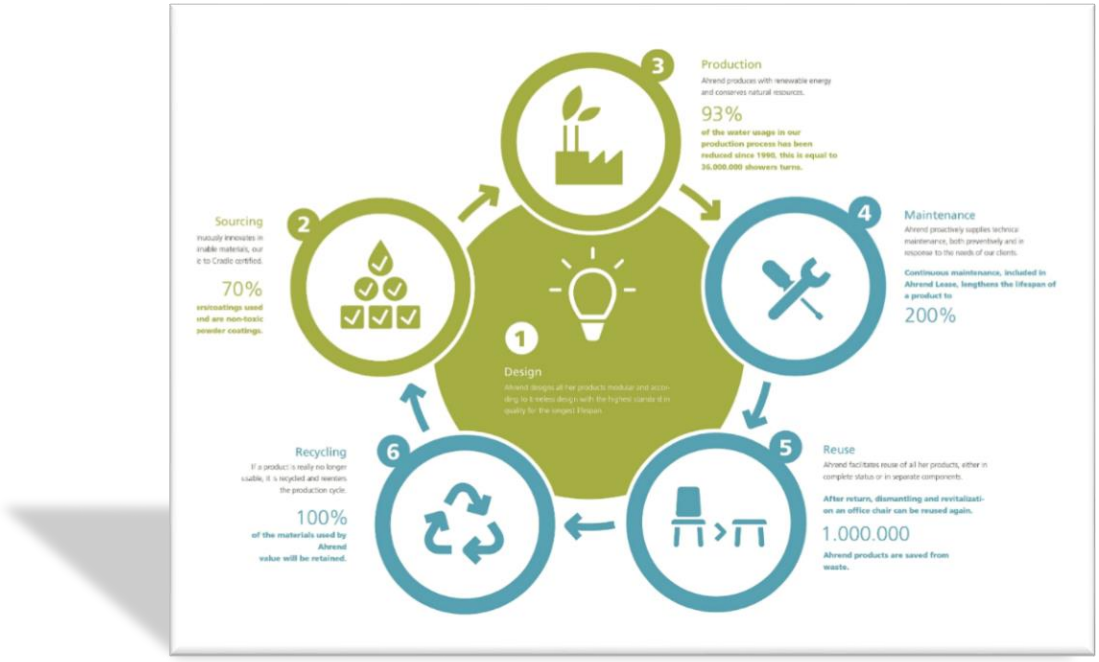

Figure 19. Principles of C2C at Royal Ahrend. Modified after (Royal Ahrend, n.d.-b)

What is unique about Royal Ahrend as mentioned earlier on is that all the company's furniture production processes still take place at its facilities in the Netherlands (Seijs, 2016). This is so unique because productions for most companies have been outsourced (ibid). However, the decision to keep all its productions in The Netherlands also meant that Royal Ahrend had to live up to even stricter environmental and social regulations that took place during the 1990's. This decision initiated the sustainability journey for Ahrend:

» That was the first time we started doing things differently, also as what the ''cradle to cradle philosophy'' say: doing the right things…« (Seijs, 2016).

Royal Ahrend started with making significant proactive technological improvements in terms of air, water and noise pollutions related to its production processes (Seijs, 2016). Becoming the first company to make an environmental performance year report in 1992, the company has ever since, kept the course of continuous environmental improvements by focusing more on the causal factors of its production processes than end of pipe effects (ibid). Back then, sound, aerosols, water and energy were the four main issues (Seijs, 2016). However, according to Seijs,

the company moved a step further by also focusing on cleaner products. While reflecting on Royal Ahrend's earlier environmental reports:

» […] it's also very nice to see that we had reports from 1992 […] and if you want to go a step further, you have to look at the products that you produce with these processes. Where do they come from and where do they go to? « (Seijs, 2016).

This is when Royal Ahrend embarked on Eco-design projects which was stimulated by the Dutch government and the company became one of the pilot companies (Seijs, 2016). More or less the root of circular economy, eco-design is a systems thinking approach to sustainability that aims at increasing resource efficiency related to energy efficiency, material recoverability, reusability of materials constituting a product while eliminating toxic chemical substances (EUR- Lex, 2009). That's when the lifecycle (LCA) approach to product design was initiated and in 1994 Royal Ahrend produced its first chair model that was completely easy to disassemble and had all LCA done (Seijs, 2016). Since then, quote:

»…so we thought that we had gold in our hands and we already had agreements with our suppliers that made sure that when the chairs were returned to us after use, the suppliers could have the materials back for reuse...« (Seijs, 2016).

After twenty years however, only about ten chairs came back (Seijs, 2016). The chair was so good that the consumers decided to reuse it or resell it on the second-hand market (ibid). Nonetheless, Royal Ahrend still kept on producing the chair up until 2013 because it was a ''hit'' to the extent that almost 60-70% of the offices in the Netherlands have that model (Seijs, 2016). Nevertheless, design for easy disassembly along with LCA thinking became significant in the design processes at Royal Ahrend (ibid). After significant reductions of waste streams, the elimination of PVC, glues, from stocks etc. the company decided to rethink the initial take back system, quote:

»…it came to a part where you cannot do anything yourself anymore…most especially when you have already improved 80%, the 20% becomes the most expensive. We need to have different kind of thinking…« (Seijs, 2016).

Therefore, around 2002 Royal Ahrend decided to explore possibilities within product-service systems (PSS) through which its focus shifted from selling physical products to selling services the products delivered (Seijs, 2016). Although there were some companies interested in PSS, it was financially infeasible at that moment because most of the clients were not ready for that (ibid). However, business turned around from 2007 upon the gaining popularity of the cradle to cradle film ''waste equals food'' by the Dutch television (Seijs, 2016) and, quote:

» […] our product designers and a lot of our productions people saw that and well, they said ''this was the thing we need to do. It fits us […] and may be it can help us to develop and our products […] « (Seijs, 2016).

PSS became so *hippie* in The Netherlands that Royal Ahrend embarked on the cradle to cradle design principles in 2008 (Seijs, 2016).

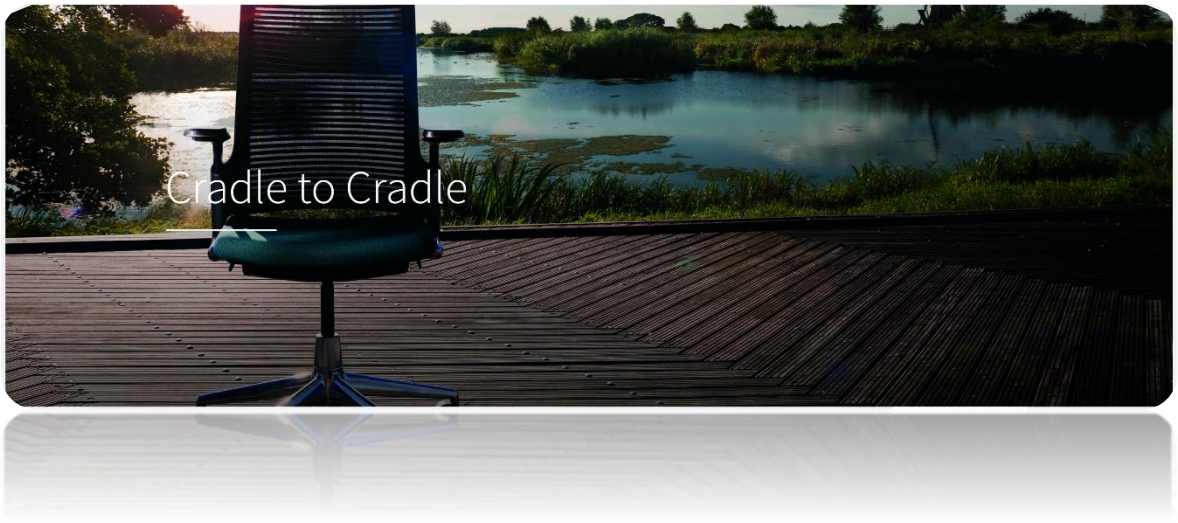

Figure 20. C2C. Modified after (Royal Ahrend, n.d.-a)

Already in 2008 according to Seijs, three prototypes based on cradle to cradle principles also reciprocal to this shift from product to service system were designed and were also C2C certified (Seijs, 2016). By 2011, Royal Ahrend became the only cradle to cradle certified company in the furniture industry (Royal Ahrend, n.d.-b). However, by 2008 the financial crisis had already affected prices of products therefore, the PSS was not implemented. Growth within the furniture industry was cut by 50% and many companies competed by producing for lower prices. However, design for cradle to cradle and easy disassembly still remained the way of designing furniture at Ahrend. For three consecutive years since the financial crisis, Royal Ahrend struggled to breakeven. In 2012, Royal Ahrend had to change the deficit course quote:

»I said, sustainability could be an issue. It could help us, so we did a lot to find financers. It's important for closing the loop. Somebody has to finance something in between because you get different business models […] « (Seijs, 2016).

This resulted into an agreement with Societe Generale that financed the leasing business model in 2014 (ibid).

6.3.2.3 Capturing and recapturing value: Royal Ahrend Product-service and take-back systems

Royal Ahrend now has since 2014 offered its leasing services (Seijs, 2016). At the clients' convenience, the company leases what it calls flexible solutions to office décor either a fully equipped office or extension of workstations. See figure 21 below for some of the office solution services

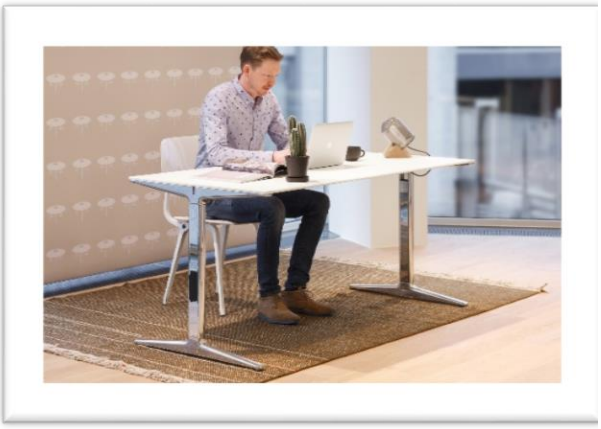

Figure 21. Workstations by Royal Ahrend. Modified after (Royal Ahrend, n.d.-b)

Royal Ahrend Leasing is made as simple as follows:

- No large investments upfront;
- Office furniture is leased starting at fixed €24 per seat per month;
- The leasing is made available either from 8 workstations or an order value of €10000;
- The leasing maturity periods are set either after 12 months or up to 60 months;
- The company takes responsibility for maintenance of functionality consistence and upgrades;
- At the end of each leasing period if the client decides not to renew, Royal Ahrend retains ownership of the product therefore, collects the furniture;
- Royal Ahrend makes sure that the furniture is fit for reuse and lease it again;
- Parts are disassembled and used again;

However, note that 50-60% of Royal Ahrend is sold through tenders which is equivalent to slightly more than €150 million or half of the company's annual turnover in total (Seijs, 2016). That being said, Royal Ahrend offers 10 years guaranteed take back for all its furniture sold through tenders where it states in the contract what it will use the old furniture for (ibid). However, all take-back systems are only offered in The Netherlands (Seijs, 2016).

Further, Royal Ahrend also collaborates with partner company Ahrend Reuse which actively collects old furniture on the market (ibid). Ahrend Reuse either resells the furniture for reuse or refurbishes it (Seijs, 2016). In this way, Royal Ahrend has been since 2012, a zero-waste to landfill company (Royal Ahrend, n.d.-b). Although Royal Ahrend offers incentives of up to €50, active participation is estimated to be less than 5%. However, from lessons learned all along the material recovery and circularity, from take-back throughout product service systems, Royal Ahrend aims at continuous optimization. The company now has inserted tags and chips in its products for tracing. Clients hardly know how much furniture they have in their offices, what type and where it is:

» […] there is no control over the materials…it's really scary […] You cannot really guide materials through circular loop if you don't have control over this information […] « (Seijs, 2016).

The chips also collect data related to furniture ergonometric, functionality and materials depreciation. Knowing how the product is used is important most especially in circular business concepts aiming at product and material circularity (ibid). Additionally, to make data collection a fun experience for both clients and the company, Royal Ahrend has also developed an interactive App (Seijs, 2016). Collecting all this kind of data is necessary for optimizing product design suitable for leasing as well as product reuse and material revalorization (ibid). Additionally, the chips are also now being used by clients to trace unused spaces in their buildings (Seijs, 2016). In return, the lighting, heating or cooling in such unused spaces can be switched off thereby saving costs of energy and related environmental impacts as well:

» […] what we have learned is never sell something just because its circular. Always have something in the model that helps people to do their work better or saves them money or help them more insight in what they are doing [...]« (Seijs, 2016).

For instance, Royal Ahrend sells 50-60% of its furniture through tenders. Although the lowest bidder wins the tender approach has changed now to a more budget oriented, 5-10% of overall clients ask for circular economy and 1% out of the 5-10% actually gets it (Seijs, 2016). However, this is increasing now (ibid).

6.3.3 State of the art experiences: Lessons learned

This is a summary of experiences and lessons learned by Royal Ahrend, summarized after (Seijs, 2016)

1. Related to raw materials

In order to ensure reciprocal and efficient material circularity along with sustainability, Royal Ahrend uses cradle to cradle certified raw materials (Seijs, 2016). Royal Ahrend works with raw material suppliers that are located close to

its production facilities in The Netherlands (ibid). In order to ensure shared values and increase resource efficiency, the company's main raw material suppliers are located within Europe, mainly in The Netherlands, Belgium, Germany, Denmark among others (Seijs, 2016). In order, to ensure shared values in terms of material circularity, sustainable practices and circular business concepts, Royal Ahrend closely collaborates with its suppliers (ibid). The company has established partnerships with some of its suppliers based on sharing materials, recycling as well as circular business concepts (Seijs, 2016).

2. *Related to production*

Royal Ahrend has for many years continuously optimized it production systems and facilities through lean management practices and cleaner technologies (Seijs, 2016). Based on best available techniques, these continuous optimizations aim at increasing resource efficiency as well as reducing water and air pollutions (ibid). The company now use 100% renewable energy in all its production systems thereby reducing the carbon footprint of its office furniture (Seijs, 2016).
In terms of design, as a cradle to cradle certified company, Royal Ahrend designs for cradle to cradle as well eco-design (ibid). Cradle to cradle design concepts encompass such features as durability, detoxification, reuse, easy assembly and disassembly for easy repair, refurbish, remanufacture and proper recycling program (Seijs, 2016). Eco-design aims at energy efficiency in the production and use as well as material recyclability (ibid). Altogether, these design concepts serve as a way of optimizing resource efficiency, circularity and recycle-ability (Seijs, 2016). For a furniture company according to Seijs, C2C is an inevitable prerequisite for circular business concepts.

3. *Related to circular business models*

In terms of circular business models, Royal Ahrend has learned that:

- Never sell something just because its circular but always have something in the business model that also directly helps people in their everyday life- could be at work, saving money or understand themselves better (Seijs, 2016);
- Circular business concepts for product and material recovery for revalorization require careful and reciprocal material selection all the way from suppliers to design concepts however, it is necessary to learn how users interact with the products during use and thereafter iterative (Seijs, 2016). There is need to have control over materials within the company but also within the consumers in order to close the loop (ibid);

- Use disruptive interactive technologies such as apps, chips etc. for data collection that in turn, will give the company a useful insight in relation to the interaction between the company's products and users. These kinds of technologies are also bringing the company and consumers closer than ever before and thereby enhancing the relationships and shared values (Seijs, 2016);
- Circular business concepts require adoption time there is therefore, need to continuously educate consumers about circular economy and how they can benefit from circular business concepts (Seijs, 2016). Through take-back system at Royal Ahrend, less than 5% of the office furniture are returned to Royal Ahrend after use (ibid);

- The financial feasibility of circular business concepts is still affected with the current prices of raw materials. The current trend so far is that virgin materials cost less than second generation materials. When a company implements circular business concepts, it is going out of its own boundaries therefore, it might be necessary to find different financers and investors for circular business models;

- Creating mutual partnerships is the key in achieving circular business concept (Seijs, 2016).
  Although meeting the right partners at the right time takes time, Seijs encourages companies to indulge more in networking activities such café workshops to develop it. Whether big or small, old or start-ups, it is necessary to interact and participate in circular economy and circular business concepts events or workshops (Seijs, 2016). Royal Ahrend currently offer advisory assistance to start-ups and small companies, however, interacting with such companies also gives old and well-established companies such

as Royal Ahrend itself time to reflect and also learn something new (ibid). There is however according to Seijs, need for more business oriented social platforms for exposure.
Most important, creating beneficial mutual partnerships demands some kind of trust that goes beyond the ‘’classic business trust’’ (Seijs, 2016). Sometimes companies need to interact more on a social level than the classic business interactions to develop trust (ibid). There is need for companies to somehow open up and share business concepts (Seijs, 2016). Usually, sustainability people talk to each other in different companies but there is need to bring in the influential stakeholders and that’s difficult because they have the normal accounts and logistic departments but then it helps when a CEO with a drive on a more senior level is on board (Seijs, 2016). It might take months or even years to make it to that level (ibid);

- There is need to focus more on the incremental continuous improvements most especially companies who have already improved 80% of the business. The remaining 20% is usually expensive;

» When you are the first to do something, you will usually invest more because nobody has ever done it before « (Seijs, 2016).

7 CENTRAL CASE STUDY- BETTER WORLD FASHION

Chapter 7 presents one of the best cases in Denmark. The company creates a fashion brand from leather waste. Additionally, the company offers its consumers both leasing and take-back schemes.

7.1 BETTER WORLD FASHION

Better World Fashion is the company that I have closely worked with throughout this last semester. Better World Fashion presents a best case in terms of systems thinking, disruptive circular business model innovations and is therefore the central case study.

This chapter will present the history and company description, systems thinking, disruptive circular business models, experiences and lessons learned by Better World Fashion. Also see appendix 11.10 for the key sustainability issues associated with the leather industry, the current development in relation to the global and EU leather productions and market.

7.2 HISTORY AND COMPANY DESCRIPTION

Primary sources: Reimer Ivang & Karsten Ivan, Co-founders of Better World Fashion

BWF in short, Better World Fashion is a start-up company which tailors and sells handmade second generation leather jackets of greater value i.e. fashion, quality, functionality and environmental wise (BWF, 2016). The company is headquartered in Nørresundby in Aalborg, Denmark (ibid)

The idea behind Better World Fashion was initiated by two businessmen Karsten Lund and Reimer Ivang in September, 2014 (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Karsten Lund has extensive practical experience within the textile and fashion industry at home and abroad (Lund, 2016). Out of 20 years of experience within the textile and leather industry, Karsten worked and lived in Southeast Asia for 14 years (ibid). Reimer Ivang has a profound history on business start-up with focus on digitalization, online marketing, e-commerce (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Additionally, he is an associate professor in international marketing and new media at Aalborg University (BWF, 2016). Further, Kresten Thomsen joined as a third co-founder.

Kresten Thomsen is called ‘’the BWF’s- technology nerd’’ and has 15 years of experience within entrepreneurship (BWF, 2016). As a serial entrepreneur, Kresten was inspired by the circular business concepts his two friends Reimer and Karsten were about to develop and he decided to team up with them (Ivang, Interview with Reimer

Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Kresten is also the general manager of Aalborg Carnival parade (BWF, 2016). As the general manager of Aalborg Carnival Parade, Kresten is also inspired by the great driving force of social networking in mobilizing innovation (ibid) (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Kresten, Reimer and Karsten are the co-founders of Better World Fashion up to date.

However, the journey towards circular business concepts at Better World Fashion began after a lunch meeting between Reimer and Karsten in September 14, 2014 (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Reflecting on his extensive years of experience within textile and fashion industry both in Europe and Southeast Asia, quote:

» I warn you not to search for images about like what's going on in Cambodia and Thailand for instance […]. You can call your local brands sustainable but if you actually witness the conditions under which these brands are manufactured and what happens with the products at the end […] « (Lund, 2016).

Among other hands-on experiences Karsten recalls, deals with the complexity of sustainability in relation to social and child labor issues within the textile and fashion industry in Southeast Asia. BBC revealed that there was a lot of child labor within the textile industry, all child laborers were thrown out (Lund, 2016). However:

» […] three years later BBC came again to follow up with what had happened thereafter […] some of the girls became prostitutes, some of the boys curving gravel stones…their conditions were worse than three before [...]« (Lund, 2016).

Karsten came up with an idea to establish an online reused leather fashion brand and that's when he decided to meet up with Reimer who has a research background on business start-up with focus on digitalization, online marketing, e-commerce (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). However, after brainstorming and discussions:

» […] We decided that it would be only half a victory if we made reused leather jackets and sold them because then they would just get passive when people didn't want to use them anymore [...] they eventually, would become waste. « (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

Ensuring continuous reuse of its jackets and materials the company offers both product-service (leasing) and take-back systems.

7.3 SYSTEMS THINKING AT BETTER WORLD FASHION

7.3.1 Raw materials

Better World Fashion uses leather waste as the major material in the production of its sustainable fashion brand of leather jackets (Lund, 2016). In terms of the decision to use waste leather as the major material, the primary driver for Better World Fashion, is to deal with sustainability issues associated with the production of raw hides and the impacts due of virgin leather (Lund, 2016); (BWF, 2016). Secondly, the company is driven by the current waste generation associated with the fashion industry today at end of use, which contradicts the durability of leather itself (Lund, 2016); (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Although, there are reuse organizations and shops, the standard reuse struggles to deal with the current volumes of waste generated within the fashion industry today:

» […] from my personal experience, what they cannot sell in the shops either because it's not good enough or they have too much they can't sell…they sell it to global traders […] « (Lund, 2016).

The reuse trade has become a big industry that ships significant volumes of old garments around the globe (Lund, 2016). The shipping among other impacts represent resource inefficiency and greenhouse gas emissions associated with shipping (ibid). Better World Fashion has made agreements to buy leather waste from reuse organizations and shops such as Red Cross, UFF in Denmark and other Scandinavia countries and Germany (Lund, 2016). Moreover, Better World Fashion accepts old leather from anyone local or regional or national with a story to tell (Lund, 2016). For instance, Better World Fashion has received an old jacket from a DSB train operator, who has been operating DSB trains all over Denmark for the past 35 years (Lund, 2016). Such stories are precious and are supposed to be told, preserved and passed on to the next generation (ibid).

In terms of the lining materials, the company uses recycled polyester (rPET) made from plastic bottles supplied from China, but printed in Denmark by an eco-friendly company (Lund, 2016); (BWF, 2016). Polyester processed from rPET is said to reduce energy consumptions with more than 70% compared to manufacturing of virgin fiber (NRDC, 2011). Additionally, based on lifecycle assessment, polyester has been reported to have the less ecological impacts compared to cotton (Cherret, Barret, Clemett, Chadwick, & Chadwick, 2005). This is due to that the production of polyester involves no use of agrochemicals, land and water.

Further, Better World Fashion uses 70% recycled zippers supplied by YKK (Lund, 2016). According to Lund, this is the most sustainable zippers that suits the quality expectations of its brand. Nonetheless, the 70% recycled zipper counts for bottom and top stops, elements and tapes parts of the zipper which are made from rPET from plastic bottles (ibid). The slider and buttons are made from new aluminium (Lund, 2016). The only virgin materials used in the production of the company's jackets are the zipper sliders, prints and threads (ibid). The old threads and leftovers are sent back to its Danish supplier while the dysfunctional zipper sliders are sent for recycling (Lund, 2016). Better World Fashion's ambition is to use zippers where all components can be recycled (BWF, 2016). Recycling aluminium has been reported to reduce energy consumptions and related CO_2 emissions by 95% (Das, S., & Kaufman, 2010).

Further, based on sharing material resources, Better World Fashion has also arranged mutual partnerships with two companies within the region. Leather waste from Mogens Hansen, a Scandinavian handmade design furniture company is shared between Better World Fashion and Strunk (Bonefeld, 2016); (Lund, 2016). Strunk is an Aarhus based start-up brand of denim jeans hand tailored from hemp fiber (Bonefeld, 2016). Further, in order to increase its resource efficiency, Better World Fashion has chosen to have its major suppliers of materials closer to where its productions will take place (Lund, 2016).

7.3.2 Productions

After a successful launch on kickstarter, in March, 2016, Better World Fashion embarked on full productions (Lund, 2016). With its own team of quality control and designers, the leather jackets are designed in Denmark (ibid). About 2-2½ old jackets are used to produce one second generation jacket (Lund, 2016). Better World Fashion has contracted specialist tailors in the Baltic region in Lithuania, Bulgaria and Ukraine where the stripping, cutting and sowing will take place (ibid). However, Better World Fashion is further training its tailors in order to acquaint them to the circular value, design concepts and expected quality (Lund, 2016). Keeping all productions in Europe sets the company apart from the common practices within its industry:

» […] from a personal experience, some of in our industry do this in Phulket area in Thailand and Cambodia. In these areas people are so poor that they are not so concerned about pollutions and so forth in those areas […] « (Lund, 2016).

Setting up its productions closer to Denmark and its suppliers is also a sensible way of increasing the company's resource efficiency (Lund, 2016). The company is reducing logistic costs and greenhouse gas emissions associated with shipping across the globe (ibid). The company has made an agreement with a carbon neutral logistic company for transportation of its products (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Also related to energy consumption, two leather jackets are produced per tailor per day and the company estimates to use 0,6-1kwh electric energy per jacket

for drying and tailoring (Lund, 2016). In terms water, the company estimates to use about 1-2 liters of water for cleaning of old leather (ibid).

That being said, Better World has currently designed six prototypes, three for men and three for women. The six prototypes tell stories about Better World Fashion's six family members, Alexander the Retro biker, Peter the Street, Thomas the Vintage biker, Dayana the Vintage biker, Eik the cowboy and Tanja the Retro biker (BWF, 2016). The six prototypes have been named after them and the stories that runs in the Better World Fashion family (ibid);

» […] I don't believe that we can convince the consumer into a circular business model only just because it's good for nature […] « (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

If designing products that were good for nature was good enough, then consumers would be buying more of such products than what they buy today (Ivang, 2016). Therefore, Better World Fashion aims at creating a fashionable brand that is competitive enough on the current market however, with a clear sustainable value proposition.

Figure 22 below shows prototype Peter, the street and Eik, the cowboy

Figure 22. Better World Fashion's Scandinavian design Peter and Eik prototypes designed from 100% recycled leather and rPET. Picture modified after (BWF, 2016)

With a Scandinavian design for sustainability, all jackets are designed for maximum reusability, reparability and material recovery that facilitates an easy remake of new jackets (Lund, 2016). The jackets are designed suitable for men and women between the age of 20 and 50 (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

7.3.3 Recapturing value: Buy-back and product service system as sustainable value proposition at Better World Fashion

Better World Fashion circular business models are inspired from the founders' experiences that environmentalism has most often coerced people into doing things they normally do not like (Ivang, 2016). The company strives to

continuously innovate its sustainable value proposition by offering solutions that let people continue doing what they like however, sustainably:

» […] our starting point is the existing consumption model and then we take the responsibility to make that consumption model less polluting, less resource demanding […] we offer our customers a leasing or buy-back [...] « (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

7.3.3.1 Product-service system at Better World Fashion

To retain ownership and ensure long life for its products and materials, Better World Fashion offers its customers a leasing model and it works as follows:

- The user leases a jacket for an average price of DKK 170 per month for a minimum leasing period of six months;
- The user can either renew the leasing contract if they still like the jacket or;
- Send the jacket back to the company and lease a new jacket of any design;
- If the user decides to lease a new jacket more than six months, the company sells this service as a package deal ranging between DKK 200-300 (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

In order to facilitate a user to transfer user-ship, Better World Fashion is developing an App as an after-market service (ibid). With this App, users can transfer the user-ship/leasing contract to their family members, friends or whoever would like to take over the jacket (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Discounts will be offered to lessees who will make ownership transfer transactions through this The lessee who transfers his/her jacket to a new user using this App will get a 2-month free upon if he/she wishes to lease a new jacket (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). The new jacket lessee will thereon have to pay leasing fee of DKK 100 per jacket per month, which is a DKK 70 discount per jacket per month (ibid).

Ownership transfers through this App will also save costs associated with packaging, logistics and environmental impacts, if these exchanges had to be done to and from Aalborg (ibid). The App has a tracking option through which Better World Fashion and users can spot each other (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Such data as for instance, users bicycling to deliver or collect a jacket will be collected, distances recorded, environmental savings calculated and story told (ibid).

For customers who opt not to lease, but purchase a Better World Fashion jacket, the company offers a Buy-back scheme (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

7.3.3.2 Buy-back scheme and story-telling

The buy-back scheme is a membership model where the customer purchases a jacket for DKK 2500 to become a member of the Better World Fashion Club (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016). Members gets a 50% discount on all jackets that they will purchase thereafter, as long as they return the old one (ibid). If a member decides to keep his/her jacket and wants to buy a new one, he/she will have to buy a new membership (ibid).

Further, adding more value to each jacket returned, Better World Fashion collects stories from users and buy-back club members about their special experiences with the jacket. This builds up the storytelling as initiated from its first six prototypes. Through storytelling, each jacket becomes more unique and "wiser" with time because each jacket will have experienced different and special moments from user to user:

» There are some African cultures that mourn more the death of the elderly than the death of a child because when the elderly die, they die along with wisdom. This is the image of our brand […] « (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016).

Further, when the jackets return from users, the following happens:

- The new stories are collected;
- The jacket is cleaned;
- The lining material is changed and the old lining materials are sent back for recycling;
- The jacket is put back into use (Lund, 2016).

Better World Fashion expects that the jacket circulates 15 times before recycled and redesigned (Ivang, 2016a). This means that the jacket would have been worn by15 different users for a given period of time preferably, for a minimum of 6 months per user (ibid). In this way, materials can be reused over and over again, thereby the closing of the material loop. See figure 23 below

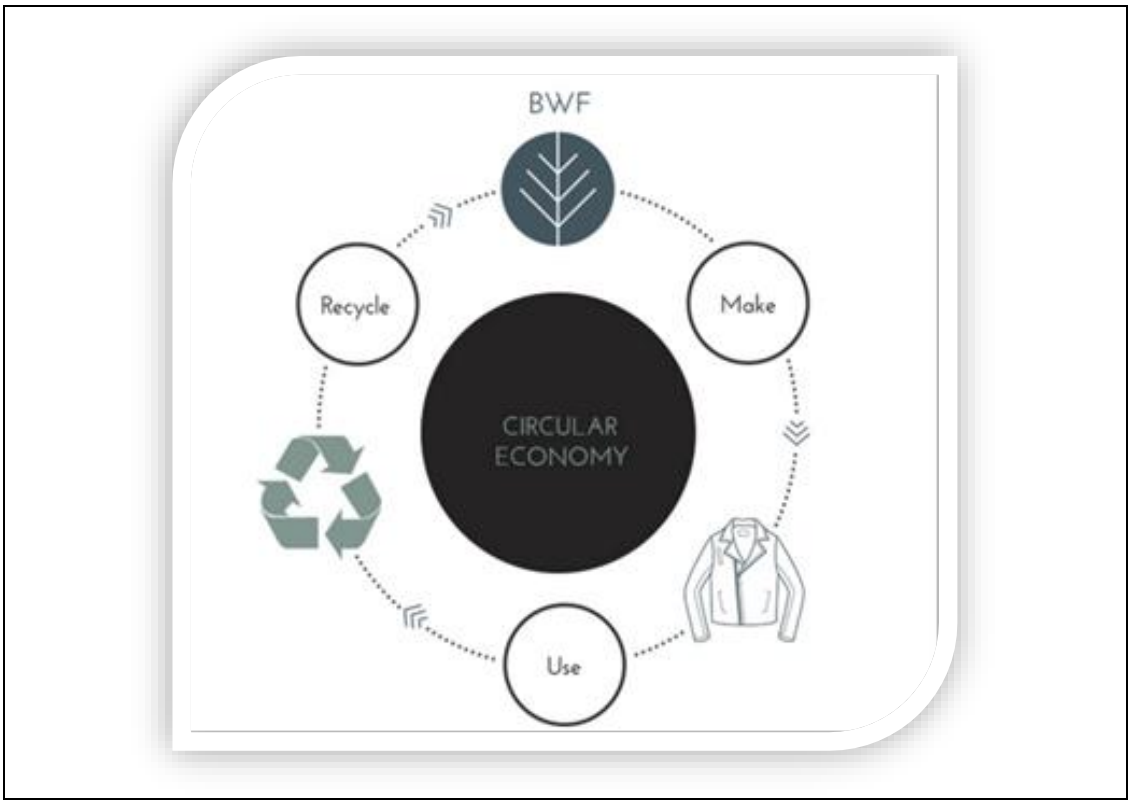

Figure 23. The closing of material loop at Better World Fashion. Figure Modified after (BWF, 2016)

7.4 STATE OF THE ART EXPERIENCES: LESSONS LEARNED

This is a summary of experiences and lessons learned by Better World Fashion, summarized after Ivang; Lund, (2016).

1. Related to raw materials

Better World Fashion has carefully selected materials for the production of its sustainable fashion brand. The selection of the materials is based on the reciprocity of its circular business concepts (Ivang, 2016). The company is inspired by the durability of leather and the generation of waste at end of use (ibid). Quite contradictory to sustainability issues associated with hides and leather productions, there are still significant volumes of waste leather jackets (Ivang, 2016). Therefore, Better World Fashion has chosen to create value from waste leather jackets. The

company is closely collaborating with nearby reuse organizations in Scandinavia and Germany (Lund, 2016). What Better World Fashion experiences is that the standard reuse cannot capacitate the current volumes of disposed garments (ibid). Therefore, the standard reuse business is currently trading old garments all over the world and the business has turned into a big industry (Lund, 2016). Although reuse is better than incineration, the global shipping involves significant greenhouse gas emissions due to logistics (ibid). Additionally, the standard reuse does not necessarily raise awareness about the issues associated with waste generation by mere shipping this waste abroad (Lund, 2016). Additionally, the waste generation in end destination causes great concern (ibid). Better World Fashion has chosen to closely collaborate with the nearby Scandinavian Red Cross and UFF in Denmark and Germany also as a way of increasing resource efficiency as well as raising awareness by reducing waste within the fashion industry (Ivang, 2016); (Lund, 2016). Among other sustainable materials used by Better World Fashion include the use of 100% recycled polyester (rPET) from recycled bottles. 100% rPET has selection for the lining material due to its environmental friendlier eco-footprint compared to cotton (Lund, 2016).

2. Related to production

To ensure sustainable productions, Better World Fashion uses cleaner technologies such as energy efficient industrial sowing machines and driers (Lund, 2016). According to Lund, the company estimates to use about 0.6-1 kwh electric energy and 1-2 liters of water in the production of one jacket. To produce one jacket, Better World Fashion saves about 2.5 jackets from becoming waste (Lund, 2016). Further the company designs for easy assembly and disassembly in order to facilitate repairs and reuse thereby prolonging the life of its jackets in the inner circles (ibid).

That being said however, Better World Fashion has learned that the current communicative tools such as eco-certifications for instance C2C are necessary. However, most of certifications need to rethink the criteria for measuring sustainability. For instance, although the production processes of a Better World Fashion jacket fulfill the requirements of the statutory EU and Nordic eco-labels, the jacket cannot be certified (Hansen, 2016). This is due to the use of chrome in the production of virgin leather (ibid). Further, although the lifecycle thinking is applicable in circular business concepts at Better World Fashion, the use of tools such as LCA can only be relevant if the company has to quantitatively compare its lifecycle thinking performance to other similar players on the market (Weidema, 2016). However, the use of waste leather may not imply that the production of virgin leather is reduced by purchasing a second generation leather jacket (ibid). This is due to that raw hides and skins are by-products of animal husbandry (Weidema, 2016).

Additionally, certifications are increasingly becoming significant media for fashion brands to communicate their sustainability to consumers (Ivang, 2016b). Buzzwords such as ‘’sustainable brand’’ and ‘’organic certified’’ are widespread within mainstream fashion brands nowadays (ibid). However, these do not clearly imply that these brands are striving for the triple bottom line and circularity (Ivang, 2016b). Complementary, as long as outsourcing in Asia is still the common practice, social sustainability in the fashion industry remains a complex and wicked problem (Lund, 2016). Therefore, in order to increase transparency and awareness of the benefits of second generation products, there will be need to rethink business to customer communicative tools and criteria that are based more on the impacts of the business circularity on the triple bottom line as an entirety (Ivang, 2016b).

3. Related circular business models

Better World Fashion is learning that:

- It is vital for circular businesses to innovate services, products and business models by observing and evolving with the current consumption trends as a starting point. In this way, the business will be capable of designing sustainable services and products that are competitive on the market (Ivang, 2016);
- Circular business concepts require careful design approach and reciprocal selection of raw materials (ibid);

- Circular business models demand exposure for both marketing, raising awareness by educating consumers, finding the right partners/collaborations and etc. (Ivang, 2016). While engaging and interacting with its consumers on Facebook, Twitter, Instagram and Pinterest, Better World Fashion accepts interview requests

from the media (ibid). The company has recently been featured by The Guardian as one of the sustainable fashion brands (Hannah Gould, 2016). Giving interviews to radio and TV stations in Denmark and abroad, the company has been interviewed by the Chief Editor of the Ellen MacArthur Foundation- a big platform for circular economy (Ivang, 2016). For more exposure and interaction, circular businesses should make use and share their business concepts and knowledge in all platforms from local Start-up Café workshops in Aalborg to radio interviews in the UK (ibid)

- Partnerships based on circularity are also necessary. Better World Fashion has already initiated mutual partnerships based on material share-ability. Leather cuttings that would otherwise, become waste at Mogens Hansen (handmade furniture company based in Aarhus) is now shared between Better World Fashion and Strunk (a denim jeans brand made from hemp based in Aarhus) (Lund, 2016); (Bonefeld, 2016).

- Keep production operations and suppliers closer as a way of ensuring resource efficiency, and shared value in terms quality expectations, social responsibility and circular business concepts (Lund, 2016)

- Standard financers, funders and investors are yet to adapt to circular business concepts. Better World Fashion has recently re-applied for funding from Innovation Fund Denmark (IFD). Although fulfilling the requirements, previous applications were turned down. Established by the Danish Ministry of Education and Research IFD funds innovative projects with potential of generating growth and employment (IFD, n.d.).
  Better World Fashion has also participated in a Danish television program called Løvernes Hule through which businesses and start-ups pitch their business concepts to a group of interested industrial investors (Ivang, 2016a). Although, the investors thought that the business models have great potential, they were skeptic towards the risk of such disruptive business models and therefore, they decided not to invest (ibid). Prior to all this, on February 15, 2016, Better World Fashion successfully launched its campaign on Kickstarter. The company was 104% backed (Kickstarter, 2016). Through Kickstarter, Better World Fashion has exposed its sustainable brand to a broader market in Denmark, the USA, the UK, Germany, the Netherlands, Australia, Canada, France, Sweden, Norway, Hong Kong, New Zealand (Ivang, Interview with Reimer Ivang, Co-founder of Better World about the company history and circular business concepts development, 2016)

8 ANALYSIS

This chapter analyzes systems thinking, sustainability and lessons learned from the investigated business cases. Lessons learned will focus only on overall common issues. Systems thinking sustainability approaches will be analyzed in terms of:

- Circular business models aiming at product and material revalorization;
- Selection of materials, suppliers and their location in relation to investigated companies' production activities, also related to;
- Production in terms of location to suppliers, cleaner productions and design concepts reciprocity to implemented circular business models
- Partnerships established to ensure optimized circularity. See figure 24 below for interconnected factors from which the analysis is based on (see appendix 11.9 for a clearer format of figure 24)

COMPANY	INDUSTRY	CIRCULAR BUSINESS MODELS	COMPANY LOCATION	LOCATION OF PRODUCTIONS	LOCATION OF SUPPLIERS	RAW MATERIALS	CREATING VALUE FROM WASTE	CLEANER PRODUCTIONS	PRODUCTS	PARTNERSHIPS
BETTER WORLD FASHION	Fashion	Lease+ Take-back	Aalborg, Denmark	Lithuania, Ukraine & Bulgaria	Red Cross and UFF in Denmark, other Scandinavian countries, Germany & China		Old leather & rPET polyester + recyclable zipper sliders	Modern sowing machines, certified printing factory, techniques for low energy and water consumptions	2nd generation leather jackets	Red Cross & UFF: Based on shared value
MUD JEANS	Fashion	Lease+ Take-back	Almere, The Netherlands	Italy, Spain, Turkey, Egypt & Tunisia		GOTS &BCI certified cotton	Recycled cotton and collection waste jeans	Cleaner technologies+FLO CERT certified factories++	GOTS & BCI certified jeans, shirts, T-shirts, Cardigans++	Yousstex, Tejidos Royo, Sagarli Srl, Quadrifoglio Srl. Based on shared value
ROYAL AUPING	Furnishing	Take-back	Deventer, The Netherlands	Deventer, The Netherlands	The Netherlands, Germany, Belgium and Denmark	C2C certified +++		Smart and cleaner technologies	Beds and C2C mattresses	Kvadrat, Tetour Matras ++Based on shared value, business concepts and material share-bility
ROYAL AHREND	Furnishing	Lease+ Take-back	Amsterdam, The Netherlands	Zwanenburg & Sint-Oedenrode, The Netherlands	In Europe e.g. The Netherlands, Germany, Belgium, Denmark	C2C certified +++		Smart and cleaner technologies+ 100% renewable energy	C2C certified office furniture	Gabriel, Ahrend Reuse, TECHO, CSR++ Based on shared value, business concepts and material share-bility

Figure 24. Interconnected factors of the Analysis

8.1 SYSTEMS THINKING AND PARTNERSHIPS

8.1.1 Circular business models: Recapturing value during and after product use

In all the investigated cases, take back systems and product service systems are the most predominant circular business concepts. Three out of four of the cases implement both take-back schemes and leasing models. Royal Auping implements only a take-back scheme for its mattresses. Both circular business models aimed at recapturing value during and at end of product use. Concerning the take back schemes, active customer participation in the investigated cases ranges between 5-30%. Less than 5% of the office furniture are returned to Royal Ahrend after use while about 25-30% of the mattresses are returned to Royal Auping. Additionally, Royal Ahrend sells 50-60% of its furniture through tenders. However, in terms of circular procurement, although the lowest bidder wins the tender approach has changed now to a more budget oriented, 5-10% of overall clients ask for circular procurement and 1% out of the 5-10% actually understands it (Seijs, 2016). Concerning the leasing model, Mud Jeans estimates 40% of customer participation. Better World Fashion has recently launched and therefore, estimates are not yet available.

8.1.2 Raw materials and suppliers

First foremost, all the investigated cases demonstrate a similar pattern in the selection of raw materials. The pattern within material selection responsively addresses issues such as material and product durability, reusability, upcycle-ability and recycle-ability. Secondly, except for Better World Fashion, all the Dutch cases have opted for certified raw materials. Royal Auping and Royal Ahrend for instance, use C2Ccertified raw materials while Mud Jeans uses GOTS (organic) and BCI certified cotton. Working with certified suppliers is a predominant approach of ensuring sustainability upstream within the Dutch companies. Additionally, like Better World Fashion that creates value from leather waste, Mud Jeans has also embarked on the collection of old jeans along with the use of recycled cotton.

Lastly, all companies have opted to keep circles of their supply chain close to production activities, predominantly in Europe. All the investigated Dutch furnishing companies for instance, Royal Auping and Royal Ahrend have kept all their suppliers strictly in Europe. As for the fashion companies, Mud Jeans has suppliers in Tunisia and Egypt however, relatively close to The Netherlands. In Denmark, although rPET lining materials are supplied from China,

Better World Fashion collects leather waste predominantly in Denmark, other Scandinavian countries and Germany. Keeping closer circles within the supply chain is a predominant approach to optimizing resource efficiency, shared value, also related to communications and close relationships within the value chain.

8.1.3 Production

In terms of production activities, as hinted earlier on, the investigated cases are striving to keep their productions as close to its supply chain as possible. For instance, both Royal Ahrend and Royal Auping have kept all their production activities strictly in The Netherlands. However, there are exceptions within the fashion business cases both in The Netherlands and Denmark. Although most of the production activities for Mud Jeans take place in Italy, Spain and Turkey, some productions take place also in Egypt and Tunisia. Logistic wise however, Egypt and Tunisia are located relatively close to The Netherlands. Additionally, these factories are certified by FLOCERT among other certifications. As for Better World Fashion all productions take place in Europe (Lithuania, Ukraine and Bulgaria).

Further in terms of design, all the investigated companies predominantly design for easy disassembly. This is to ensure easy repairability, product reusability, easy upcycle-ability and recycle-ability. For instance, Royal Ahrend and Royal Auping have adopted C2C design concepts that require product and material revalorization, elimination of toxic chemical substances and effective recycling programs. In Denmark, Better World Fashion designs jackets that can be used, repaired and reused by fifteen different users at a minimum period of 6 months per user. Both C2C and easy disassembly design concepts optimize resource efficiency by prolonging products life within the inner circles and ensuring upcycling and recycling in the outermost circle.

Furthermore, cleaner production is also predominant. For instance, Royal Auping and Royal Ahrend have over the past decades, continuously optimized their production factories. These have been achieved through investing in cleaner technologies and lean production management practices. Such cleaner technologies as related to high resource efficiency in terms of energy and water consumptions as well as reductions of waste, water and air pollutions. For instance, Royal Ahrend exceptionally uses 100% renewable energy. Mud Jeans is also striving to produce in factories that are certified and use best available technologies. In Denmark, Better World Fashion uses best techniques in terms of water and energy reductions in the production. Additionally, through the use modern sowing and drying machines, Better World Fashion estimates to use about 0,6-1kwh electric energy and 1-2 liters per jacket produced.

In terms cleaner technologies, the bigger companies are more independent compared to Better World Fashion and Mud Jeans. Both Royal Ahrend and Royal Auping have their own production factories, while the other two companies do not. The smaller companies are more dependent on contracting better factories as well as striving for best techniques.

8.1.4 Partnerships

Partnerships play a vital role within the investigated cases all along the value chain. However, their bases vary from one company to another. Although these variations exist, there is somewhat as observed, a pattern that may also relate to purposes of the partnerships. The pattern of partnerships starts from raw material suppliers, production, end of use and in one case, the financing of circular business concepts.

Close collaborations with suppliers are in relation to shared values in terms of quality, sustainability also in relation to material circularity. For instance, three out of four cases have established partnerships with some of their suppliers in order to ensure the aforementioned shared values. Royal Auping has established a partnership with Kvadrat, a Danish fabric supplier based on principles of C2C and sharing materials, that would otherwise become waste. Close collaborations between these two companies are also aiming at sharing business concepts. Similar partnerships are also observed at Royal Ahrend. Royal Ahrend has however, established an additional partnership based on financing its circular business concepts. In Denmark, aiming at enhancing leather waste collection, Better World Fashion has established partnerships with Red Cross and UFF in Scandinavia and Germany. Additionally, the company has established partnerships between Mogens Hansen and Strunk based material share-ability. As for Mud Jeans, sustainability in the upper stream is majorly ensured through the use eco-certified raw materials and the

company's own waste collection program. Within the production, Mud Jeans has established partnerships with all its production factories in Italy. Based on enhancing cotton recycling, the company has also established a close relationship with Tejidos Royo in Spain.

The downstream partnerships at end of product use are mainly observed within the two furnishing companies. Royal Auping has established partnerships with RetourMatras, a company that upcycles old mattresses into for example, yoga mats and carpets. Royal Ahrend works with Ahrend Reuse, a sister company that collects, repairs, refurbishes and remanufactures Royal Ahrend old furniture.

8.1.5 Lessons learned and Prerequisites for circular business concepts

In spite of the differences in the company size, age and maturity, all the investigated are observed to have similar experiences in relation to the development and implementation of circular business concepts.

First and foremost, value propositions in circular business concepts disrupt or challenges the predominant product ownership thinking. Concerning the take back schemes, active customer participation in the investigated cases ranges between 5-30%. Less than 5% of the office furniture are returned to Royal Ahrend after use, while about 25-30% of the mattresses are returned to Royal Auping. Additionally, although Royal Ahrend sells more than 60% of its office furniture through tenders, 1% out the 10% of the clients who ask for circular procurement really understands it. In terms of the leasing model at Mud Jeans, it accounts for about 40% of the company's turnover. The three Dutch cases have learned that circular business concepts need adoption time and should be approached likewise in a step-by-step way. Therefore:

- Companies should seek to continuously educate their target market about the benefits of their circular value proposition. It is inevitable to engage the target market on a journey that raises awareness. Common methods include to engage by continuously interacting with customers through the use of social media and viral marketing. The story telling approach may be useful for viral marketing;

- However, the sustainability story telling by itself is not enough. Therefore, companies should rethink by creating services and products that are competitive on the market. Straightforwardly, create services and products that are fashionable, competitive and beneficial to the target market. In this way, the circular value proposition becomes an X-factor of setting the company and its consumers apart from the rest;
- Companies should seek to make their circular value proposition clear and simple. Avoid jungles of options and information- customers will get astray. Clear and short, highlight your concept, offer your product and a few options;

- Further, there is need to rethink the standard criteria and/or tools for measuring sustainability that's rather based on the triple bottom line than selective elements. For instance, being organic certified is an important aspect of sustainability but does not whatsoever, automatically reflect the certified products lifecycle perspective unless circularity has been embedded in the design. Nonetheless, in spite their significance, sustainability reporting and eco-labels have increasingly become buzzwords within the fashion industry as most of the eco-labels address selective aspects of sustainability. That being said, the significance of sustainability reporting and eco-labels is becoming more important, especially when companies have to communicate to customers who are increasingly becoming aware of for instance, the waste generation issues associated the fashion industry. However, this observation has been more related to the two fashion companies. The two furnishing companies are cradle to cradle certified, which strongly requires material circularity. Although for instance, Better World Fashion fulfils most of C2C requirements, it has been established that the company's jackets may not achieve the certification due to the use of chrome in the production of virgin leather;

- In terms of financial feasibility of the investigated circular business concepts, material revalorization is at the moment sensitive to and affected by the current lower prices of virgin materials. During the adoption time, all the investigated business cases are in one way or the other, striving to find alternative means for

their circular business concepts to become financially sensible. For instance, the furnishing companies are collaborating with partner companies that take over the reuse, refurbish and remanufacture of the recovered materials. Within the fashion cases, Mud Jeans is now collaborating with Tejidos Royo for the recycling of cotton while Better World Fashion has established collaborations with Red Cross and UFF. Additionally, all the investigated cases are also striving to find alternative means of financing their circular business concepts. Collectively, the investigated cases express the need to rethink the banking system and policies. Below are lessons learned also in support of need to rethink the banking system and policies:

- Rethink the standard banking system: As observed from three investigated cases, active customer participation in circular value proposition ranges between 5-30%. Less than 5% of the office furniture are returned to Royal Ahrend after use while about 25-30% of the mattresses are returned to Royal Auping. Also note that Royal Ahrend sells 50-60% of its furniture through tenders. Although the lowest bidder wins the tender approach has changed now to a more budget oriented, 5-10% of overall clients ask for circular economy and 1% out of the 5-10% actually understands circular procurement and its benefits. Additionally, the leasing model at Mud Jeans accounts for about 40% of the company's turnover. Observed from these three cases, circular business concepts require adoption time therefore, there is need for the standard banking system to change from collateral to cash flow based approach;

- Additionally, and also related to second generation products, there is need for the standard banking system to change the current valuation and risk model. There is need for a valuation and risk model that captures the value of second generation products instead of the current model that writes them off instead. There is need for financers to take into account the value of products at end of their lifetime (ING, 2015). However, this is at the moment, viewed as too risky by the current banking system most especially, for products with a negative value at end of life (ibid). The negative end of life value in some products is associated with the collection and disassembly costs which in some cases may be, higher than the value of the recycled material (ING, 2015). However, for many products according to ING, (2015) the end of life value is often yields a positive return. There is therefore, need for the financers to aid the recapturing of end of life value of products by developing more accurate models that rather forecast the price development of second generation materials than write them off (ING, 2015);

- The last lesson expresses the need to rethink policies. Also interconnected to the aforementioned current banking system and active customer participation, the adoption time of circular business concepts requires reciprocal policies. All business cases point towards the need for such policies that facilitate and stimulate circular business concepts through for instance, financial incentives and consumer education. In order to raise consumer awareness, there is need for policies that educate society about circular economy and promote the benefits circular value propositions.

- Lastly, in all investigated cases, partnerships have been observed to play a significant role in the development and implementation of circular business concepts. Close relations have been observed all the way from raw material suppliers, productions and the end of products use. These close relations are variably based on promoting shared values, material circularity and sharing business concepts.

9 CONCLUSION

Success in doing business has for many decades been measured on sales volumes, the single bottom. Design for planned obsolescence has been the predominant approach to maximize the single bottom line. However, planned obsolescence has resulted into the *make-use-discard* linear economy which has led to generation of waste along with the loss of valuable materials. Besides, the linear economy has resulted into the depletion of finite resources due to the continuous extraction of virgin materials.

The predominant uses of non-renewables and toxic chemical substances in current value creation activities has led to both short and long term environmental and social impacts. Therefore, sustainability discourse nowadays seeks to find ways of achieving the triple bottom line. The success to doing business nowadays is shifting focus from the single bottom line to embedding the success in dealing with the social and ecological impacts a business's value creating activities bear. However, the triple bottom line deals with being successful in optimizing the financial, social and environmental benefits of the business. To achieve these three interconnected elements, require systems thinking approaches. Therefore, a paradigm shift is currently going on from linear towards a circular economy which is based on the cradle to cradle philosophy. Cradle to cradle philosophy is based on imitating biological metabolism in the way we make things where materials are recovered and revalorized, while toxic chemicals substances are eliminated. Some of the business models that have been conceptualized out of principles of circular economy that are aimed at indefinite material revalorization include take-back systems and product-service system.

The goal of this master thesis was therefore to explore state of the art systems thinking approaches and lessons learned by four companies, which have implemented the aforementioned business models within the fashion and furnishing industry. Additionally, this master thesis aimed at exploring what kinds partnerships are established in the development of circular business concepts.

1. ***How are systems thinking and circular business models aiming at product and material revalorization with the fashion and furnishing companies approached?***

- *Circular business models*

Take-back and product-service systems have been the most predominant circular business models aimed at product and material recovery for revalorization. Three investigated cases successfully implement both business models while one only implement take-back system.

- *Raw materials/materials*

A careful selection of materials and suppliers has been observed predominant in all cases, however reciprocal to their design concepts, circular business models and keeping closer circles. Systems thinking approaches in terms materials for primary productions range from the use of virgin materials to creating value from waste to a mix of both. Two furnishing companies primarily use virgin materials while one fashion company exclusively create value from waste. However, one fashion company uses both virgin and waste materials.
Further, with the exception of one case study that exclusively creates value from waste, the use of certified raw materials is the predominant approach of ensuring sustainability within raw material suppliers. However, partnerships with suppliers based on circularity and shared value have been observed within all investigated cases. Additionally, three out of four cases have exclusively opted to keep suppliers of materials closer to their production activities as a way of optimizing resource efficiency and shared values.

- *Production*

As a way of ensuring their quality expectations as well as sustainability values in terms of resource efficiency, cleaner productions and social sustainability, all cases are striving to keep their productions in Europe. All production activities for two out four of the investigated cases take place in their home country while the other two have kept their productions within Europe. Although some of the productions of one of the case studies are outsources to Tunisia and Egypt in Africa, these countries are logistic wise closely located. Further in terms of productions, the use of cleaner technologies is predominant in all cases. Two of companies owned their production facilities while the other two are more dependent on contracted production facilities however, either certified or with access to cleaner technologies.

2. ***What are the lessons learned?***

In spite of their differences in size, age and maturity, all the investigated cases demonstrate to have similar experiences and lessons learned from their circular business concepts. All the investigated cases have learned that design for easy disassembly and durability is inevitable when approaching take-back and product-service systems. This fundamentally enables reuse and easy repair, refurbish and remanufacture thereby prolonging the product and material life time respectively. With design laying a fundamental approach to circularity, all investigated cases have

learned that it is necessary to design products that are competitive enough on the current market trends because storytelling of the circularity concepts by itself, is insufficient.

That being said, circular business value proposition has to be simple and clear for the target market as a way of attracting consumers. Dealing with market related issues additionally, value proposition in circular business concepts often challenges the current predominant product ownership. Therefore, circular business concepts require adoption time. To increase awareness, it is necessary to educate the target market by continuously interacting with and engaging consumers during the adoption time. This is also a way of increasing market exposure. The use of viral marketing through the social media along with developing interactive Apps are the predominant approaches of interacting with the consumers.

Further, all the investigated cases have also learned that there is need to find alternative collaborations and financers in the development of circular business concepts. Circular business concepts such as leasing are rather based on a cash flow approach than the predominant collateral based. Additionally, circular business concepts are rather based on recapturing than the predominant writing off the value of second hand assets. The aforementioned fundamental characteristics of circular business concepts challenge the current standard banking system.

Furthermore, active customer participation in circular business value proposition ranges between 5-40%. Less than 5% of the office furniture are returned to Royal Ahrend after use while about 25-30% of the mattresses are returned to Royal Auping. Related to circular procurement within the office furniture, although up to 60% of the office furniture is sold through tenders at Royal Ahrend, about 1% of the 10% of the clients who ask for circular economy understands what it is. Additionally, the leasing model at Mud Jeans accounts for about 40% of the company's turnover. While all the companies are continuously promoting the benefits of circularity, they indicate the need for intervention at policy level. There is therefore, need for policies that should aim at educating consumers about circular economy along with the benefits of circular value propositions/procurement. Additionally, the two furnishing case studies are experiencing that the prices of material revalorization from second hand assets are higher than the those of virgin materials. Therefore, there is need for supportive and stimulating policies that incentivize circular business concepts.

Additionally, transparency in reporting and measuring sustainability has become increasingly significant in terms of communicating sustainability performance of the company to consumers. Conscious consumers are increasing becoming aware of waste generation due to planned obsolescence. Although C2C certification requires circularity, this exploration has not established any certifications well suited for second generation products. There may therefore, be need to rethink the criteria for measuring sustainability that also accommodate second generation products. However, this requires further study.

3. What kinds of partnerships exist between the investigated companies?

As well summarized by Diana Seijs, Sustainability officer at Royal Ahrend, when a company approaches circular business concepts, going outside its own boundaries is inevitable (=system and partnership perspective). Therefore, according to Diana Seijs, creating partnerships is one of the significant keys in the development and implementation of circular business concepts. Evidently throughout this exploration, partnerships ranging from material suppliers, production and products end of use have been in all the investigated cases. Although established based on different reasons, partnerships based on circularity and shared value have been predominant. Some of the partnerships established also involves sharing business concepts. Within the furnishing case studies, the prices of virgin materials are currently lower than the costs involved in the retrieval and processing of the recovered materials. Therefore, to spread the financial risks associated with their circular business concepts, the two companies have partner companies that take over revalorization business concepts such repair, reuse, refurbish and remanufacture. That being said, creating partnerships goes beyond the standard business approach to establishing partnerships. Meeting the right partners indulges companies to continuously embark on explorative social interaction activities that in turn, develops the trust necessary for establishing beneficial partnerships.

Further, there some areas of this thesis that require further investigation. The following areas have remained areas for future perspectives:

- How are the current eco-certifications developing to encompass the criteria based on circularity, triple bottom line while accommodating second generation products?
- How are the policies developing to stimulate and support circular business concepts?

Conclusively, based on my current experiences from a number of companies that I work with within the fashion and furnishing sectors, there is a growing interest towards circular business concepts. However, circular economy as a new paradigm shift is challenging, as it indulges companies to interact more outside their own boundaries. Often time I have been asked by companies whether I know how their prospective circular business concepts are working out for other companies.

However, as introduced in chapter 1 and 4, this thesis is neither a comparison nor generalization. This master thesis has been an exploration of systems thinking, take-back and product-service systems and lessons learned by four companies. This exploration has been aware that each of the case studies are unique therefore, may be different in many aspects. First of all, in the way they do business and their organizational culture. Secondly, two of the case studies operate within the fashion sector while two within the furnishing. Thirdly, in their size, age and maturity of their respective circular business models. These differences are what have also been exciting and nice to observe. However, the central focus of this thesis aimed at exploring state of the art experiences and lessons learned by each of these companies in their respective fields of circular business and capacities. The focus intended to learn each of these companies' experiences and lessons learned in terms of their respective systems thinking towards the triple bottom line and product and material recovery for revalorization. Although this exploration might be beneficial to the companies I have worked with, it should be noted that circular economy still is an emerging paradigm shift. Therefore, there is need for companies to be open and share experiences.

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11 APPENDICES

COMPANY	INDUSTRY	CIRCULAR BUSINESS MODELS	COMPANY LOCATION	LOCATION OF PRODUCTIONS	LOCATION OF SUPPLIERS	RAW MATERIALS	CREATING VALUE FROM WASTE	CLEANER PRODUCTIONS	PRODUCTS	PARTNERSHIPS
BETTER WORLD FASHION	Fashion	Lease+ Take-back	Aalborg, Denmark	Lithuania, Ukraine & Bulgaria	Red Cross and UFF in Denmark, other Scandinavian countries, Germany & China		Old leather & rPET polyester + recylable zipper sliders	Modern sowing machines, certified printing factory, techniques for low energy and water consumptions	2nd generation leather jackets	Red Cross & UFF: Based on shared value
MUD JEANS	Fashion	Lease+ Take-back	Almere, The Netherlands	Italy, Spain, Turkey, Egypt & Tunisia		GOTS &BCI certified cotton	Recycled cotton and collection waste jeans	Cleaner technologies+FLO CERT certified factories++	GOTS & BCI certified jeans, shirts, T-shirts, Cardigans++	Yousstex, Tejidos Royo, Sagarli Srl, Quadrifoglio Srl. Based on shared value
ROYAL AUPING	Furnishing	Take-back	Deventer, The Netherlands	Deventer, The Netherlands	The Netherlands, Germany, Belgium and Denmark	C2C certified +++		Smart and cleaner technologies	Beds and C2C mattresses	Kvadrat, Tetour Matras ++Based on shared value, business concepts and material share-bility
ROYAL AHREND	Furnishing	Lease+ Take-back	Amsterdam, The Netherlands	Zwanenburg & Sint-Oedenrode, The Netherlands	In Europe e.g. The Netherlands, Germany, Belgium, Denmark	C2C certified +++		Smart and cleaner technologies+ 100% renewable energy	C2C certified office furniture	Gabriel, Ahrend Reuse, TECHO, CSR++ Based on shared value, business concepts and material share-bility

11.10 KEY SUSTAINABILITY ISSUES ASSOCIATED WITH THE LEATHER INDUSTRY

The following chapter highlights sustainability issues associated with the production activities and tanning processes of the raw materials (rawhides and skins) within the leather industry. However, prior to presenting the key sustainability issues, this chapter will provide an overview of the trends related to the scale of productions and market within the leather industry.

11.10.1 Overview of leather productions, market share and major outlets

About 80-90% of the global tanneries are based on conventional practices that use chromium salts as the main tanning agent (Black, et al., 2013). Globally by 2013, approximately 6.0 million tons of raw hides and skins on a wet salted basis were processed every year (ibid). About 522600 tons of finished heavy leather and 1185 million square meters of light leather, including split leather were produced globally (Black, et al., 2013). EU productions by then accounted for about 71700 tons of heavy leather and 230 million square meters of light leather (ibid).
Regarding goat and sheep skins at a global scale, 646800 tons of raw skins on a dry basis were processed and yielded almost 438 million square meters finished leather per year (Black, et al., 2013). Light leather production from goat and sheep skins in Europe yielded approximately 82 million square meters (ibid).

Altogether, the global finished leather productions were reported to range between 21-22 billion square feet every year (UNIDO, 2010). Expressed in square meters, this is equivalent to 1,950,963,840-2,043,866, 880 m^2 (ibid). This is based on conversion rate of 1 square foot is equivalent to 0.092903m^2 (Metric conversions, 2016). However, it has been recently reported that the total global leather productions as of now are 2.4 billion square meters of finished leather every year (Kirchain, Olivetti, Miller, & Greene, 2015). This shows a significant increase in global productions.

Further, in terms of the market share by region, Southeast Asia, the EU25 (European Union member states by then) and South Asia have been by hierarchical order, the leading exporters of leather products since 2000 (Trade and Industrial Policy Strategies, 2012). See figure 1 below

Regions' exports of leather products for 2005 expressed in US$'000

Regions	YEAR 2000	YEAR 2005	AVERAGE ANNUAL GROWTH 00-05	PERCENTAGE OF TOTAL % (2000)	PERCENTAGE OF TOTAL % (2005)
East Asia	7,458,495	11,731,539	9.48	40.68	40.43
EU25	6,315,311	11,601,322	12.93	34.44	39.98
South Asia	1,033,777	1,938,234	13.14	5.64	6.68
NAFTA	1,131,703	1,183,223	0.89	6.17	4.08
South East Asia	1,440,313	862,286	-9.75	7.86	2.97
Middle East	331,808	348,144	0.97	1.81	1.2
South America	182,794	331,989	12.68	1	1.14
Central America	43,307	88,608	15.39	0.24	0.31
SADC	23,229	67,550	23.8	0.13	0.23
Regions' total	17,960,739	28,152,895	9.41	97.96	97.03
Global Exports	18,335,363	29,014,593	9.61	100	100

Figure 1. Modified after (Trade and Industrial Policy Strategies, 2012)

However, in terms imports of leather products also by hierarchical order, EU25, NAFTA (the North American Free Trade Agreement between the US, Canada and Mexico (NAFTA, 2012)) and East Asia were the leading importers (ibid). See figure 2 below

Regions' imports of leather products for 2005 expressed in US$'000

Regions	YEAR 2000	YEAR 2005	AVERAGE ANNUAL	PERCENTAGE OF TOTAL % (2000)	PERCENTAGE OF TOTAL % (2005)

			GROWTH 00-05 (93-03)		
EU25	8,317,569	13,628,924	10.38	30.44	35.8
NAFTA	8,610,357	10,954,100	4.93	31.52	28.78
East Asia	8,143,099	9,659,630	3.47	29.81	25.38
South Asia	355,645	597,848	10.95	1.3	1.57
South East Asia	409,686	580,608	7.22	1.5	1.53
Middle East	276,797	398,655	7.51	1.01	1.04
South America	66,693	153,351	18.12	0.24	0.4
SADC	33,434	68,302	15.36	0.12	0.18
Central America	9,439	47,032	37.88	0.3	0.12
Regions' total	26,222,718	36,087,449	6.59	95.98	94.8
Global Exports	27,320,531	38,066,728	6.89	100	100

Figure 2. Imports of leather products on global market. Modified after (Trade and Industrial Policy Strategies, 2012)

Maintaining the trend as shown in figures 1 and 2 above, the EU and East Asia have maintained their positions as the global leather market leaders. As the second global market leader, the EU tanning industry turnover accounted for 26,7% of the global total after China, accounting for 29,5% (COTANCE, 2012). The total EU tanning industry turnover in 2011 was €7.8 billion Euro, corresponding to sales of 224,000,000m^2 of finished leather and about 44,000 tons of sole leather (ibid). In terms of global trade, leather products indicated a significant 7% growth from US$27,321 million in 2000 to US$38,067 million in 2005 (Trade and Industrial Policy Strategies, 2012).

Further, in terms of the global outlets of finished leather, the footwear, leather goods, furniture, clothing and automotive industries are the major outlets (UNIDO, 2010). See figure 3 below showing the trend of the global outlets' consumption in % over a period of 40 years.

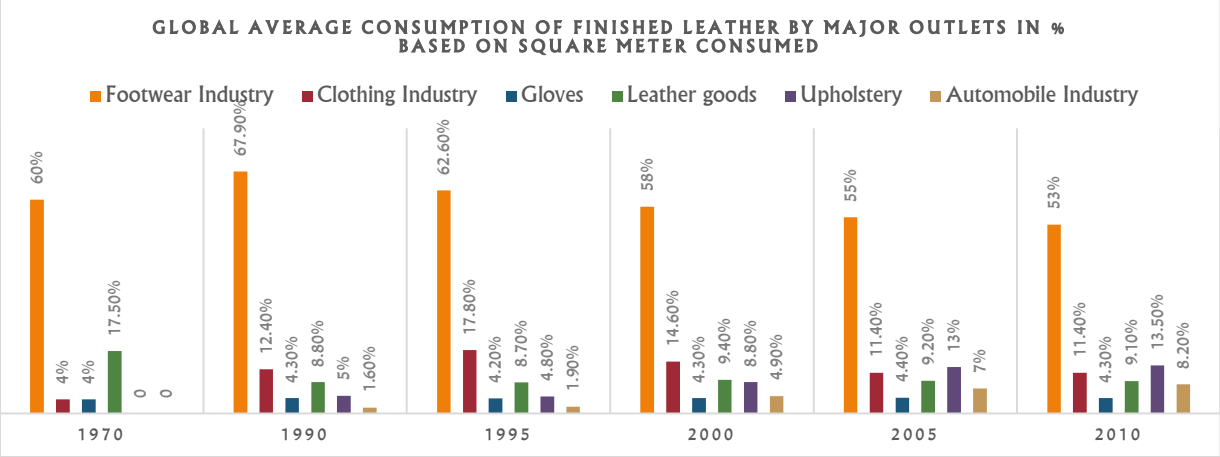

Figure 3. Global average consumption of finished leather by the global major outlets over a period of 40 years. Data derived from (UNIDO, 2010) pp. 42

More specific to the clothing industry, the consumption trends have however, constantly varied between the ranges of 11 and 18% over the three decades (UNIDO, 2010). Recently within the EU, the major outlets of finished leather produced by the EU tanners are as follows in figure 4 below:

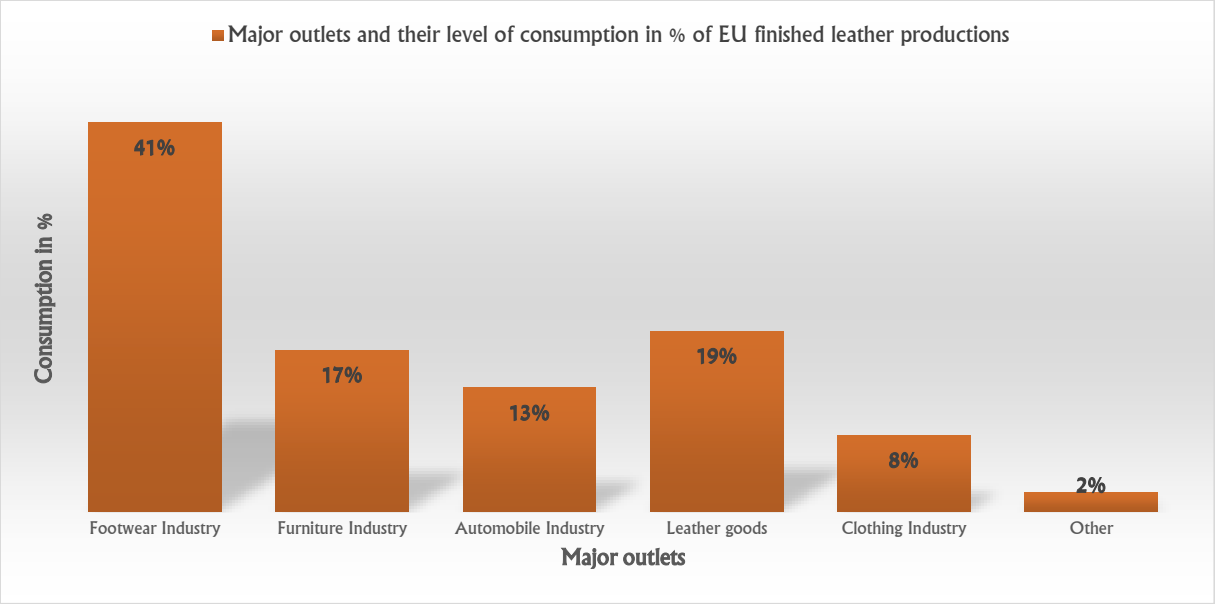

Figure 4. Major outlets of EU tanneries' production. Data derived from (European Commission, 2016a)

That being overviewed, based on historic global market trends, the production of light leather has been forecasted to increase if the present trends continue (Kirchain, Olivetti, Miller, & Greene, 2015). See figure 5 below

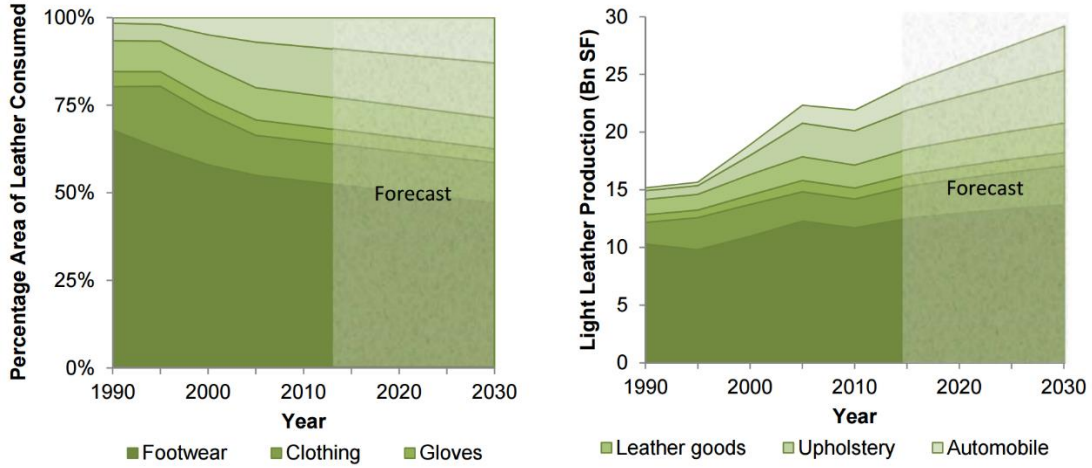

Figure 5. Historic market trends and future projections for leather by end use. Modified after (Kirchain, Olivetti, Miller, & Greene, 2015)

Due to the increase in use of rubber and plastic, the use of leather within the global footwear industry has dropped from 30% to 15% between 2003 and 2013 (Kirchain, Olivetti, Miller, & Greene, 2015). However, the use of leather for upholstery and automobile will grow within the next two decades (ibid). Globally, a total of 26.5 billion square feet of light leather productions are estimated by 2020 and 29.9 billion square feet are estimated by 2030 (Kirchain, Olivetti, Miller, & Greene, 2015). Converted in square meters, this means that globally by 2020, light leather productions will be 24.62 billion square meters and 27.78 billion square meters by 2030 at metric conversion rate of 1 square foot equivalent to 0.092903 square meters.

That being said, the following sub-chapters present key sustainability issues associated with the leather industry from raw material production to tanning processes.

11.10.2 Raw materials: Hides and skins

More than 95% of leather used in all industries come from meat and dairy animal husbandry i.e. bovine (cattle), sheep, goats and pigs (UNIDO, 2010); (Brugnoli and Kráľ, 2012). Figure 6 below shows an overview of raw materials by animal type

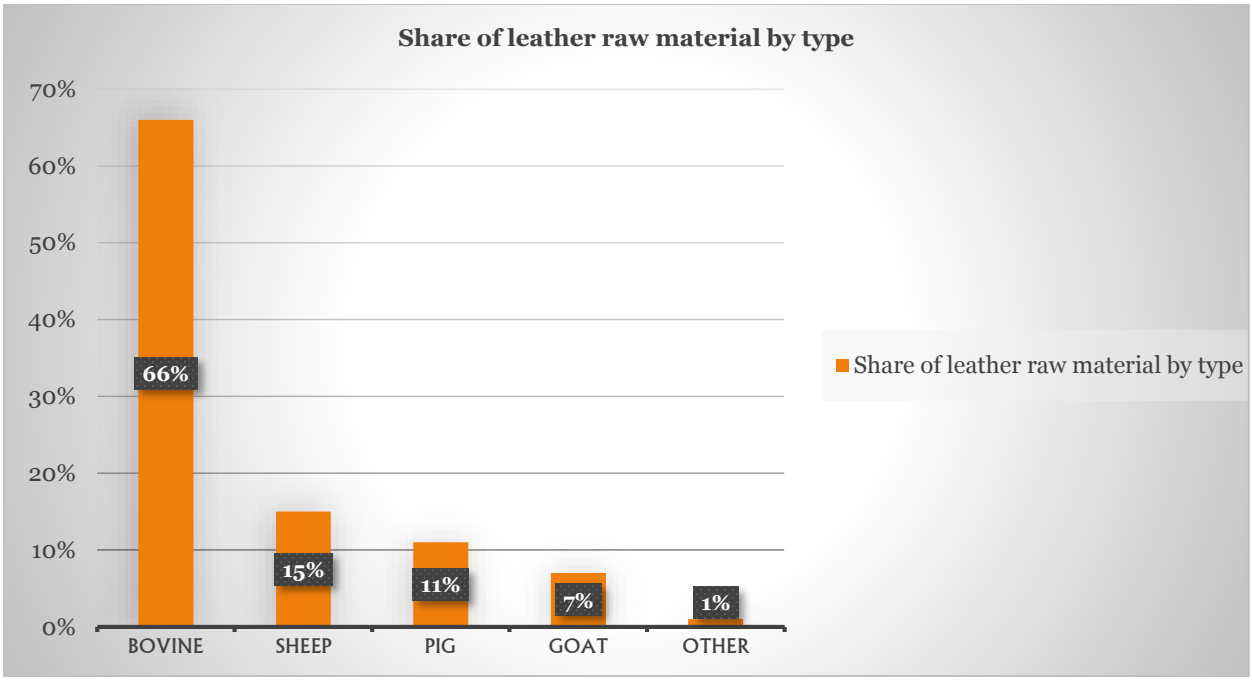

Figure 6. Leather raw materials by type. Modified after UNIDO, (2010) and cross-referenced after data (FAO, 2013)

As shown in figure 6 above, bovine hides represent about two thirds of the raw materials used by the global leather industry, which makes them by far the most important raw material (UNIDO, 2010). Further, the most significant impacts within the leather industry are rather associated with the upstream than the downstream activities (Kirchain, Olivetti, Miller, & Greene, 2015). The upstream activities of greater concern are agricultural/animal husbandry (ibid). Figure 7 below highlights the key environmental impacts of animal husbandry

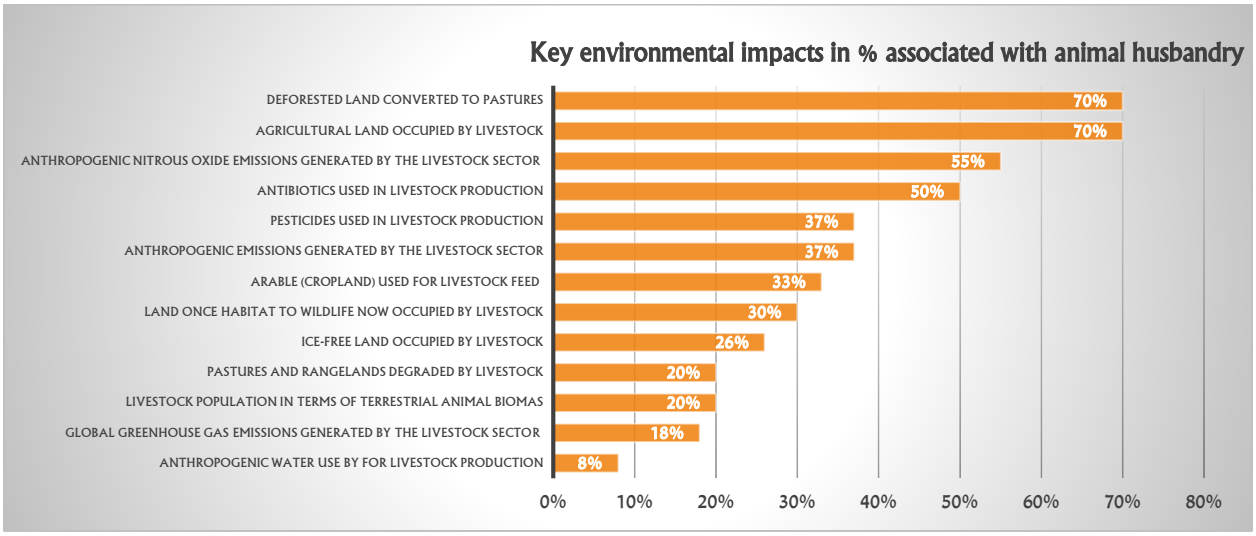

Figure 7. Key environmental impacts associated with animal husbandry. Modified after (FAO and LEAD, 2006)

Note that raw hides account for 5-7% of the total animal live weight and therefore, account for 5-7% of the total impacts of animal husbandry (EPD, 2011); (Kirchain, Olivetti, Miller, & Greene, 2015). This is based on LCA mass allocation (ibid). Environmental impact assessment per mass-allocation is the most widely accepted method in LCA (Kirchain, Olivetti, Miller, & Greene, 2015). Therefore, environmental impacts for bovine finished leather considering only those from animal husbandry and slaughterhouse are usually allocated in % as follows in figure 8 below:

CATEGORY	LIVE WEIGHT (KG)	RAW HIDE	COMESTIBLES	SCRAPS
Calf (male or female, 0-12 month)	245	7%	64%	29%
Bull (male, > 12 month)	680	7%	65%	28%
Cow (female, > 12 month)	650	5%	44%	51%

Figure 8. Mass allocation of slaughtering outcomes. Modified after (EPD, 2011)

However, the impacts for goats and sheep are similar and approximately half that of cattle (Kirchain, Olivetti, Miller, & Greene, 2015). Further, the upstream activities of greater burden to sustainability are majorly related to the tanning processes (Black, et al., 2013). The following chapter will highlight the sustainability hotspots associated with the tanning industry.

11.10.3 Tanning processes

Tanning processes of raw hides and skins contribute significantly to the impacts on sustainability. This due to intensive water, energy, chemical consumptions and waste generation involved in the processes (Black, et al., 2013). For a clear structure, the key sustainability issues associated with the tanning processes have been divided into inputs, outputs, environmental and social.

11.10.3.1 Inputs

In terms of input materials for instance, the tanning processes involved in producing 200-250 kg finished bovine leather require up to 50000 liters of water, 500 kg of different mixtures of chemicals and 11666.76 kWh of energy (Black, et al., 2013). See figure 9 below highlighting the input-output overview involved in the processing of one tonne of raw bovine hides

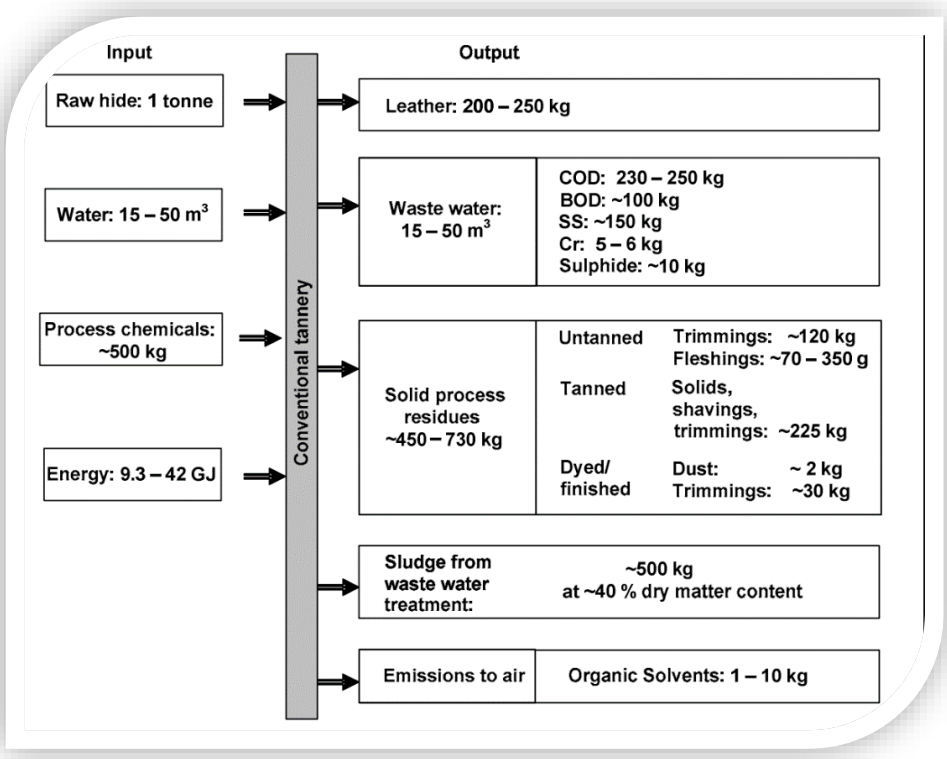

Figure 9. Input-output overview for a conventional chrome-tanning processing of a tonne bovine wet salted bovine hides. After (Black, et al., 2013)

Expressed otherwise, figure 9 above shows that up to 200 litres of water, 2 kg of chemicals and 46.67 kWh of energy are used to produce a kilogram of finished bovine leather. To be discussed later on, the latter inputs also indicate some of the sustainability issues associated with the tanning industry. Nonetheless, the input-output overview of tanning processes varies depending on the source of raw materials (Black, et al., 2013). Figure 10 below shows an overview of average material input and output involved in the processing of 1 tonne of raw hides of all types

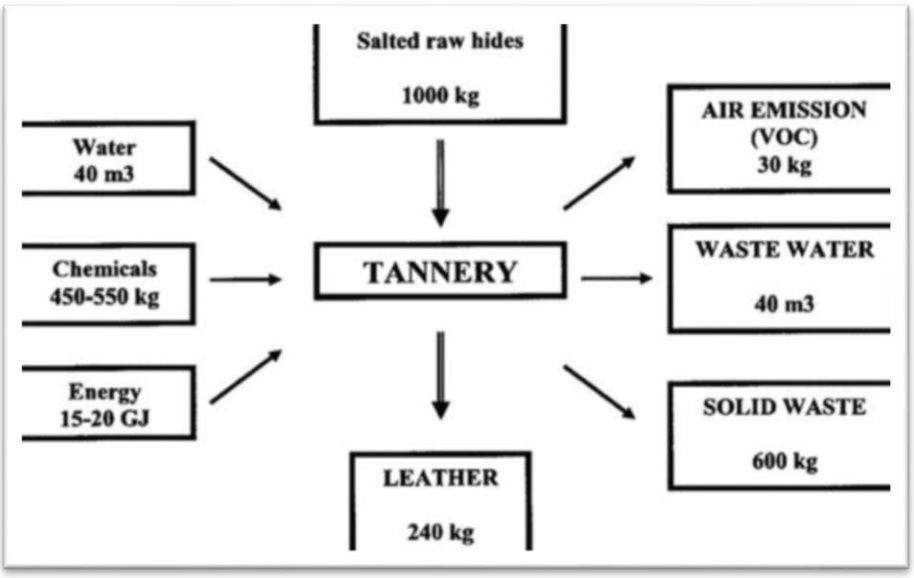

Figure 10. Average mass balance during the processing of 1 ton of raw hides of all types. Conventional tanning processes after (Bilitewski, Darbra, & Barceló, 2012) pp.248

As shown in figure 10 above, up to 166.67 liters of water, 2.29kg of chemicals and 23.15kWh of energy are required to produce a kilogram of finished leather of all types.

11.10.3.2 Outputs

Referring to figure 10 above, the tanning processes of 1 tonne of all types of raw hides discharge up to 40000 liters of wastewater, 600kg of solid waste and 30 kg of volatile organic compounds emissions (Bilitewski, Darbra, & Barceló, 2012). Expressed in specific terms, per kg of leather produced, 166.67 liters of wastewater, 2.5kg solid waste, 0.125kg of volatile organic compounds. Volatile organic compounds are solid or aqueous chemical substances that evaporate at room temperature (Cakmak, et al., 2014). Among others, such toxic volatile organic compounds as Hydrogen sulfide (H_2S), Ammonia (HN_3), formaldehyde, Carbon monoxide (CO), Carbon dioxide (CO_2) and Nitrogen dioxide (NO_2) are used during the tanning processes (Bilitewski, Darbra, & Barceló, 2012). Hydrogen sulfide is emitted during unhairing, Ammonia during bating (deliming), formaldehyde during the finishing and Carbon monoxide, Carbon dioxide and Nitrogen dioxide are emitted during heating (ibid). As shown in figures 9 & 10 above, about 500-600kg of solid waste is discharged into wastewater and these discharges also represent high levels of nutrient from biodegradable organic tissues such as hair, fat and skin tissues into the wastewater.

See figure 11 below for an overview of all processes, inputs and outputs involved in conventional tanning of rawhides

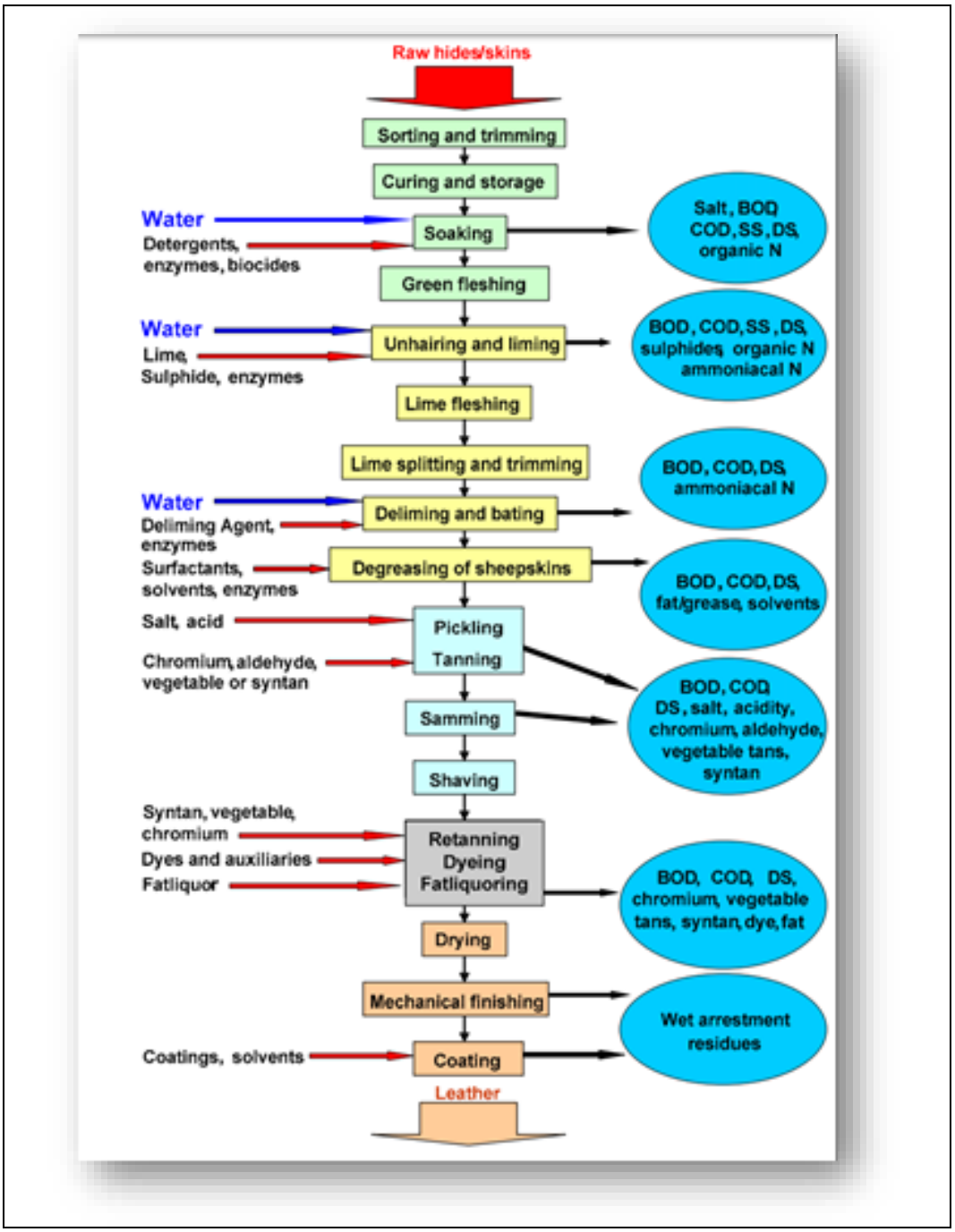

Figure 11. An overview summary of conventional tanning processes, inputs and outputs. Modified after (Black, et al., 2013)

Conventional chromium tanning is the predominant technique within the tanning industry and it is dependent on the use of chromium after the pickling process (Black, et al., 2013). About 80-90% of all world tanneries operate on standard conventional chromium based tanning (ibid). While increasing the pH after acidic pickling, chromium is applied so that the hide becomes resistant to bacteria and high temperatures.

11.10.3.3 Sustainability issues associated with tanning processes

11.10.3.3.1 Intensive water consumption and waste generation

The paradox related to social and environmental impacts associated with leather tanning processes are first and foremost, the intensive use of water (Sundar, et al., 2001). There is lack of drinking of drinking water on a global scale (ibid). 97.5% of the global water reserves is salty water and only 2.5% is freshwater (Sundar, et al., 2001). Out of the 2.5% percent of freshwater, only 30% is groundwater (source of drinking water), 0,3% are lakes and rivers, 0.9% is soil moisture and 68.8% are glaciers and permanent snow cover (ibid).

Secondly, referring to figures 9 & 10 presented earlier, nearly the same amount of water used during leather tanning processes is discharged into municipal sewers along with high concentrations of pollutants (Sundar, et al., 2001). About 20 – 25 % of the weight of raw (salted) bovine hide becomes finished leather while 12 – 15 % of the weight of sheep or goat salted raw skins become finished leather (Black, et al., 2013). Although some of the organic materials which are not transformed into products may be recovered as useful by-products, the rest become solid residues or pollutants in the liquid effluent (wastewater) (ibid). As mentioned earlier on, up to 600kg of solid waste is discharged into wastewater and these discharges also represent high levels of nutrient from biodegradable organic tissues such as hair, fat and skin tissues into the wastewater (Black, et al., 2013). Nutrient levels in water bodies are measured in biochemical oxygen demand (BOD), usually expressed in mg/l (Bosnic, Buljan, & Daniels, 2000). High levels of nutrients of up to 100kg/50m^3 as shown in figure 9 above are found in wastewater from tanneries. Aquatic fauna such as fish, planktons and sensitive plants are reported to be susceptible to high levels of BOD in wastewater (Bosnic, Buljan, & Daniels, 2000). In India for instance, the River Ganges has been reported to be a dead zone due to tanneries wastewater discharges containing high levels BOD and toxic chemicals such as arsenic, lead, cadmium and chromium (Alexandra Cousteau, 2009).

11.10.3.3.2 Intensive chemical consumption, toxic waste discharges and air emissions

Among other pollutants, high concentrations of nitrogen, strong acids, sulphates, heavy metals, pesticides and chromium are discharged either into surface water bodies as liquid wastes or in municipal landfills as regular solid wastes (Black, et al., 2013). Representing one of the greatest concerns of the tanning industry, chromium sulphates are widely used at an average dosage of 80kg/ton of raw hides (Bilitewski, Darbra, & Barceló, 2012) p.248. This is equivalent to 15kg pure chromium per ton of wet salted raw hides (ibid). Chromium trivalent (Cr III) is toxic to humans and animals (European Commission, 2013). Cr III oxidizes to form Cr VI (ibid). Cr VI is carcinogenic i.e. it causes cancer and skin irritations (European Commission, 2013). More than 80% of wastewater effluents from tanneries contain chromium (Black, et al., 2013). Research studies have thus recommended the need to use alternative tanning agents (Himberg, 2007).

Further, COD levels of up to 230-250kg per tonne rawhides processes have been reported in wastewater effluents from tanning processes (Black, et al., 2013). COD stands for chemical oxygen demand and is a method that indirectly measures the amount of chemical pollutants that cannot biodegrade and yet have high affinity of oxygen in water (Bosnic, Buljan, & Daniels, 2000). COD measurement are expressed in mg/l of water (ibid). COD levels of 250-250kg per tonne rawhides indicate high concentrations of toxic chemical pollutants most of which end up in surface water (rivers and lakes) (Black, et al., 2013). Discharges of such levels of contaminants into surface water lead to loss of aquatic and soil fauna and pollution to groundwater pollution (ibid). Additionally, loss of biodiversity due to effluent from tanneries is also linked to intensive use of sulphuric acids (2%) and sodium chlorides (8%), 84kg of sulphates and 192kg chlorides per ton of raw hide are discharged (Bosnic, Buljan, & Daniels, 2000). These bases and acids constantly affect the alkalinity and acidity of the water and soil therefore, constantly changing optimal conditions of fauna (ibid). pH of discharges from tanneries were recorded between the range of 2-3- thus extremely acidic (Black, et al., 2013). Majorities of fish and plants are susceptible to pH between 6.5- 7.5 (Bosnic, Buljan, Daniels, & Rajamani, 2003).

Further, the uses of pesticides, biocides and fungicides are predominant within the leather industry most especially, in countries where regulations are less strict (Himberg, 2007); (Black, et al., 2013). Pesticides are used to prevent pests in animal husbandry while biocides and fungicides are respectively used to prevent the growth of bacteria and fungi (ibid). Tanneries provide extremely favourable conditions of bacterial and fungal growth (Black, et al., 2013).

Although the uses of agrochemicals such as HCH, DDT and naphthalene are prohibited in Europe, these are still used in non-EU hides and leather producing countries (ibid). HCH, DDT and naphthalene may be imported into the EU through raw hides from such non-EU states (Black, et al., 2013). HCH, DDT and naphthalene have been studied to be endocrine disruptors i.e. chemical substances that interfere with the hormonal system functionality of male humans and fish, among others (Zeliger, 2011). For example, endocrine disruptors are linked to feminization of male fish (Liney, Jobling, Shears, Simpson, & Tyler, 2005).

Further, due to such significant volumes of highly toxic wastewater and solid wastes, large investments are required to capacitate reasonable wastewater treatment infrastructures (Sundar, et al., 2001). However, the standard conventional wastewater treatment processes are not capable of produce less eco-toxic effluents (Sundar, et al., 2001); (Black, et al., 2013).

Around 300-400 different chemicals are used during the tanning processes, most of which are toxic to humans viz. ecosystem (Bilitewski, Darbra, & Barceló, 2012). About 20-50% of chemicals used in the processing of wet salted hides are inorganic standard chemicals such as calcium hydroxide, sodium chloride, sodium sulphide, acids (mainly sulphuric acids), carbonates, sulphates, arsenic, lead, cadmium and chromium (ibid). By 2006, about 3-3.5 million tons of chemicals were being used yearly to process an annual average of 6 million tons of raw hides and skins (Kanagaraj, Velappan, Babu, & Sadulla, 2006).

Further, toxic volatile organic compounds such as Hydrogen sulfide (H_2S), Ammonia (HN_3), formaldehyde, Carbon monoxide (CO), Carbon dioxide (CO_2) and Nitrogen dioxide (NO_2) are used during the tanning processes (Bilitewski, Darbra, & Barceló, 2012).

11.10.3.3.3 Intensive energy consumptions and air emissions

Due to intensive use of energy as shown in figures 9 & 10, current studies show that the global leather manufacturing industry emits 130 million tons CO_2eq per year (Kirchain, Olivetti, Miller, & Greene, 2015). CO_2 emission from leather manufacturing has impacts almost equivalent to emissions from 30 million passenger vehicles per year (ibid).

For example, based on LCA calculations from raw material extraction, manufacturing and distribution processes, an overview of the carbon footprint of aniline leather of all specific industrial thicknesses looks as follows in figure 12 below

Aniline	All thicknesses	1.5±0.1mm	1.7±0.1mm	1.9±0.1mm
Raw Material Extraction(kgCO2e/m2)	5.68E+01	4.88E+01	5.83E+01	6.33E+01
Maufacturing(kgCO2e/m2)	1.62E+01	1.60E+01	1.61E+01	1.64E+01
Distribution(kgCO2e/m2)	1.03E-02	4.87E-03	1.29E-02	1.32E-02
Total (kgCO2e/m2)	7.30E+01	6.48E+01	7.45E+01	7.96E+01

Figure 12. Carbon footprint of leather. After (Chen, Lin, & Lee, 2014)

According to Chen et al., (2014 p.1064), from raw material extraction, manufacturing, distribution and retail system boundaries, the CO_2 emissions in figure 5 above are equivalent to:

- 64.8 kgCO_2eq/m2 of 1.5 ± 0.1 mm,
- 74.5 kgCO_2eq/m^2 of 1.7 ± 0.1 mm,
- 79.6 kgCO_2eq/m^2 of 1.9 ± 0.1 mm and
- 73 kgCO_2eq/m^2 of all thicknesses.

However, the development and forecasts in terms of the total global warming impact associated with the global leather industry are shown in figure 13 below

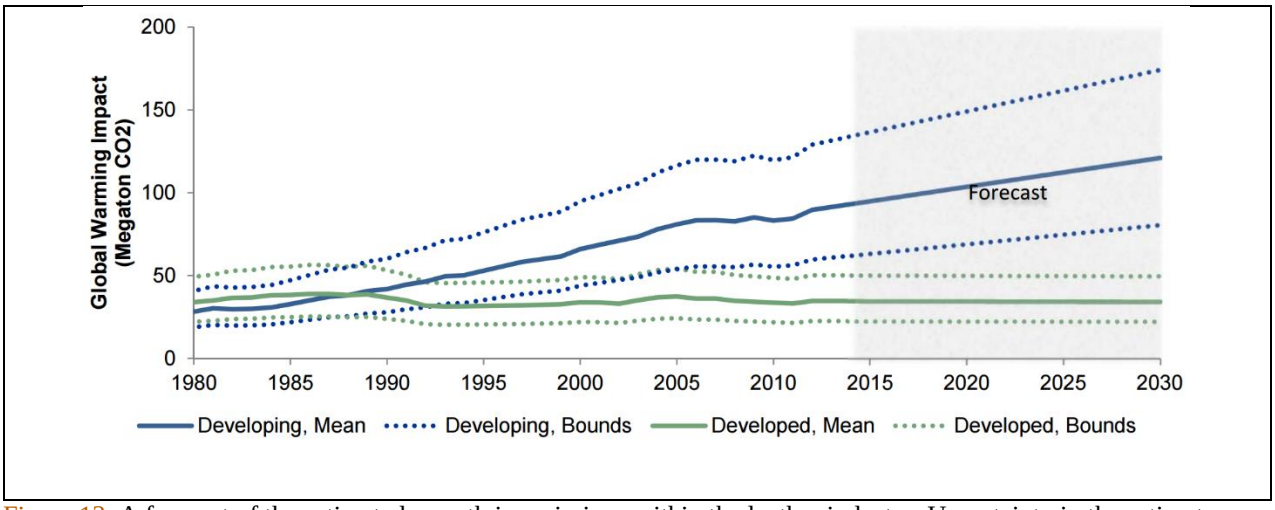

Figure 13. A forecast of the estimated growth in emissions within the leather industry. Uncertainty in the estimates are represented by the bounds. Modified after (Kirchain, Olivetti, Miller, & Greene, 2015)

As shown in figure 13 above, it is forecasted that emissions from the leather industry within the developed will maintain the current course which is significantly lower compared to developing countries. Complementary to this development, high energy efficiency has since 2012 been reported within the European tanning industry. An average of 2.0 Tonnes of Oil Equivalent (TOE) were used per 1000m^2 of processed leather (COTANCE, 2012). 1 TOE is equivalent to 11630 Kwh therefore, 23260Kwh were required to produce 1000m^2 finished leather (equivalent to 23.26Kwh/m^2). However, the use of non-sustainable energy sources is still predominant within EU tanneries. See figure 14 below showing an overview of energy consumption by source (based on European tanneries)

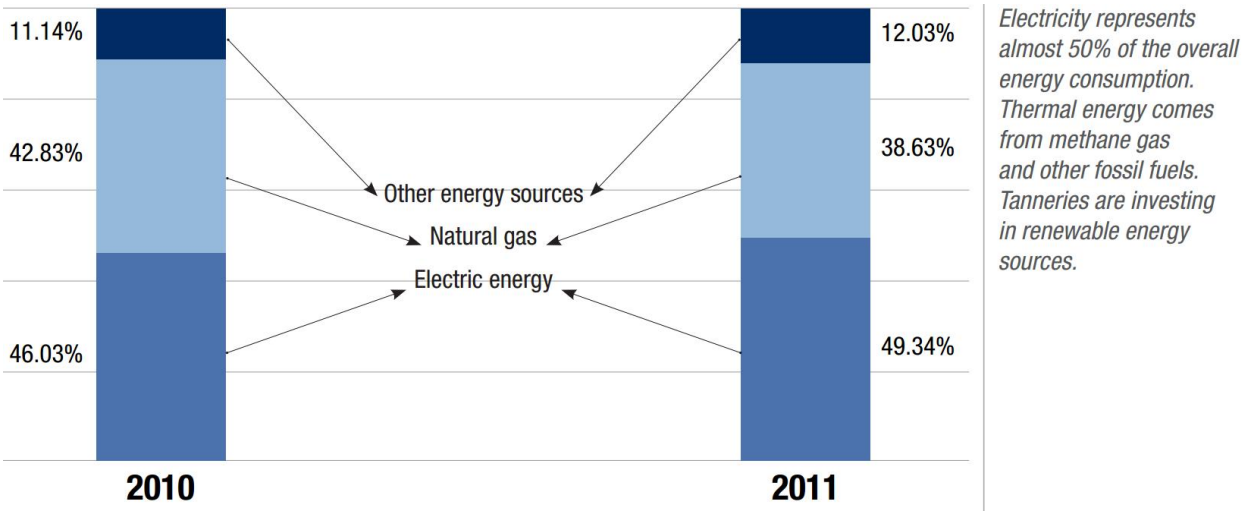

Figure 14. Energy consumption breakdown 2010 - 2011 (%). Modified after (COTANCE, 2012)

Almost 50% of overall energy consumption within the European tanneries comes from electricity and almost 39% of overall thermal energy- used for heating comes from methane (CH_4). The comparative impact of methane on climate change is more than 25 times greater than CO_2 over a 100-year period (EPA, 2016). Moreover, methane is more efficient at trapping radiation than CO_2 (ibid). Additionally, in spite of high energy efficiency within the European tanning industry, on a global scale, developing countries produce 64% of the number of raw bovine hides found on the global market (Black, et al., 2013). Regarding sheep and skins, 65% of the skins on the global market are produced in developing countries (ibid). This research has failed to establish whether such high energy efficiency has been reported in developing countries.

11.10.3.3.4 Social sustainability issues

Among other catastrophes associated with the fashion industry, 115 tanneries workers producing leather for Western clothing brands were reported dead in Hazaribagh, Dhaka in Bangladesh (Renton, 2012). As detected in wastewater discharges from tanneries in Hazaribagh, the deaths have been linked to daily exposures to excessive levels of chromium, lead, organohalogens and other significant toxins, higher than exceeding the EC_{50} legislative guideline (ibid). Notwithstanding the low wages of about US$37 per month that were associated with the tanning work in Dhaka, 90% of the 8000-12000 workers in Hazaribagh tanneries were expected to die before the age 50 (WHO, 2001).

58% of the population of the tannery workers suffered from gastrointestinal diseases, 31% from dermatological diseases, 12% from hypertension and 19% from jaundice (ibid). Moreover, due to chemical pollutions from neglected and untreated wastewater discharges from tanneries in Dhaka, a population of about half a million residents were reported to be at a greater risk of illnesses (WHO, 2001). Up about 150 tanneries representing 90-95% of the tanning industry in Bangladesh takes place in Hazaribagh (Cedillo, 2012). On a national scale, it was reported that 24% of the whole population in Bangladesh suffered from gastrointestinal diseases, 9% from dermatological diseases, 0.9% from hypertension and 19% from jaundice (WHO, 2001). Related to child labor, 25% of tanneries workers were children under the age of 11 (Renton, 2012).

The fashion industry nowadays is faced with a challenge to find ways to solve these sustainability issues. Due to the complexity of these sustainability issues and outsourcing dominating the fashion industry, some fashion companies are therefore, striving for systems thinking approaches to solving the wicked problems associated with the industry today. One of such companies is Better World Fashion.