

# Circular Economy in the Clothing Industry: Challenges and Strategies

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### ***Abstract***

This exploratory research identifies how can clothing companies implement textile recycling technologies that help transition them to a sustainable circular economy business model, given the challenges of eco-innovation diffusion. The study is exploratory in nature, employs a literature review and a case study of Patagonia, the outdoor equipment and clothing company that pioneered the use of recycled fibers in the outdoor clothing industry and continues to have today several initiatives for diverting textile waste away from landfills.

To implement textile recycling technologies, the company created the Worn Wear Program, the Common Threads Recycling Program and the possibility to return a worn-out garment to Patagonia's distribution center by mail or from any store or local authorized dealer of Patagonia's products. To make the recycling (or repurposing) of worn-out garments work, the company also established a repair department at its distribution center which receives all worn-out clothes sent for recycling or repurposing.

**Keywords:** circular economy, textile recycling, economy-environment interdependence, technology diffusion

## ***Abbreviations***

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<i>CE</i>	Circular Economy
EREP	European Resource Efficiency Platform
E.U.	European Union
Inc.	Incorporated
PET	Polyethylene terephthalate
Ppm	Parts per million
U.K.	United Kingdom
U.N.	United Nations
UNEP	United Nations Environment Program
U.S.A.	United States of America
WCED	World Commission on Environment and Development
WRAP	Waste & Resources Action Programme

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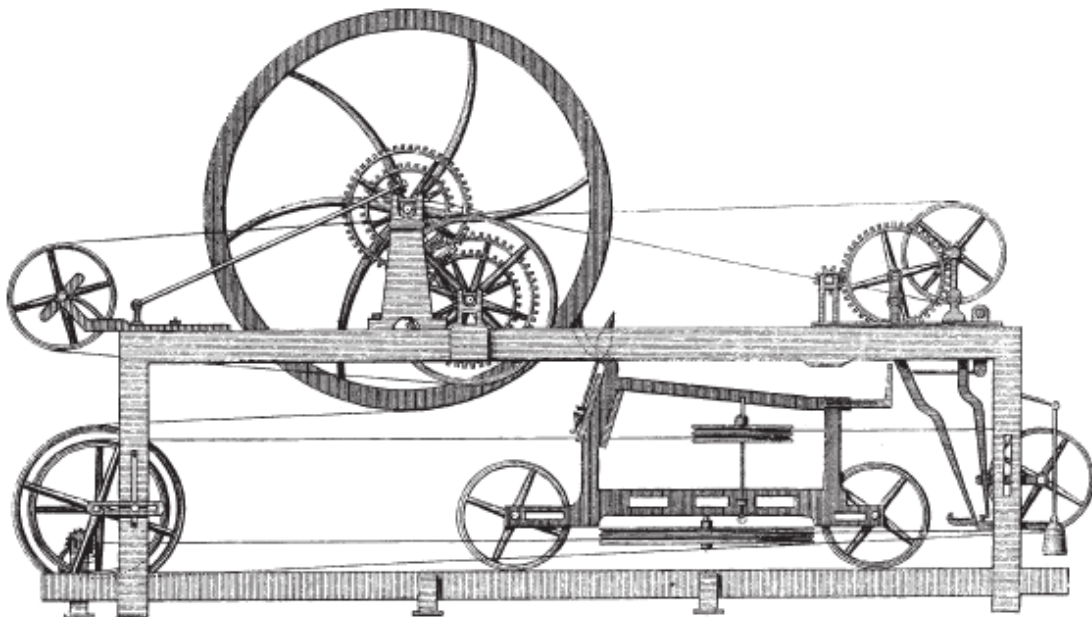
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# INTRODUCTION

*This chapter presents the body of knowledge, the purpose, the research question and an overview of the structure of the present study.*

Early eighteenth-century British industries were generally small-scale cottage industries (Ashton, 1966) (Baines, 1835). Cotton manufacturing, for example, was centered almost exclusively on private homes or small workshops where spinners, weavers and dyers would spin cotton into threads for weaving into cloth by hand (Baines, 1835). As a result of the innovative techniques and technologies in agriculture, a surplus of cheap agricultural labor and rising poverty in many rural areas made peasants to move from the countryside to bigger cities which then increased the demand for clothes (Baines, 1835). In order to meet the rising demand, automation in the hand-knitting operations used in the production of textiles was needed (Griffiths, Hunt, & O'Brien, 1992) (Baines, 1835).

The replacement of human labor to machinery in the manufacturing of textiles started in the beginning of the 1730s (Ashton, 1966) (Griffiths, Hunt, & O'Brien, 1992) after British inventor John Kay invented the first flying shuttle in 1733 (Ashton, 1966) (Baines, 1835), an innovation that enabled weavers to increase productivity (Ashton, 1966). Over the next half century, other inventions further mechanized the weaving of cloth, revolutionizing the process of cotton spinning and weaving by advances in technology (Baines, 1835).



*Figure 1 – Invented in 1779 by Samuel Crompton, the ‘Mule Jenny’ “has carried the cotton manufacture to a perfection it could not otherwise have attained” (Baines, 1835, p. 199). Illustration from ‘History of the cotton manufacture in the Great Britain’, 1835, p. 206.*

The development of the first steam-powered cotton weaving technologies together with the organization of operations under a factory system for the production of cotton had a ripple effect on other industries, paving the way to the industrial revolution beginning around the mid-eighteenth century and accelerating the growth of the world economy through stimulation of a number of innovations in products, processes and services (Hobsbawm, 1999). Three centuries later, the clothing industry is facing the challenge of developing textile recycling technologies that

may pull other industries into a greener economy, which has been deemed as the next great economic era (Ki-moon, 2008) (Rifkin, 2011) (Manyika, et al., 2013).

## **1.1. Rationale for Research**

With 2015 being the hottest year on record with temperatures about 1°C above the pre-industrial era and with fifteen of the sixteen hottest years on record having occurred since 2000 (WMO, 2016), meteorologists report that the global atmospheric concentration of carbon dioxide – which ranged between about 180 to 300 parts per million (ppm) for the past 650,000 years (WMO, 2016) (Rahm, 2009) – has risen from an annual average of 280 ppm just before the industrial era to 401 ppm registered at Mauna Loa, Hawaii (U.S.A) in 2015 (EPA, 2015). The atmospheric concentrations of methane and nitrous oxide – the other two greenhouse gases – are also showing rising trajectories (EPA, 2015). With more than half the world's clothing retail being concentrated in North America and Western Europe (International Labour Organization - Sectoral Activities Department, 2014) and fueled by the supply of goods manufactured in low-wage countries (World Trade Organization, 2015) (International Labour Organization - Sectoral Activities Department, 2014), the clothing industry has today some of the world's rapidly growing retailers (Keller, Magnus, Hedrich, Nava, & Tochtermann, 2014) thanks in part to the success of the release of new trends in fashion on shorter term basis (Fast Fashion) (Keller, Magnus, Hedrich, Nava, & Tochtermann, 2014). The faster release of new trends generates more textile waste and increases the use of natural resources and pressure over landfill space (see figure 2, section 2.1). The purpose of this exploratory research is therefore to investigate the opportunities for clothing companies to recycle and/or repurpose textile waste, thereby diverting worn-out clothing from landfills and decreasing the use of raw virgin resources.

## **1.2. Research Question**

Studying, in detail, how a pioneering clothing retailer has been implementing innovative ways to promote the sustainability of its economic activity within the context of the natural environment can provide valuable insights to and minimize the risks of other companies facing similar challenges. This exploratory research seeks to identify some of the challenges and solutions in adopting textile recycling technologies by investigating the following research question:

- How can clothing companies implement textile recycling technologies that help transition them to a sustainable circular economy business model, given the challenges of eco-innovation diffusion?

## **1.3. Structure**

In chapter 2 an overview of the theoretical concepts necessary for the complete understanding of this study is provided. Chapter 3 presents an overview of the methodology used and is followed by chapter 4 which presents the case study used in this exploratory research. Chapter 5 presents the discussion of the findings and is followed by the conclusions of this study and further research in chapter 6.



## 2. FRAME OF REFERENCE

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*This chapter presents the theoretical reference frame necessary for the complete understanding of the exploratory research hereby presented, provides a summary of the key theoretical concepts and describes the findings of the literature review.*

### 2.1. Circular Economy

The concept of circular economy (CE) was first introduced by British environmental economists David W. Pearce and R. Kerry Turner (Pearce & Turner, 1989) (Perman, Ma, McGilvray, & Common, 2003) (Heshmati, 2015). In *Economics of Natural Resources and the Environment*, first published in 1989, the two economists outlined the new environmental economics policy stance which should point towards maintaining a non-declining natural capital stock (see figure 2) and the coexistence, in equilibrium, of economics and the natural environment (Pearce & Turner, 1989) (Heshmati, 2015). For the purpose of this exploratory study, CE is defined as a sustainable development strategy (Heshmati, 2015) whose scope, in the context of industrial organizations, is to produce no pollution and waste (Heshmati, 2015) (Pearce & Turner, 1989). CE's 3R principles – Reduce, Reuse and Recycle – account for a circular, closed-loop system in which materials reenter, either by intention or design, the natural environment safely or circulate without a great loss of quality in the production systems (Pearce & Turner, 1989) (Perman, Ma, McGilvray, & Common, 2003). The CE concept can be therefore compared to the concept of linear economy in which companies consume resources, produce goods and dispose waste as a result of their economic activity (Heshmati, 2015).

During the 1970s, reflecting a growing concern about the rising environmental degradation and the finite nature of the resources of the planet (Brundtland, et al., 1987), the concept of sustainability and the interdependence between economic activity and the state of the natural environment appeared on the world political agenda (Perman, Ma, McGilvray, & Common, 2003), and established a turning point in the development of global environmental politics (United Nations - Department of Economic and Social Affairs, n.a.). The United Nations (U.N.) Conference on the Human Environment, held in Stockholm, Sweden from June 5 to 16, 1972, was the U.N.'s first major conference on international environmental issues (United Nations - Department of Economic and Social Affairs, n.a.) and led to the creation of the U.N. Environment Program (UNEP) in December 1972 which became responsible for the coordination of global initiatives promoting sustainability (Perman, Ma, McGilvray, & Common, 2003) (Pearce & Turner, 1989).

In 1980, the World Conservation Strategy of the International Union for the Conservation of Nature was the first report to coin the concept of sustainable development (International Union for Conservation of Nature and Natural Resources, 1980). Three years later, in 1983, the U.N. established the World Commission on Environment and Development (WCED) to re-assess the critical environmental and developmental problems and to propose new forms of global cooperation on the identified issues (Perman, Ma, McGilvray, & Common, 2003). The challenge posed in the 1980s was to harmonize globalized economic growth with the rising environmental degradation occurring on a global scale (Perman, Ma, McGilvray, & Common, 2003). In 1987, a WCED report – *Our Common Future* – advanced the concept of 'sustainable development,' defining the nature of economy-environment interdependence, identifying a number of potential environmental constraints on future economic growth and arguing that the trends of that time could not be continued far into the future (Perman, Ma, McGilvray, & Common, 2003) (Brundtland, et al., 1987).

Having defined sustainable development as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, et al., 1987, p. 43), WCED’s 1987 report states that the way to make the growth rates of the most industrialized countries environmentally sustainable is to continue to move towards a less resource- and energy-intensive operations as well as to continuously improve their efficiency (Brundtland, et al., 1987). WCED’s main report strongly influenced the ‘Earth Summit’ in Rio de Janeiro, Brazil in 1992 and the third U.N. Conference on Environment and Development in Johannesburg, South Africa in 2002.

Figure 2 is a schematic representation of the economy-environment interdependence. The outer heavy black lined box represents the environment, which is a thermodynamically closed system as exchanges of energy (but not of matter) occur and within each all economic activities take place.

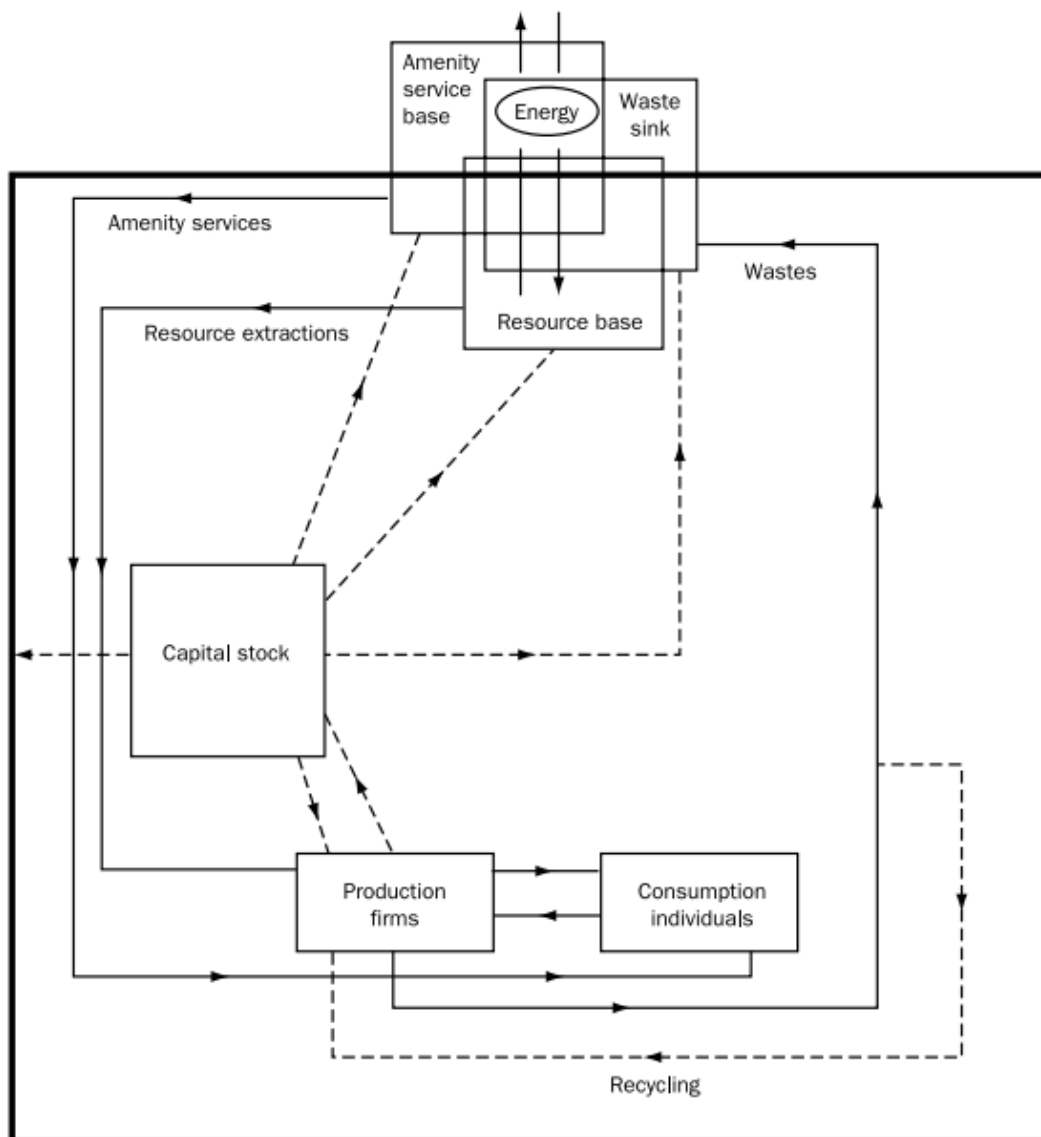


Figure 2 – Economic activity in the natural environment. Taken from ‘Sustainability and Policy’, Michael Common (1995) p.32.

## **2.2. Innovation Diffusion**

For the purpose of this exploratory research, innovation diffusion is the process through which a particular innovation is presented and communicated over time to the members of a social system (Karakaya, 2014) (Rao, 2010). In general, diffusion processes follow an S curve and different diffusion models have been applied over time in order to translate the S-shaped pattern of the diffusion of innovations to mathematical equations (Rao, 2010) (Meade N, 2006). By modelling the diffusion of innovations, it becomes possible to forecast those diffusion processes and develop methodologies that allow different technologies to diffuse more quickly and efficiently through the channels in which they are communicated and among their prospective users (Meade, 2006).

These different diffusion models generally divide the diffusion of innovations in five stages – awareness, interest, evaluation, trial, and adoption (Rao, 2010). Although there is some degree of uncertainty with regard to the time for and extent of the diffusion of a technology, the members of the system can be further classified as innovators, early adopters, early majority, late majority and laggards; that classification is dependent on the time of adoption of the technology since its introduction to the social system in study (Rao, 2010).

For the purpose of this exploratory research, the members of the social system are consumers and the technology introduced is the textile recycling technology that allow the recycling of worn-out clothing into new yarns to be used in the production of new clothes.

## **2.3. Textile Waste**

In terms of worn-out clothes, the disposal of a non-worn-out garment has the largest impact on the natural environment, which is not yet widely recognized (Slater, 2003). While the natural fibers such as cotton and wool produce methane gas, polyester – the most common non-biodegradable synthetic fiber used in the clothing industry – can remain in the soil for several decades (Slater, 2003).

In countries like the U.K. – the third largest exporter of used textiles in the world in 2014 (WRAP, 2016)– good quality garments are re-used through charity shops, textile banks or door-to-door charity bag collections (WRAP, 2016).. Almost half of the clothes not retailed in shops or unwanted are sold and shipped to Africa and South Asia where they are resold at local second-hand markets (WRAP, 2016) as part of a 36.7 billion Swedish kronor (\$4.4 billion) second-hand garment trade (Rodgers, 2015).

Based on 2010 data, over half of the textiles that have been collected for re-use, recycling or repurposing in the U.K. are exported (WRAP, 2016), while 32 percent are destined for re-use in the country and 9 percent for recycling (WRAP, 2016). However, almost half of the worn-out clothes in the U.K. still end up in landfills or are incinerated, a number that decreased between 2010 and 2014 before increasing in 2015, according to the Waste & Resources Action Programme (WRAP), a U.K. government and E.U.-backed agency tasked with reducing waste (WRAP, 2016).

Some of the textiles that are unsuitable for re-use can be recycled or repurposed, thereby avoiding an increased pressure on landfills. In most of these solutions, the different fabrics are re-spun and recycled as substitutes for other materials and later used in insulation, automotive felt, wipers, flocking or shoddy (WRAP, 2016). Recently, alternative ‘closed-loop’ textile recycling technologies had emerged (WRAP, 2016). Although the technology used to enable worn-out clothes to be collected, processed and made back into new yarn, textiles and clothes again is not disclosed publicly by the different actors in the field, U.K.-based company Worn Again has already developed a chemical textile recycling technology that is able to separate and extract synthetic

polyester from organic cotton into new polyester used in the production of new clothes (WRAP, 2016). Worn Again's new technology addresses the major technological barriers in textile-to-textile recycling, namely how to separate dyes and other contaminants from blended fibres – especially polyester and cellulose – and how to separate blended fibres themselves. In April 2015, Worn Again launched a partnership with Swedish fashion retail group H&M – the second largest fashion group in the world – and Kering, through its subsidiary PUMA, aiming to show that the process can be commercially viable and may be able to provide an effective solution for the recycling of clothes and textiles. Once separated, the aim is for this process to enable the recaptured polyester and cellulose from cotton to be spun into new fabric, creating a closed-loop circular resource model for textiles, thus keeping clothing already in circulation away from landfills and diminishing the impact of the clothing industry on the use of virgin resources. Another example of a recent technology introduced with similar purposes is Teijin's Ecocircle recycling system, a chemical textile recycling technology from a Japanese textile company to recycle polyester from worn-out clothes into new polyester used in the production of new garments (WRAP, 2016).

## **2.4. From Green Couture to Sustainable Fashion**

Although the recycling of clothing is not new to the clothing industry, a major problem inherent to the use of recycled fibers has been its varying average length and degree of maturity (Grasso, 1995), which make the recycled fibers suitable for a limited number of categories of products, as described in the previous section.

Today, textile producers are making the move toward environmentally-conscious products and create strategies to integrate the recollection of their end-of-use products in their business models, as also described in the previous section. Part of these corporate environmentally-conscious values is the development of clothing from organic 'green' resources to more sustainable recycled fibers.

While companies such as Esprit (U.S.A.) and Patagonia (U.S.A.) pioneered the use of organic cotton in the early nineties (Esprit, n.a.) (Patagonia, 2016), Burlington Industries (U.S.A.) developed a technique in 1994 to produce jeans made from 50 percent reclaimed denim fibers and 50 percent virgin cotton fibers (Folk, 1994) (Bhatia, Sharma, & Malhotra, 2004). In 2006, Unifi Manufacturing Inc. (U.S.A.) launched Repreve, a fully recycled polyester fiber currently used for the production of Polartec fabrics by Polartec (U.S.A.) which is currently used by Patagonia (Textileweb, 2007).

In 1993, Patagonia – in collaboration with Malden Mills (U.S.A.) – pioneered the implementation of textile recycling technologies in product development with the launch of the world's first outdoor eco-clothes, Patagonia's Synchron fleece jacket entirely made from recycled Polyethylene terephthalate (PET) plastic bottles (Patagonia, n.d.). By using this fabric, the company contributed to divert textile waste away from landfills and incinerators and to reduce the emission of greenhouse gases. Other global clothing retailers, including Marks & Spencer (U.K.) and H&M (Sweden), allege they are encouraging customers to reuse, recycle and repurpose garments they no longer wear either in collaboration with other companies or independently (Marks & Spencer, n.d.) (H&M, n.d.).

## 3. METHODOLOGY

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*This chapter describes the research methodology adopted and the research design employed to analyze critically the phenomena in study.*

The combination of approaches and techniques used with the intention to answer to the research question presented in section 1.2 are described as follows. Although the use of multiple methods and data triangulation is encouraged in order to improve the credibility of the findings of a research, and these involve data collection from various sources for the same issue (Denscombe, 2003) (Yin, 2003), this study was designed bearing in mind the nature of the phenomena under study but also its constraints. Such constraints – mainly the eight-week time frame for research design and data collection and analysis – can also affect other aspects of the research, including the process of the research and the type and amount of data collected.

### 3.1. Research Paradigm

A research paradigm is the philosophical framework giving support to the way a scientific research is conducted (Collis & Hussey, 2013), and interpretive research is any type of research where the findings are interpreted from qualitative research data (Collis & Hussey, 2013).

Following these definitions, the research paradigm used to conduct the current research is of an interpretive, subjective nature relying mainly on interpretivism as its philosophical framework. This classification aligns with the approach selected to conduct the research of the phenomena under study: a case study, a qualitative method of data collection based on observation and interpretation of data in a nominal form, rather than the quantitative measurement of data in a numerical form (Collis & Hussey, 2013).

### 3.2. Research Design

Closely linked to the research paradigm is the research design, which refers to the choices made in terms of the methodology, i.e. the chosen approach to the process of the research, and methods, i.e. the technique or techniques used for collecting and analyzing research data (Collis & Hussey, 2013).

The research design through which the researcher collected data is exploratory research that uses a case study approach and focuses on a company as its unit of analysis. Rather than ascertaining the characteristics of the phenomena in study, as in descriptive research, measuring causal relations among them, as in analytical research, or inferring the likelihood of similar phenomena occurring elsewhere, as in predictive research, exploratory research focus on gaining insights about new phenomena, when there are few or no earlier studies in the subject area (Collis & Hussey, 2013). Additionally, exploratory research also gives guidance on whether the existing solutions can be applied to the problem and on what future research should be conducted (Collis & Hussey, 2013).

Initially, the research design conceived for this study was of a mixed quantitative and qualitative nature, through an online and street survey and semi-structure interviews. This research design changed, however, during the course of its data collection phase mainly due to the difficulty in setting interviews during the limited time frame given the heavy working demands of the envisioned interviewees. As the typical techniques used in exploratory research, which include case studies, have fewer constraints regarding the nature of the procedures and type of research data (Collis & Hussey, 2013) a case study approach was therefore chosen for being better suitable

for the exploratory study of the new advances in textile recycling technologies under the limited time-frame. The protocols for the online//Internet self-completion and street face-to-face questionnaires and semi-structured interviews can, however, be found in the appendix of this study so that they can be later used as the starting point to a more thorough quantitative study in the same subject area.

### **3.3. Data Collection**

Reliability and validity are the two aspects of a research that refer to the credibility of the findings of a study (Collis & Hussey, 2013). However, as under an interpretivist paradigm the activities of the researcher influence the research, the reliability of the findings, i.e. their precision and accuracy, is often less important as the replication of the findings is difficult to achieve (Collis & Hussey, 2013). For that reason, the focus of an interpretivist research is on the validity of the findings, i.e. their authenticity and the extent the findings measure the phenomena the researcher wanted to measure (Collis & Hussey, 2013).

The research is predominantly based on secondary data, the case study subject's website, reports and referencing articles. Books by the founder and co-owner of the case study subject and others were also used to collect the data, allowing data triangulation as data sources are of different sources and nature. As the subject of the case study is a privately owned company, public valid data is scarce but the data obtained from scholar sources were privileged.

#### **3.3.1. Case Study**

Given the nature of the phenomena under investigation, the method used relies on a qualitative approach (Yin, Applications of Case Study Research, 2003) (Denscombe, 2003), implemented through a case study of a company.

The reasons for the reduction of size to a single company is time constraints although the reduced sample size creates the opportunity to provide deep insight on the phenomena in study.

The subject of study is Patagonia, Inc. The researcher chose this California-based outdoor equipment and clothing company as subject of the case study because it pioneered the development of textile recycling technologies in 1993 and their implementation in outdoor equipment, and today the company continues with several initiatives for diverting textile waste away from landfills. Patagonia, though not without its faults and challenges (also covered in this thesis), is a widely recognized pioneer in ethical and sustainable business practices in many areas of relevance to this study.

### **3.4. Delimitations**

This research's data collection is limited to a single company, Patagonia, operating globally yet under the jurisdiction of the state of California, U.S.A. Additionally, the phenomena in study and their theoretical framework are limited to the context of a single industry (clothing) and technology (textile recycling technologies). This research aims also at analyzing the case study from a specific theoretical framework (the diffusion of the technology) having circular economy and the transition to a circular business model as its context, and not the technical aspects of the technology nor the organizational structure or other internal characteristics of the company.



These delimitations limit the generalizability of the research conclusions, i.e., the extent to which the research findings can be extended from one particular setting to other similar settings (Collis & Hussey, 2013). However, it is possible to generalize from even a single case, if the characteristics of the phenomena in study are captured in a comprehensive and extensive way (Collis & Hussey, 2013).

### **3.5. *Ethics and Sustainability***

During the present study, the researcher followed the code of conduct made available through the course syllabus under which this research was conducted and the findings hereby reported do not violate any intellectual property rights and are communicated with honesty and transparency. Additionally, this research did not obtain sponsorship or any other affiliation and the discussion of its findings by the researcher is independent of any third-party. This research also advocated for the sustainability of its process and no unnecessary environmental or societal distress was caused during the time the research was conducted.

## 4. CASE STUDY

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*This chapter presents empirical data through a case study focusing on how the company Patagonia implemented recycled textiles technologies into its products. It also describes the strategies used by the company to promote the diffusion of such technologies and overcome the challenges found.*

Patagonia, Inc. (Patagonia) is a privately held high-end outdoor equipment and clothing company based in Ventura, California, U.S.A. According to data of European Outdoor Group's State of Trade 2014 – a yearly market research by the European Outdoor Group of which Patagonia is a founding member –, the European outdoor market grew by 1.4 percent in volume and by 1.2 percent in value in 2014, with an overall value of €4.83 billion at wholesale, equating to an estimated €10.2 billion at retail (European Outdoor Group, 2015); data were not publicly available for the U.S.A.

The company's value proposition is to design and produce lasting responsibly-sourced clothing so its customers can live in a more environmentally responsible fashion (Mackinnon, 2015). The company proactively pioneers environmental policies and initiatives on a regular basis, which includes sustainable manufacturing practices and the use of eco-friendly materials and fabrics in its product portfolio (Wang, 2010) (Chouinard & Stanley, 2012).

### 4.1. Company's History

Founded by accredited rock climber Yvon Chouinard in 1973 (Cole, 2015) (Visser, 2016), the company was incorporated in 1984 as a wholly owned subsidiary of the Lost Arrow Corporation, succeeded by Patagonia Works in 2013 (Gray & Petropoulos, n.d.).

The company was founded as an expansion of Chouinard's previous business of selling pitons and other rock-climbing equipment and generates today revenues around US\$ 600 million (Fry, Erika et al, 2015) (Visser, 2016).

Patagonia pioneered in the 1980s – at a time when mountaineers relied on traditional, moisture-absorbing materials such as cotton or wool – the concept of layering aiming at creating the ideal mountain layer, one that would at the same time transfer body moisture away from the skin and insulate well from wind and rain thus reducing the number of layers a climber had to wear (Patagonia, n.d.) (Chouinard, 2006). Layering involves the use of an inner layer against the skin for moisture transport, a middle layer to provide additional insulation, and a breathable polypropylene shell layer for wind and water protection (Wang, 2010) (Patagonia, n.d.) (Chouinard, 2006). The company's innovative solutions at the time were communicated to its loyal customers through essays in the company's direct-mail recycled-content paper catalog; in addition to traditional communication channels – such as catalogs –, the company also uses today the weblog 'The Cleanest Line,' run by the company's employees, friends and core customers, and Patagonia Works' subsidiary Patagonia Media for documentaries and short-films depicting Patagonia's environmentally-driven values. With the early success of its technical products, and given some limitations of the fabrics used, the company continued to invest in its fabric research lab and fabric development processes and worked closely with a variety of textile mills to improve the quality and overcome the limitations of those fabrics (Patagonia, n.d.) (Chouinard & Stanley, 2012) (Chouinard, 2006).

In October 1999, Chouinard retired and Michael Crooke – former CEO of sports apparel company Pearl Izumi (About Michael Crooke, n.d.) – was appointed as President and CEO of Patagonia and its parent company (Gray & Petropoulos, n.d.). In the same year, the sales of the company reached US\$182 million (Gray & Petropoulos, n.d.).



Since Rose Marcario – former executive vice-president at private equity company Capital Advisors and now President and CEO of Patagonia and Patagonia’s parent holding company Patagonia Works – joined the company as CFO in 2008, Patagonia has doubled its scale of operations and tripled its profits, with about \$600 million in revenues in fiscal 2013 (Voight, 2013). Sales at the 1265-person company stood at \$US 315 million in 2009 (Wang, 2010) and 2015 was the most profitable year in the company’s history (Bradley, 2015).

## **4.2. Environmental Responsibility**

Patagonia’s environmental ethics began in the early 1970s with the direct involvement of Patagonia’s workers in the defeat of a development plan that included the channeling of the local river’s mouth (Patagonia, n.d.) (Chouinard & Stanley, 2012). The development plan would not only destroy the remaining patches of habitat of the remaining bird- and wildlife that spawned in the estuary but also an important local surf break for most of Patagonia’s workers (Chouinard & Stanley, 2012). After that, Patagonia began to make regular donations to a variety of grassroots environmental organizations (Gray & Petropoulos, n.d.) (Chouinard & Stanley, 2012).

To institutionalize its giving, Patagonia launched its Environmental Grants Program in 1985 (Gray & Petropoulos, n.d.). In the fiscal year of 2014, the company donated \$6.2 million to 741 different groups, \$70 million in total since the program was launched (Patagonia, 2015). The company’s Environmental Grants Program is funded by Patagonia’s ‘Earth Tax’ corresponding to 1 percent of sales or 10 percent of pre-tax profit, whichever is greater (Gray & Petropoulos, n.d.).

Following the Environmental Grants Program, the company established the Footprint Chronicles in the early 1990s as a way to evaluate its own operations and determine their impact on the natural environment (Chouinard, 2006). Part of Patagonia’s internal commitment was to continually monitor the environmental footprint of its facilities and operations which eventually led to several innovative solutions to reduce the environmental impact of its economic activity, namely the use of recycled fibers, green building practices and the shift from conventional to organic cotton.

Some of the solutions implemented by Patagonia to reduce the impact of its operations in the natural environment are the implementation of textile recycling technologies in its product development, which started in 1993 with the launch of the Synchilla fleece jacket, the first outdoor clothing produced from recycled PET bottles instead of petroleum-based polyester (Chouinard & Stanley, 2012) (Patagonia, n.d.). Although Patagonia was initially successful in convincing other clothing companies to use the fabric due to its lower environmental impact, few of those companies later continued to use these fibers because of its higher costs (Chouinard & Stanley, 2012) (Chouinard, 2006). Besides its eco-clothing line, Patagonia’s new distribution center in Reno, Nevada was also built using all recycled or reclaimed products achieving a 60-percent reduction in energy consumption when it was open in 1996 (Chouinard & Stanley, 2012).

## **4.3. Strategy**

Patagonia’s strategy is to design and produce high-end outdoor clothing and equipment while implementing environmental initiatives that reduce the impact of its economic activity in the natural environment (Gray & Petropoulos, n.d.).

### **4.3.1. Switch to Organic Cotton**

In spring 1988, days after the opening of a Patagonia store in Boston, Massachusetts some of the sales assistants at the store were reporting feeling sick (Patagonia, 2016). The problem was found

to be the ventilation system which was recycling the same tired air, probably rich in formaldehyde (Patagonia, 2016) – a colorless gas, at room temperature, whose exposure can irritate the eyes and airways and trigger headaches. The source of the formaldehyde could be the finish on the cotton clothes stored in the basement of the store, which then led the company to commission, in 1991, independent research of conventional cotton and the company's other three major fibers (Patagonia, 2016). The study found that cotton, the natural fiber used in most of Patagonia's products, had the greatest environmental impact, with 25 percent of all toxic pesticides applied worldwide in agriculture used in conventional cotton farming. In fall 1994, having planned the switch to a 100-percent organically grown cotton line by the spring of 1996 (Patagonia, 2016), the company had to work directly with the few individual farmers who had gone back to organic methods as there was not enough certified organic cotton commercially available. Additionally, the switch to organic cotton was more beneficial to the environment than to the company itself, as the prices of its clothing line were then higher to reflect the higher cost of the raw resources.

### **4.3.2. Worn Wear Program**

Patagonia created the Worn Wear program in 2013 as a way to encourage consumers to take good care of their outdoor equipment, washing and repairing as needed (Simpson, 2015). For this program, Patagonia employs 45 full-time repair technicians at its Reno Repair Department in Nevada, U.S.A. Since 2015, the company also sends a biodiesel-fueled sales and repair truck around the U.S.A. to repair busted zippers, rips and tears, buttons and pulls for free, to teach its customers how to fix their own garments and to sell Patagonia second-hand clothing (Patagonia, 2016).

The Worn Wear program offers the free lifetime repair of some of the products so that Patagonia's customers do not have to buy more, extending the life of Patagonia's garments through proper care and repair or providing an easy way to recycle Patagonia worn-out garments when they are beyond repair (Patagonia, 2016). As a result, it can reduce carbon dioxide emissions, waste output and water usage required to produce them (Chouinard & Stanley, 2012). In addition to the Worn Wear program, any Patagonia product beyond repair can be returned to the Patagonia Service Center at Patagonia's Reno Facility for recycling or repurposing by mail or from the nearest Patagonia retail store or at a participating Patagonia dealer. Since 2005, the company claims to have recycled over 82 tons of clothing for recycling, diverting textile waste away from landfills and incinerators (Patagonia, 2016).

To Marcario, to repair damaged garments that consumers would otherwise dispose is a radical act and a countercultural mark for a clothing company such as Patagonia (Marcario, 2015). Patagonia's President and CEO also believes that rather than the cycle of take-produce-discard (see figure 3, section 4.3.2) which is driving societies towards ecological collapse, consumers can be educated and become responsible for their own purchases as well as for all the subsequent steps of repairing, reusing, repurposing, recirculating or, if beyond repair, recycling (Marcario, 2015).

The program completed about 40,000 individual repairs (Marcario, 2015) and, in 2015, Patagonia partnered with electronic-repairing company iFixit to publish more than forty free repair guides for Patagonia's products on the company's website, providing to its customers the opportunity to fix their own garments, re-purpose or send them back to Patagonia for recycling if necessary (Marcario, 2015).

### **4.3.3. Limiting Growth**

In September 2013, Patagonia unveiled the initiative 'The Responsible Economy' with marketing promos (see figure 3) on its website, catalog and other channels (Voight, 2013). The new

positioning of the company aimed at producing less than the company had in previous years and at challenging Patagonia's customers to be more environmentally responsible with their purchases, when they do buy.

To weekly trade online publication *Adweek*, Rick Ridgeway – Patagonia's vice-president of environmental affairs since 2005 – recognized that clothing companies like Patagonia are still increasing their impact on the environment as they grow even though companies reduce the environmental footprint of their individual products (Voight, 2013).

Although denying posing Patagonia as the model of a responsible company and recognizing that, in the end, the company may never be completely responsible (Marcario, 2015) (Patagonia, 2016), the company has been starting different initiatives towards being responsible, both environmentally and socially. Part of these initiatives are the early bet on organic cotton (see section 4.3.1) or the opening, in 2013, of used-clothing sections in its stores across the U.S.A dedicated to selling worn-out Patagonia clothes (Mackinnon, 2015) (Voight, 2013) (Ryan, 2014). The company has also made product repair and recycling a growing part of its business model with Patagonia's Worn Wear Program (see section 4.3.2.). These choices aim to further reduce overconsumption, repair what is damaged, recirculate what customers no longer use, and recycle or repurpose what wears out (The Cleanest Line's Editors, 2013).



Figure 3 – “The Responsible Economy”, Patagonia's 2013 advertisement.

In April 2013, the company started the \$20 Million & Change investment fund to support pro-environment startups that revolve around extending the life of products already owned by consumers (Patagonia, 2016) (Voight, 2013). The company recently invested in Yerdle – a Web startup whose stated mission is to reduce new-product purchases by 25 percent – as a simple way for people, and even the company itself, to swap or give away used Patagonia garments or equipment, putting goods back into circulation and reuse what currently exists (Mackinnon, 2015) (Patagonia, 2016).

The company's Black Friday marketing campaign launched in 2011 featured the tagline ‘Don't Buy This Jacket,’ urging its customers to purchase less and reuse what they already owned. The advertisement broke down the environmental costs of one of the company's top-selling 60-percent-recycled polyester R2 fleece sweater and asked consumers to think twice before buying it or any other product. The attention the ad received helped to bump Patagonia's 2012 sales significantly (Mackinnon, 2015).

## 5. DISCUSSION

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*A discussion of the empirical findings is presented in this chapter by comparing the different initiatives the subject company of the case study has with the different theories that have been reviewed in chapter 2.*

As described in section 4.2, in 1993 the outdoor equipment and clothing company Patagonia pioneered the implementation of textile recycling technologies in fabric development with the launch of the world's first outdoor eco-clothes. Patagonia's Synchronia-based fleece jacket, launched in 1993, was produced from recycled PET plastic bottles. Over the years, Patagonia used different strategies in pushing these technologies into use by other companies – including its competitors – and their adoption by Patagonia's customers while leading the way to a more sustainable use of the natural resources, diverting worn-out clothes away from landfills and incinerators and diminishing the impact of Patagonia's economic activity in the natural environment. These practices make the company a good case study of how can businesses acknowledge the economy-environment interdependence schematically represented on figure 1 of section 2.2 and innovate in their business models in order to move from a linear business model towards a sustainable circular economy business model.

The switch from conventional to organic cotton in a time in which the organic cotton farming was not competitive is one of the examples described in section 4.3.1 that illustrate Patagonia's early willingness to change what and how the company produces in order to minimize the impact of its business in the natural environment. As a company started by surfers and mountaineers, however, one can argue that perhaps Patagonia is more attuned to the impact its business is having on the natural environment and is therefore more willing to take risks to protect the environment than traditional publicly-traded clothing retail corporations. Nevertheless, and as stated by WCED's 1987 report presented in section 2.1, the growth rates of industrial countries, namely their companies, can only become environmentally sustainable if companies continue to move towards a more efficient and less resource- and energy-intensive operations which make Patagonia's business choices a good example for companies within the clothing sector that already acknowledge the existing interdependence between their economic activity and the state of the environment and the finite nature of the planet's resources.

Among the strategies applied by Patagonia to push textile recycling technologies into use by other companies and their adoption by Patagonia's customers is the effective and efficient use of different channels. The use of these channels makes the company able to raise awareness of its innovative solutions among its loyal innovators (see section 2.2), thereby paving the way for the company's later textile recycling technologies to diffuse more quickly and be adopted beyond the early adopters (see section 2.2) who get inspired by the company's environmentally-driven values. Early on, Patagonia relied on the use of its direct-mail catalog to educate its core customers of the advantages of layering compared to what was common practice before in mountain climbing. The company's catalog had also a pivotal role in raising awareness for the incremental technological innovations that the company has been adding on its materials and fabrics, namely the development of recycled-PET Synchronia – in partnership with Malden Mills and, more recently, with Japanese textile company Teijin. Besides the use of traditional channels, the company also explored innovative ways to relate to its customers and build a bigger core of loyal consumers with the repair truck, the weblog 'The Cleanest Line' and online booklets.

These channels also allowed the company to educate its customers about the different solutions used by the company to implement textile recycling technologies in its operations and transition to a sustainable circular economy business model. By taking these choices, the company not only



educates consumers as also leads them to become environmentally responsible and, as a consequence, to later influence government policies.

By a thorough product development and innovative design, the company produces lasting products and has implemented ways to recollect its worn-out products thus making its business model move from a linear model towards a sustainable circular economy business model. Part of the solutions used by the company to implement textile recycling technologies and move towards a sustainable circular economy business model were Patagonia's Worn Wear Program, the Common Threads Recycling Program or the possibility to always return a worn-out garment to Patagonia's distribution center by mail or from any store or local authorized dealer of Patagonia's products. To make the recycling (or repurposing) of worn-out garments work, the company established a 45-people repair department at its distribution center to where all worn-out clothes are sent to be recycled or repurposed. The company also created a grants program and an investment fund to invest in organizations or startups that share Patagonia's environmental values and can provide new ways for Patagonia to accomplish its environmental goals. This is an additional strategy that other clothing companies facing similar challenges can emulate, bringing valuable knowledge in sustainable manufacturing into the company thus allowing them to become competitive in the sector of sustainable fashion and further reducing the costs of textile recycling technologies by increases in the demand of recycled fibers.

As a medium-size privately owned company, one can argue that it may be easier for Patagonia to take the risks involved in the mentioned choices, which appear to favor the company's ecological and social ethics rather than its financial results; risks that large publicly-traded clothing companies are more limited to take. However, having successfully implemented textile recycling technologies and ways to recover its worn-out products on its operations, Patagonia continues to have positive financial results and 2015 was the most profitable year in the company's history.

Now that more textile recycling technologies are available and blended fibers can be recycled, as presented in the section 2.4 of the literature review, the clothing industry has the opportunity to look at recycled fibers as a constituent part of the pool of resources from where they can generate value to its customers, just like the natural fibers such as cotton or linen and, more recently, the synthetic fibers such as polyester are. This also creates the opportunity for new start-ups to establish and become part of the supply chain of clothing manufacturers by dedicating their economic activity to the recycling of collected worn-out garments into fibers that clothing manufacturers can later use for the production of new recycled clothes.

The referred choices of Patagonia that make the company move towards a sustainable circular economy business model can serve as good practices for and minimize the risks of other clothing companies aiming at reducing the environmental cost of their economic activity. The comprehensive case study of Patagonia done by this research therefore brings valuable insights on how can these companies overcome similar challenges to the challenges Patagonia once faced.

## 6. CONCLUSIONS AND FURTHER RESEARCH

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*This chapter presents the conclusions and limitations of this exploratory research based from the discussion with the intention to answer the research question formulated in section 1.2. Future recommendations are also presented, aiming at proposing further research within the same topic.*

The aims of this exploratory research were to identify how can clothing companies implement textile recycling technologies that help transition them to a sustainable circular economy business model, given the challenges of eco-innovation diffusion. This was done through a case study of Patagonia, an outdoor equipment and clothing company that pioneered the use of the PET-recycled Synchilla fibers in 1993 and continues to have today several initiatives for diverting textile waste away from landfills.

### 6.1. Conclusions

Part of the solutions applied by the company to implement textile recycling technologies that help its transition to a sustainable circular economy business model were different strategies in product development and resource recovery. Early on, Patagonia invested in fabric development and made of product design an important step for the development of lasting products and, by pioneering the concept of layering on its products, the company minimized the use of different fibers blended together which is known to make the later process of textile recycling more difficult. Initiatives such as the Worn Wear Program, the Common Threads Recycling Program or the possibility to always return a worn-out garment to Patagonia's distribution center by mail or from any store or local authorized dealer of Patagonia's products are also an important part of resource recovery. To make the recycling (or repurposing) of worn-out garments work, the company established a 45-people repair department at its distribution center to where all worn-out clothes are sent to be recycled or repurposed.

Although, as a medium-size and privately-owned outdoor clothing and equipment company, Patagonia may be more attuned to the impact its economic activity is having on the natural environment and it may be easier for Patagonia to take such risks and continually transform themselves into a more responsible company. However, having successfully implemented textile recycling technologies on its operations and ways to recover its worn-out products, the company continues to have positive financial results and 2015 was the most profitable year in the company's history.

### 6.2. Limitations

The main limitations of the conducted research are its reliance on secondary data and the limited time frame in which the research had to be designed, implemented, and terminated. As the subject of the study is a privately owned company, this research is also limited in the amount of the data collected although all efforts were made to collect data from the available scholar sources.

As the findings of this research rely on secondary data and on a single case study, it is difficult to make causal inferences and the phenomena in this one unit of analysis may or may not reflect the phenomena of different entities in similar settings. To overcome such limitations, semi-structured interviews and public questionnaires were initially envisioned and prepared (whose protocols are now at the appendix of this research) but due to the limitation on the time frame in which this research had to be conducted the research design shifted to the case study of Patagonia.

### **6.3. Further Research**

Despite the valuable insight brought up by the present study, additional research would be needed to better verify whether the findings of this study can be translated to similar settings or not. This could be achieved with additional case studies of other companies with relevance to the topic, as H&M and PUMA appear to be from the literature review done by this research.

Although textile recycling is not new to the clothing industry and the subject of the case study has been developing outdoor clothing produced from recycled fibers since 1993 and recovering, for recycling or repurposing, its worn-out products, the use of textile recycling technologies is still limited to a niche market and did not diffuse quickly. It would be therefore also interesting to understand with a new study whether clothing retailers believe they can push textile recycling technologies into the market and investigate whether there is a real demand for recycled clothing and to what extent is that demand acting as a driver for the diffusion of these technologies in particular. To better understand the dynamics and nature of the main drivers and barriers of this technology in particular a research could be also conducted with public questionnaires and semi-structure interviews to Patagonia and other key players in the field; for this purpose, the protocols in the appendix of the present study can be used as a starting point to identify such drivers and barriers. Additionally, the diffusion processes of the technology could also be investigated with a thorough PEST ('Political, Economic, Social and Technological') analysis to understand if and to what extent government policies, economic cycles, and/or social and technological trends can facilitate the diffusion of this technology in particular. The strategies used by Patagonia to educate consumers and make them become environmentally conscious could also be studied to better understand whether Patagonia's choices have been right or wrong so that other companies aiming at introducing recycled clothing to their consumers could follow better practices.

Additionally, it would also be interesting to evaluate the impact of the current green/sustainable trend in the diffusion of this technology or if it is making other clothing companies implement business model innovations that make them move towards a sustainable circular economy business model. This could be achieved in part through a quantitative analysis of newly-established start-ups in the last few years whose economic activity aims at diverting textile waste away from landfills or incinerators.

## 7. REFERENCES

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- About Michael Crooke. (n.d.). Retrieved April 16, 2016, from Michael Crooke: <http://www.michaelcrooke.com/about-michael-crooke/>
- Ashton, T. (1966). *The Industrial Revolution 1760-1830* (Vol. 109). In the Hands of a Child.
- Baines, E. (1835). *The History of the Cotton Manufacture*. H. Fisher, R. Fisher, and P. Jackson.
- Bhatia, D., Sharma, A., & Malhotra, U. (2004). Recycled Fibers: An Overview. *International Journal of Fiber and Textile Research*.
- Bradley, R. (2015). *The woman driving Patagonia to be (even more) radical*. Retrieved from Fortune: <http://fortune.com/2015/09/14/rose-marcario-patagonia/>
- Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., . . . MacNeill, J. (1987). *Our Common Future* (\‘Brundtland report\’). Oxford University Press.
- Chouinard, Y. (2006). *Let My People Go Surfing: The Education of a Reluctant Businessman*. Penguin Books.
- Chouinard, Y., & Frost, T. (1974). *Patagonia*. Retrieved April 23, 2016, from A Word: <http://www.patagonia.com/us/patagonia.go?assetid=3316>
- Chouinard, Y., & Stanley, V. (2012). *The Responsible Company: What We’ve Learned From Patagonia’s First 40 Years*. Patagonia Books.
- Cohen, L. M. (2000). *Research Methods in Education* (Fifth Edition ed.). RoutledgeFalmer.
- Cole, H. (2015). *Statement in Support of SB-788 – A bill to prevent future offshore drilling in Santa Barbara County*. Retrieved April 13, 2016, from The Cleanest Line: <http://www.thecleanestline.com/2015/06/statement-in-support-of-sb-788-bill-to-prevent-future-offshore-drilling-in-santa-barbara-county.html>
- Collis, J., & Hussey, R. (2013). *Business Research - A Practical Guide for Undergraduate and Postgraduate Students*. Palgrave Macmillan.
- Denscombe, M. (2003). *The Good Research Guide for Small-scale Social Research Projects* (Second Edition ed.). Open University Press.
- EPA. (2015, June). *Climate Change Indicators in the United States - Atmospheric Concentrations of Greenhouse Gases*. Retrieved March 10, 2016, from United States Environmental Protection Agency: <http://www3.epa.gov/climatechange/science/indicators/ghg/ghg-concentrations.html>
- Esprit. (n.a.). *Sustainability in Practice*. Retrieved April 12, 2016, from Esprit: [http://www.esprit.com/company/sustainability/sustainability\\_in\\_practice/](http://www.esprit.com/company/sustainability/sustainability_in_practice/)
- European Outdoor Group. (2015, September). *Overview of the European outdoor market*. Retrieved April 28, 2016, from European Outdoor Group: <http://www.europeanoutdoorgroup.com/research/current-project/overview-of-the-european-outdoor-market>
- Fletcher, K. (1999). Towards Environmental Responsible Design in Textiles. In A. R. Horrocks, *Ecotextile '98 - Sustainable Development*. Woodhead.
- Folk, M. (1994). Making Use of Scraps: Burlington Finds Way to Turn Yarn Into Jeans. *Greensboro News and Record*.



- Fry, E. e. (2015). *Change the World - Companies That Are Doing Well by Doing Good*. Retrieved April 09, 2016, from Fortune: <http://fortune.com/change-the-world/patagonia-24/>
- Fry, Erika et al. (2015). *Change the World - Companies That Are Doing Well by Doing Good*. Retrieved April 09, 2016, from Fortune: <http://fortune.com/change-the-world/patagonia-24/>
- Grasso, M. M. (1995). Recycled Textile Fibers: The Challenge for the Twenty-First Century. *Environmental Economics*, 27(5).
- Gray, D. Y. (2010). *Values-centered Entrepreneurs and Their Companies*. Routledge.
- Gray, E., & Petropoulos, K. (n.d.). *Yvon Chouinard: Patagonia Inc*. Retrieved May 2, 2016, from American National Business Hall of Fame: <http://anhf.org/fellows/yvon-chouinard/>
- Griffiths, T., Hunt, P., & O'Brien, P. (1992). Inventive Activity in the British Textile Industry, 1700–1800. *The Journal of Economic History*, 52(04).
- H&M. (n.d.). *Garment Collecting*. Retrieved May 13, 2016, from H&M: <http://about.hm.com/en/About/sustainability/commitments/reduce-waste/garment-collecting.html>
- Heshmati, A. (2015). A Review of the Circular Economy and its Implementation. *Institute for the Study of Labor*.
- Hobsbawm, E. J. (1999). *Industry and Empire: The Birth of the Industrial Revolution*. The New Press.
- International Labour Organization - Sectoral Activities Department. (2014). *Wages and Working Hours in the Textiles, Clothing*. International Labour Organization.
- International Union for Conservation of Nature and Natural Resources. (1980). *World Conservation Strategy - Living Resource Conservation for Sustainable Development*. IUCN-UNEP-WWF.
- Karakaya, E. H. (2014). Diffusion of eco-innovations: A review. *Renewable and Sustainable Energy Reviews*, 33.
- Keller, C., Magnus, K., Hedrich, S., Nava, P., & Tochtermann, T. (2014). *Succeeding in tomorrow's global fashion market*. McKinsey & Company.
- Ki-moon, B. (2008, October). *Age of Green Economics*. Retrieved May 13, 2016, from United Nations: <http://www.un.org/sg/articles/articleFull.asp?TID=84&Type=Op-Ed&h=1>
- Mackinnon, J. B. (2015, May 21). *Patagonia's Anti-Growth Strategy*. Retrieved April 26, 2016, from The New Yorker: <http://www.newyorker.com/business/currency/patagonias-anti-growth-strategy>
- Manyika, J., Sinclair, J., Dobbs, R., Strube, G., Rassey, L., Mischke, J., . . . Ramaswamy, S. (2013). *Manufacturing the future: The next era of global growth and innovation*.
- Marcario, R. (2015, November 25). *Repair is a Radical Act*. Retrieved April 27, 2016, from The Cleanest Line: <http://www.thecleanestline.com/2015/11/repair-is-a-radical-act.html>
- Marks & Spencer. (n.d.). *How Can I Get a £5 M&S Voucher From Oxfam*. Retrieved May 15, 2016, from Marks & Spencer: <http://help.marksandspencer.com/support/products-services/oxfam-voucher>
- McCormack, B. a. (1997). *Conducting a Survey, The SPSS Workbook*. International Thomson Business Press.

- Meade N, I. T. (2006). Modelling and forecasting the diffusion of innovation – A 25-year review. *International Journal of Forecasting*, 22.
- Patagonia. (2015). *Environmental + Social Initiatives 2015*. Patagonia Books.
- Patagonia. (2016). *Becoming a Responsible Company*. Retrieved April 26, 2016, from Patagonia: <http://www.patagonia.com/us/patagonia.go?assetid=2329>
- Patagonia. (2016). *Reuse Recycle*. Retrieved April 27, 2016, from Patagonia: <http://www.patagonia.com/us/reuse-recycle>
- Patagonia. (n.d.). *Company History*. Retrieved April 18, 2016, from Patagonia: <http://www.patagonia.com/us/patagonia.go?assetid=3351>
- Pearce, D., & Turner, R. (1989). *Economics of Natural Resources and the Environment*. Johns Hopkins University Press.
- Perman, R., Ma, Y., McGilvray, J., & Common, M. (2003). *Natural Resource and Environmental Economics* (Third edition ed.). Pearson Education Limited.
- Rahm, D. (2009). *Climate Change Policy in the United States: The Science, the Politics and the Prospects for Change*. McFarland.
- Rao, K. U. (2010). A review of technology diffusion models with special reference to renewable energy technologies. *Renewable and Sustainable Energy Reviews*, 3(14).
- Rifkin, J. (2011). *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World*. St. Martin's Press.
- Rodgers, L. (2015, February 11). *Where do your old clothes go?* Retrieved February 17, 2016, from BBC News: <http://www.bbc.com/news/magazine-30227025>
- Ryan, K. (2014, July 31). *The Bottom Line: Patagonia, North Face, and the Myth of Green Consumerism*. Retrieved April 26, 2016, from Groudswell Stories: <http://groundswell.org/the-bottom-line-patagonia-north-face-and-the-myth-of-green-consumerism/>
- Simpson, C. (2015, March 31). *PATAGONIA MOBILE WORN WEAR TOUR: IF IT'S BROKE, FIX IT*. Retrieved April 28, 2016, from Patagonia Works: <http://www.patagoniaworks.com/press/2015/3/31/patagonia-mobile-worn-wear-tour-if-its-broke-fix-it>
- Slater, K. (2003). *Environmental Impact of Textiles: Production, Processes and Protection*. Woodhead.
- Textileweb. (2007, February 1). *Unifi Inc. Has Developed A Recycled Yarn With Permanent Performance Benefits*. Retrieved February 18, 2016, from TextileWeb: <http://www.textileweb.com/doc/unifi-inc-has-developed-a-recycled-yarn-with-0001>
- The Cleanest Line's Editors. (2013, September). *"Better Than New" - Fashion Week, The New York Times, Worn Wear & Patagonia's Common Threads Partnership*. Retrieved April 26, 2016, from The Cleanest Line: <http://www.thecleanestline.com/2013/09/better-than-new-fashion-week-new-york-times-worn-wear-patagonia-common-threads-partnership.html>
- United Nations - Department of Economic and Social Affairs. (n.a.). *United Nations Conference on the Human Environment (Stockholm Conference)*. Retrieved April 23, 2016, from Sustainable Development: <https://sustainabledevelopment.un.org/milestones/humanenvironment>
- Wang, J. (2010, June). Patagonia, from the ground up. *Entrepreneur*, 38(6), p. 26.

- Visser, W. (2016). *The World Guide to Sustainable Enterprise* (Vol. 4). Greenleaf Publishing.
- WMO. (2016, January 25). *2015 is hottest year on record - Press Release No. 2*. Retrieved March 10, 2016, from World Metereological Organization: <https://www.wmo.int/media/content/2015-hottest-year-record>
- Voight, J. (2013, September). *Patagonia Is Taking On a Provocative 'Anti-Growth' Position*. Retrieved April 25, 2016, from Adweek: <http://www.adweek.com/news/advertising-branding/patagonia-taking-provocative-anti-growth-position-152782>
- World Trade Organization. (2015). *International Trade Statistics 2015*. WTO Publications.
- WRAP. (2016). Textiles Market Situation Report. *WRAP*.
- Yin, K. R. (1993). *Applications of Case Study Research*. SAGE.
- Yin, K. R. (2003). *Applications of Case Study Research*. SAGE.

## 8. APPENDIX: SUPPLEMENTARY INFORMATION

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### ***The Online and Street Surveys***

#### ***On Textile Recycling: A Survey***

Worn Again is developing promising textile-to-textile chemical recycling technologies in partnership with H&M and PUMA in order to make the recycling of textiles a sustainable reality. With this three-minute survey I intend to analyse how much a priority is textile recycling to you and anonymously gather data on how can the retail clothing industry innovate while continuously merge with your needs, as a potential costumer.

Thank you for completing the survey and wish you a greener planet.

André Rosa, arosa@KTH.se

**\*Required**

1. Where do you usually buy your clothes?

*Tick all that apply.*

Newly-established designers

Second-hand

Smaller boutiques & high-end

Large fashion retailers

Tailor-made

2. Do you choose outer clothes by yourself or not?

3. From 1 to 4, how relevant is WHERE are your clothes produced on your decision to buy them? (as indicated by the tag 'Made in ...') \*

*Tick all that apply.*

1, not relevant at all

2, quite relevant

3, very relevant

4, very much relevant

4. From 1 to 4, how relevant is HOW are your clothes produced on your decision to buy them? (regarding company's policies, values, codes of conduct or use of resources) \*

*Tick all that apply.*

1, not relevant at all

2, quite relevant

3, very relevant

4, very much relevant

5. From 1 to 4, how relevant is WHICH COMPANY produced your clothes on your decision to buy them? (regarding the top brand, not suppliers) \*

*Tick all that apply.*

- 1, not relevant at all
- 2, quite relevant
- 3, very relevant
- 4, very much relevant

6. From 1 to 4, would you be willing to pay a higher price for your clothes if they were produced from recycled fibres (rather than from virgin resources)? \*

*Tick all that apply.*

- 1, very unlikely
- 2, unlikely
- 3, likely
- 4, very likely

7. From 1 to 5, rank the type of clothing you would be willing to buy knowing it was produced from recycled fibres \*

Underwear & Loungewear

Footwear

Tops (shirts, t-shirts, and blouses)

Sports apparel

Bottoms (trousers, shorts, and skirts)

Coats & jackets

8. Which would be your TOP CONCERN regarding the use of clothing produced from recycled fibres?

*Mark only one oval.*

Quality of the items

Longevity of the items

Final cost of the items

Versatility of the items

Other:

9. From 1 to 5, rank your MAIN CONCERNS regarding the use of clothing produced from recycled fibres.

1 2 3 4 5

10. From 1 to 5, rank your MAIN REASONS to buy clothing produced from recycled fibres.

1 2 3 4 5

11. Which would be your TOP REASON to buy clothing produced from recycled fibres?

*(open question)*

12. Besides a lower impact on the resources of the planet, which other feature or features would you PRIORITIZE at the moment of buying clothing produced from recycled fibres?

*(open question)*

13. Please select your GENDER. \*

Female

Male

Prefer not to answer

14. Please select your AGE GROUP, in years. \*

0-17

18-25

26-45

46-70

+71

Prefer not to answer

15. Please select your CULTURAL BACKGROUND.

*Mark only one oval.*

European

Sub-Saharan African

Middle Eastern & North African

Russian & Central Asiatic

Southern Asiatic

North American

Latin American & Caribbean

South American

Austral & Insular Oceania

Other (specify):

16. Are you answering this survey from Sweden?

*Mark only one oval.*

YES

NO

## ***The Semi-Structured Interview Protocol***

Background of the company.

(NB. Some of the questions may be answered prior to the interview.)

Is [company] aware of the possibility to weave new, recycled fibres using end-of-use textiles as raw material and produce any type of fabric just like it is with virgin resources such as cotton or polyester?

Which activities does [company] have regarding the recycling of end-of-use textiles?

IF THE ANSWER TO THE SECOND QUESTION IS 'NONE': What are the main factors leading [company] to NOT USE recycled fibres as raw material?

IF THE ANSWER TO THE SECOND QUESTION IS 'NONE': Would [company] consider the use of recycled fibres in its products? Together with or by replacing the use of fibres from virgin resources? Is the use of recycled fibres as raw material part of [company]'s strategic plan?

IF THE ANSWER TO THE SECOND QUESTION IS 'NONE': From [company]'s perspective, how would the following drivers for the development of the technology be ranked in the decision of using recycled fibres as raw material?

Legislative support

High consumer demand

Competitive pressure/general trend

Lower production costs

Final cost to the consumer

Fabric quality/textile design

Availability of raw material

IF THE ANSWER TO THE SECOND QUESTION IS OTHER THAN 'NONE': In which sector does [company] see the potential use of recycled fibres?

IF THE ANSWER TO THE SECOND QUESTION IS 'PRODUCTION/COMMERCIALIZATION': Does [company] have in-house production of any textiles produced from recycled fibres or is the production outsourced?

Is it feasible to mix recycled fibres with virgin materials (organic or synthetic) such as cotton or polyester? Does this improve or change any specifications of the final recycled items?

IF THE ANSWER TO THE SECOND QUESTION IS 'COMMERCIALIZATION': Which product categories are on the market today and are produced from recycled fibres and commercialized by [company]?

What tonnage does [company] produce per year of such items? And in 2015? And in the year before?

How do the production costs of items produced from recycled fibers compare with items produced from virgin resources?

How does [company] address the impact of dyes and other blended fibres on the final items during the production of recycled fibres? (NB. may be subject to non-disclosure.)

IF THE ANSWER TO THE SECOND QUESTION IS ‘DEVELOPMENT’: Which step is the development of the technology in?

How do recycled fibres compare with fibres from virgin resources? And in terms of cost and quality?

What are the main challenges that [company] is facing in the [insert company’s activities here; possibly: development/production/commercialization] of items produced from recycled fibres?

Is there any current limitation in terms of legislation that can compromise or is compromising the commercialization of items produced from recycled fibres?

IF ANSWER TO PREVIOUS QUESTION IS YES: Does [company] have an on-going strategy to influence the change of such legislation so that it becomes favourable to that commercialization?

Is there any governmental initiative that is currently promoting the commercialization of such products?

Does [company] or [the interviewee] believe that the success of items produced from recycled fibres in reaching the early majority is dependent on a substantial change of behaviour by the consumers?

IF ANSWER TO PREVIOUS QUESTION IS FAVORABLE: Do you believe that consumers’ behaviour can be changed by companies or is it seen as a limitation for the adoption of the technology?

What limitations of recycled fibres had [company] identified or is aware of that can act as a barrier for the adoption of the technology by consumers?

Did [company] make or outsource any market research aiming the market size or existing demand for items produced from recycled fibres?

Company’s Vision and Future.

What is the main vision that [company] is pursuing for the [insert company’s activities here; development/production/commercialization] of items produced from recycled fibres?

Can you think of any reasons why recycled fibres are not widely used in the clothing industry yet?

Are there any changes taking place to [company’s] business model in order to establish a stable supply of end-of-use clothing so that the company can offer items produced from recycled fibres to its customers?



If not by using recycled fibres, is there any other activity that [company] is implementing in order to move towards a sustainable circular economy model?

Personal data of the interviewees.

First, Last name

What is your role in the company?

When did you join the company?

Do you have any item produced from recycled fibres or know any other brand producing clothes from recycled fibres?