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Understanding circular business models: drivers, obstacles and conditions towards a successful transition

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Abstract

A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which resources are kept in use for as long as possible, value creation is maximized in the use phase and products and materials are recovered at the end of each service life**.** The thesis explores this concept by taking a business model perspective. The theoretical part of the thesis clarifies the phenomenon of circular economy. It summarizes the development of the concept from an historical perspective and clarifies its position with regards to existing contemporary concepts (biomimicry, industrial ecology, cradle to cradle, blue economy, performance economy). By taking a business model perspective on the concept, the thesis attempts to offers a first typology of circular business models. Through the field work, the thesis extends knowledge on the understanding of circular business models at practical level. It highlights the differences between the theoretical underpinnings of the concept (its principles) and its implementation, showing that there is a gap between the concept and the way companies implement it. The findings allow the author to discuss how circular business models are classified and shows that many hybrid circular approaches can emerge. The analysis of the common features of the cases allow the author to draw a first set of normative requirements that define how a circular business model is organized. The cross analysis of the cases supports the development of a framework highlighting the current drivers at internal and external level pushing company to operate within circular economy principles, addressing a set of conditions allowing for the successful implementation of circular business models, while acknowledging a number of recurrent challenges preventing from a full implementation of the concept. At the core of the framework is set of key steps explaining how the transition occurs.

Keywords Circular Economy, business model innovation, Sustainability.

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1. Introduction

1.1 Background

Our current consumption and production patterns follow a linear 'take-make-dispose' approach. From the early phase of material extraction, along the manufacturing and usage phases, companies use high level of energy and resources to design, produce and deliver products which eventually get discarded, once they do not serve anymore their initial purpose. This conventional approach is not without consequences and bears strong environmental consequences. While some material gets already wasted even before reaching the consumer, less than 40% of waste generated yearly in Europe is reused, recycled or composted (Eurostat 2011). When discarded products end up in landfill, a significant amount of residual energy is lost untouched and a larger amount of energy is required to manufacture a new product. In a planet of finite resources, these behaviours are not without effect on the ecosystems that support and enhance our current being. Among the 24 ecosystems services provided by our environment (from food and fresh water provision to air purification), 15 are being degraded or used unsustainably (Millennium Ecosystem Assessment, Current State & Trends Assessment, 2005).

Various attempts have been made to reduce the environmental impacts of this linear model through the implementation of eco-efficiency measures, with the goal of reducing the amount of resources and fossil energy consumed per unit of manufacturing output. In a world of finite resources, evidence for absolute decoupling, when the gains in efficiency outstrip the growth in consumption, is however hard to find (Jackson, 2009). New disruptive models that rethink our current production and consumption patterns are therefore needed, if we want to ensure the sustainability of our current society.

In contrast to today's largely linear, 'take-make-use-dispose' economy, a circular economy offers a development strategy that enables economic growth by capturing value in using resources efficiently through circular business models. Referred to an "*industrial economy that is restorative by intention; aims to rely on renewable energy; minimises, tracks, and hopefully eliminates the use of toxic chemicals; and eradicates waste through careful design (…), the concept of the circular economy is grounded in the study of non-linear, particularly living systems*" (Ellen MacArthur Foundation, 2013)**.** Circular economy aims to retain the added value in products for as long as possible and eliminate waste. Resources are kept within the economy when a product has reached the end of its life, so that they can be productively used

again and again and hence create further value. By helping to decouple economic growth from resource use and its impacts, circular economy offers the prospect of sustainable growth that will last.

According to a survey conducted by Finnish innovation agency Sitra, a circular economy represents an opportunity for Finland worth 1.5 to 2.5 billion euros. If Finland is in a good position to thrive in the face of global competition with factors such as high education level, solid technological expertise and a strong reputation as a clean-tech operator, much remains to be done: currently only 54 per cent of all waste in Finland is recycled or reused in any way, and, similarly, few innovative service concepts concerning the maintenance, reuse or remanufacturing of equipment have emerged (Sitra, 2015).

The concept of circular economy, if not new, has gained a lot of interest in the last year from businesses (EMF 2012, 2013, 2014) to public institutions (European Commission, 2014). At this stage though, it is not currently a well-defined academic construct, but rather a political one.

1.2 Research objectives and research gap

Transition to a more circular economy requires changes throughout value chains, from product design to new business and market models, from new ways of turning waste into a resource to new modes of consumer behaviour. This implies full systemic change, and innovation not only in technologies, but also in organisation, society, finance methods and policies (EC, 2014). Examples of businesses operating within circular economy principles are growing but are however still limited and experimentation, implementation and dissemination of new business models which support the circular economy are needed (Kok, Wurpel, and Ten Wolde, 2013).

To date, there is a clear knowledge gap in understanding better what differentiates circular business models from traditional linear ones. Circular business models, from their emergence to their implementation, rely on specific conditions that are not yet well described. The objective of this thesis is so fill that gap by studying different cases of companies having transitioned and implemented circular business models in order to facilitate the comprehension of what makes a specific business model circular on one hand, while identifying the conditions facilitating the transition on the other hand.

Hence, the research question of this thesis:

What are the drivers and conditions explaining the successful transition of companies towards circular business models?

When focusing on companies having started their transition towards circular business models, research areas to investigate are as follow: *"Which principles of circular economy have been implemented?" What drivers initiated the shift to a circular business model? What are the conditions facilitating the transition? What are the barriers preventing successful and complete transitions?*

1.3 Structure of the thesis

Following the introduction chapter, the second chapter of the thesis provides an overview of the concept of circular economy based on the existing related literature. First by looking at the various existing definitions of the concept, in order to crystallize the key aspects defining it. Secondly, by taking a short historical perspective to understand how the concept has come to life over the years. Third, by looking deeper into the schools of thought from which the concept is derived (i.e.: industrial ecology, cradle to cradle, biomimicry, performance economy, blue economy) in order to clarify the principles that characterize the foundations of the circular economy.

Once the circular economy notion is clarified, the next chapter offers an overview of the concept of business model. Business model provides a relevant approach to study circular economy at a company level as it outlines the key business elements involved when designing a new value proposition involving the circulation of resources (from customer interface, infrastructure and profit equation). As it is the unit of analysis used for this research, the chapter reviews theory around business model innovation, and sustainability-oriented business models. Chapter four bridges the concept of circular economy with business model innovation by providing an overview of circular economy business models. The chapter is concluded by a new circular business model typology used as a foundation for the field work. Chapter five introduces the research process methodology used for the field work. Chapter six presents the five case studies analysed. The cases represent five specific approaches of circular business model innovation. Chapter seven presents the results of the cross-analysis. Chapter eight discusses the learnings and chapter nine concludes the paper with recommendations for future research.

2. Scoping the circular economy: a literature review

2.1 Towards a definition of the Circular Economy

As opposed to sustainable development, a concept generally addressed through the 1987 Brundtland definition[1], there is not yet a clearly accepted definition of circular economy. Since its appearance a few years back, various attempts have been made in the increasing number of consultancy reports and public policy publications to grasp and define the phenomenon. Each definition however highlights some of its underlying principles.

According to Ellen MacArthur foundation, an organisation established in September 2010 by Dame Ellen MacArthur with the aim of accelerating the transition to a regenerative circular economy, the idea is "*to shift from a linear model of resource consumption that follows a 'take-make- dispose' pattern, to an industrial economy that is 'restorative by intention'; i.e. that replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models*" (Ellen MacArthur Foundation, 2012). The comprehensive definition highlights several aspects of what a circular economy could look like, with a specific focus on the materials and resources in one hand and the transformation of the whole economy towards a specific goal - regeneration- on the other hand. The section below provides an overview of the definitions from this dual approach.

Resource-oriented definitions

A large number of authors define circular economy with a strong focus on how material resources are managed. According to Hislop and Hill (2011), *"The circular economy represents a development strategy that maximises resource efficiency and minimises waste production, within the context of sustainable economic and social development".* For Preston (2012) *"A circular economy is an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process–and*

[1] Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

products could be repaired, reused or upgraded instead of thrown away." If waste and resources are central aspects of the concept, the definitions aim at clarifying that circular economy goes beyond conventional waste management principles. *"A circular economy goes beyond the pursuit of waste prevention and waste reduction to inspire technological, organisational, and social innovation throughout the value chain in order to 'design -out' waste from the beginning, rather than relying solely on waste recycling at the end of the chain"* (Ellen MacArthur Foundation, 2013). The notion of material flows can be found in several definitions. For the world resource forum (WRF, 2012): *"the concept "circular economy" describes an industrial economy in which material flows keep circulating at a high rate (in terms of quality, property, function, range of use) without the materials entering the biosphere, unless they are biological nutrients"*. In this definition, the distinction between the types of flows (technological or biological) is significant. According to Aldersgate (2012) "*A circular economy is a restorative industrial economy in which materials flows are of two types: biological nutrients, designed to re-enter the biosphere safely, and technical nutrients (non-biological materials), which are designed to circulate at high quality, with their economic value preserved or enhanced".*

Economy-oriented definitions

Several authors have gone beyond the notions of resource management in the definition to focus on specific economic dimensions. There, the idea behind circular economy leads to rethink the whole purpose of economy and redesign it so that it achieves positive outcomes. One central aspect in some definitions is the economic goal of value creation. For TNO (2013), "*A circular economy is an economic and industrial system based on the reuse of products and raw materials, and the restorative capacity of natural resources. It attempts to minimize value destruction in the overall system and to maximize value creation in each link in the system".* The Dutch House of Representatives (2013) goes further and extends the notion of value creation not only for the economy but for people and the environment as well: "*A circular economy is an economic system that takes the reusability of products and materials and the conservation of natural resources as starting point. It also strives for value creation for people, nature and the economy in each part of the system".* In the Netherlands, OPAi & MVO Nederland (2014) introduced the notion of resilience in the definition: "*A circular economy is an industrial economy, which has resilience as intention and replaces usage by using. The circular economy is based on closing loops and (where possible, infinitely) extending cycles*." Beyond the concept of resilience, notions of transformation and redesign are also inherent. The

European commission (EC, 2014), which took an active role in promoting the concept under the term of Commissioner Janez Potočnik, defines the concept as "*a development strategy that enables economic growth while optimising consumption of resources, deeply transforms production chains and consumption patterns, and redesigns industrial systems at the system level.*" Table 1 below provides an overview of keywords according to the definitions.

Table 1: Overview of key notions in existing circular economy definitions

Author	EMF (2012)	Hislop and Hill (2011)	Preston (2012)	EMF (2013)	Aldersgate (2012)
Key words	Restorative, renewable energy, No Toxic chemicals, no waste	Resource efficiency, No waste, Sustainable economic development	Waste as input, Repair reuse upgrade	technological, organisational, and social innovation, design out waste	Restorative, Technical and biological nutrients, Economic value

Author	TNO (2013)	Dutch House of Representatives (2013)	OPAi and MVO Nederland (2014)	European commission, (EC 2014)
Key words	Reuse of products and materials, Restorative capacity, Minimize value destruction, Maximize value creation	Reusability of products and materials, Conservation of natural resources, Value creation	Resilience, Usage, Closing loops	Economic growth, Resource optimisation, Transformative, Redesign, System level

The review clearly pinpoints the variety of aspects surrounding the concept. The analysis shows that current definitions offer a variety of interpretations, whether resource-oriented (waste reduction, renewable energy) or economic-oriented (transformative, regenerative economy, value creation). If some definitions go further in linking circularity with a whole new approach to define economy, the core notions of the definitions exclusively focus on the "circularity" of resources and materials, leaving more room for interpretation as to how this new "restorative" economy operates.

No generally accepted definition of the circular economy has emerged to date. For the purpose of this thesis, a new definition is developed and guided by the following two principles. First, the definition aims to integrate and synthesize the earlier attempts in this area. Second, the definition is constructed to be simple enough so that it can be easily understood, communicated, and remembered. Hence, in the next pages of the thesis, the circular economy is understood and defined as follow:

"*A circular economy is a transformative economy redefining production and consumption patterns, inspired by ecosystems principles and restorative by design, which increases resilience, eliminates waste and creates shared value through an enhanced circulation of material and immaterial flows".* The next section will address the phenomenon from an historical perspective as circular economy and the notions it embraces (value creation through resource optimisation) have been explored for more than a century already.

2.2. Origins of the concept

If the concept of circular economy is high on the agenda today, it is far from being a recent phenomenon. Take for instance, the exchange between firms in which by-products of one industry become the valuable inputs. If this approach focusing on waste reutilisation is a strong feature of the circular economy, these types of inter-firm exchanges are far from being new. Historical evidence shows that industries have long been exploring different ways of turning residuals into resources and thus experimenting with a circular economy. Long before the emergence of circular economy as a new buzz word for sustainability-oriented companies, documents and texts were published containing detailed illustrations of by-product reuse in different industries (Desrochers, 2001). Examples include "Waste Products and Undeveloped Substances: Or, Hints for Enterprise in Neglected Fields", in which a British journalist, Peter Lund Simmonds, describes a common practice taking place in mid-19th century: "*in every manufacturing process there is more or less waste of the raw material, which it is the province of others following after the original manufacturer to collect and utilize. This is done now, more or less, in almost every manufacture, but especially in the principal ones of the [United Kingdom]—cotton, wool, silk, leather, and iron"* (Simmonds 1862 cited in Desrochers, 2001). Following the First World War, similar practises are also documented in Germany. Frederick Talbot wrote that "*the German, when he encounters a waste, does not throw it away or allow it to remain an incubus. Saturated with the principle that the residue from one process merely represents so much raw material for another line of endeavour, he at once sets to work to attempt to discover some use for refuse*" (Talbot, 1920, cited in Desrochers, 2001).

What were the motives for this early closed-loop strategies? As Peter Lund Simmonds wrote in 1876, competitive pressures continually forced manufacturers to identify new ways of creating wealth out of everything that came through their hand, which typically led to the conversion of "*useless products into those possessed of commercial value*" (Simmonds 1876 cited in

Desrochers, 2001). In doing so, manufacturers could reduce disposal costs and earn new revenues, both activities benefiting their bottom line. In the Capital (Marx, 1867), Karl Marx also acknowledged that turning waste products into something valuable reduced the cost of the raw material to the extent to which it is again saleable and that these savings increased profitability. Marx even went so far as to say that after economies of scale, waste recovery was the second big source of economy in industrial production.

If manufacturers have long understood the motives to use resources smartly, their main motivation was not driven by an increasing awareness on resources depletion. Until the sixties, environmental problems were largely disregarded in social decision making as well as in economy theories (Van den Bergh, 1995). The need to shift to closed-loop systems based on environmental considerations was described several decades later, from the 1960s.

In 1966, US economist Kenneth Boulding called for a shift away from the expansionist "cowboy economy", where endless frontiers imply no limits on resource consumption or waste disposal, to "a spaceship economy", where everything is engineered to be constantly recycled: "*The closed earth of the future requires economic principles which are somewhat different from those of the open earth of the past.[...] I am tempted to call the open economy the "cowboy economy," the cowboy being symbolic of the illimitable plains and also associated with reckless, exploitative, romantic, and violent behaviour, which is characteristic of open societies* (Boulding, 1966). Boulding describes a possible alternative paradigm, a closed economy that might also be called a "spaceman" economy. In this approach, earth is perceived as a single spaceship with no unlimited resources, in which man has no alternative but reconnect with cyclical ecological system that only can provide materials to be reused continuously. In the "spaceman" economy, states Boulding, throughput is regarded as something to be minimized rather than maximized. Boulding departs from a measure of success based on levels of production and consumption and advocates for a measure based on the nature, quality and of the total capital stock, including state of human bodies and minds.

15 years later, the circular economy concept starts being used. In the early 80s, Stahel and Reday (1981) are appointed by the Commission of the European Communities (today the European Commission) to study 'the potential for substitution manpower for energy. The report, published in 1981 under the title "Jobs for Tomorrow, the potential for substituting manpower for energy" analysed cars and buildings from a micro and macroeconomic perspective. Results showed that every product-life extension, in comparison with manufacturing, constitutes a

substitution of manpower for energy. It concluded that a circular economy, as opposed to manufacturing new goods, would create jobs locally and reduce resource consumption, greenhouse gases emissions and waste. In the report, the benefits of reconditioning activities are highlighted as they would require the use of skilled and experienced craftsmen that could be working in small decentralized workshops placed wherever the goods need to be repaired, thus also solving unemployment issues. Thirty years later, the conclusions of the Swiss researcher, now recognized as one of the father of the circular economy concept, remain more than valid. Extensive reports have shown since then the economic benefits of shifting to a circular economy. (EMF, 2012; EMF, 2013, EMF, 2015).

2.3 Contemporary related schools of thought

If circular economy is not a new phenomenon as a practise, it has been mainly theorized only in the last two decades. The section introduces schools of thought currently associated with the circular economy: Industrial Ecology, Cradle to Cradle, biomimicry, performance economy and blue economy. These approaches and their associated principles form the backbone of the circular economy framework. As these five core concepts position themselves with the earlier notion of eco-efficiency, this concept is introduced as a first section.

2.3.1 Eco-efficiency

Eco-efficiency is a term coined in 1991 by the World Business Council of Sustainable Development. It is a management philosophy which encourages business to search for environmental improvements that yield parallel economic benefits. Eco-efficiency seeks to match business opportunities with environmental responsibility. This can be achieved "*by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the earth's carrying capacity*" (WBCSD, 2000). The goal of eco-efficiency strategies is to maintain or increase the value of economic output while simultaneously decreasing the impact of economic activity upon ecological systems. Ultimately, the notion looks at decoupling economic growth from environmental damages.

According to the WBCSD, eco-efficiency strategies aim at a reduction in the material and energy intensity of goods or services , a reduced dispersion of toxic materials, an improved recyclability, a maximum use of renewable resources, a greater durability of products and an increased service intensity of goods and services.

Quite often, eco-efficient techniques implemented seek to minimize the volume and toxicity of the material flow systems by implementing end of pipe solutions, as materials are not necessarily designed to be fully recyclable. The concepts presented in the following sections are developed around the same environmental challenges but depart from the original efficiency concept and extend further the approaches used to deal with these challenges.

2.3.2 Industrial Ecology

The Industrial Ecology neologism was popularized by Frosch and Gallopoulos (1989). The authors call for the transformation of the traditional model of industrial activity into a more integrated one. Where individual manufacturing processes took raw materials to generate products and left a large portion of materials turned into waste, the new industrial model should be built like an ecosystem. In this approach, the consumption of energy and materials would be optimized while waste generation minimized. Most importantly, the effluents of one process would serve as the raw material for another process. The industrial ecosystem is consequently expected to function as an analogue of biological ecosystems. Ayres (1989) refined the analogy and urged industries to learn from the biosphere in order to modify our industrial metabolism. He oriented the modifications needed both toward the increase of reliance on regenerative (or sustainable) processes and on the search for efficiency, both in production and in the use of by-products. Industrial metabolism - the whole of materials and energy flows going through the industrial system - is studied through an essentially analytical and descriptive approach aimed at understanding the circulation of the materials and energy flows (and stocks) linked to human activity. Industrial ecology aims to go further. First by understanding how the industrial system works, how it is regulated, and its interactions with the Biosphere; then, by determining how it can be restructured to make it compatible with the way natural ecosystems function (Erkman, 2001). Three key elements define the industrial ecology perspective: Industrial ecology encompasses a systemic, comprehensive, integrated view of all the components of the industrial economy and their relations with the Biosphere. It departs from current approaches which mostly consider the economy in terms of abstract monetary unit and focusses on the dynamics of material flows. It also considers technological dynamics as a crucial (but not exclusive) element for the transition from the actual unsustainable industrial system to a viable industrial ecosystem.

According to Erkman (2001) four principles must be met for the industrial ecology to be fully met. Waste and by-products must systematically be valorised (1): networks of resource and

waste use in industrial ecosystems need to be created so that all the residues become resources for other enterprises or economic entities (through eco-industrial networks). Traditional recycling is perceived only as one aspect in a series of matter flow recovery strategies. Loss caused by dispersion must be minimized (2): new products and services must be designed to minimize dispersion or at least eliminate its harmful effects. The economy must be dematerialized (3): the objective is to minimize total matter (and energy) flows while making sure equivalent services are provided. Distinction must be made between relative and absolute dematerialization: relative dematerialisation is sought through increased resource productivity while absolute dematerialisation aims at reducing the absolute amount on matter in circulation. Energy must rely less on fossil hydrocarbon 4): fossil fuels being at the source of many environmental problems (from GHG emissions to smog, acid rains, oil spills).

According to Erkman, industrial ecology leads to two major consequences for the management of companies. First, it challenges the traditional exclusive emphasis on the product alone and forces companies to have a systems view (including the way waste and used resources are remaining within the boundaries of companies influence). Second, it challenges the competitiveness dogma by valuing collaboration between distinct entities in order to ensure efficient resource management.

These industrial ecology principles are central to the transition to a circular economy. First, it signals a shift from end of pipe solutions generally used towards strategies based on systems view of the relationships between human activities and environmental problems. Industrial ecology studies the material and energy flows and their transformation into products, by-products and wastes throughout industrial systems. By doing so, it provides a first set of closed-loop strategies to be implemented at micro-level, either as internal processes (through energy and material efficiency processes aiming at reducing the amount of material used and waste produced) or through active network collaborations (aiming at creating value from the exchange of by-products). Within a circular economy, the concept fits particularly in helping companies improve their internal efficiency processes, while creating value within business to business relationships through the exchange of material and energy flows. Difficulties in translating industrial ecology principles into practical implementations is however a weakness that has been identified by practitioners. The inter-enterprises synergies are not naturally created and the support of an external facilitator (through publicly-founded projects) is often seen as a requirement to facilitate the detection of synergies. The concept is also less relevant when it comes to providing circular solutions to end users. The cradle to cradle concept introduced in

the next section, is also inspired by industrial ecology principles but goes further by presenting approaches that can be applied to business to consumers strategies.

2.3.3 Cradle to cradle

In their book Cradle to cradle, remaking the way we make things (2002), Michael Braungart and William McDonough called for a radical change in industry: a switch from a cradle-to-grave pattern to a cradle-to-cradle (C2C) pattern. Taking a counter intuitive approach to the 3R strategy (Reduce Reuse Recycle), the concept strives to rethink the notion of recycling, as most of the traditional recycling activities are actually "downcycling" (i.e.: waste materials or useless products are converted into new materials or products of lesser quality and reduced functionality) instead of "upcycling", where old products are given more value not less. To do so, the authors introduce the notions of biological nutrients and technical nutrients, notions often used in circular economy literature. Biological nutrients are materials that can safely re-enter the environment. Technical nutrients on the other hand are materials that should remain within closed-loop industrial cycles. By designing products that can distinguish the two types of nutrients, C2C aims to close the loop of industries, technical nutrients being reused indefinitely without quality loss, while biological nutrients being able to restore soil quality.

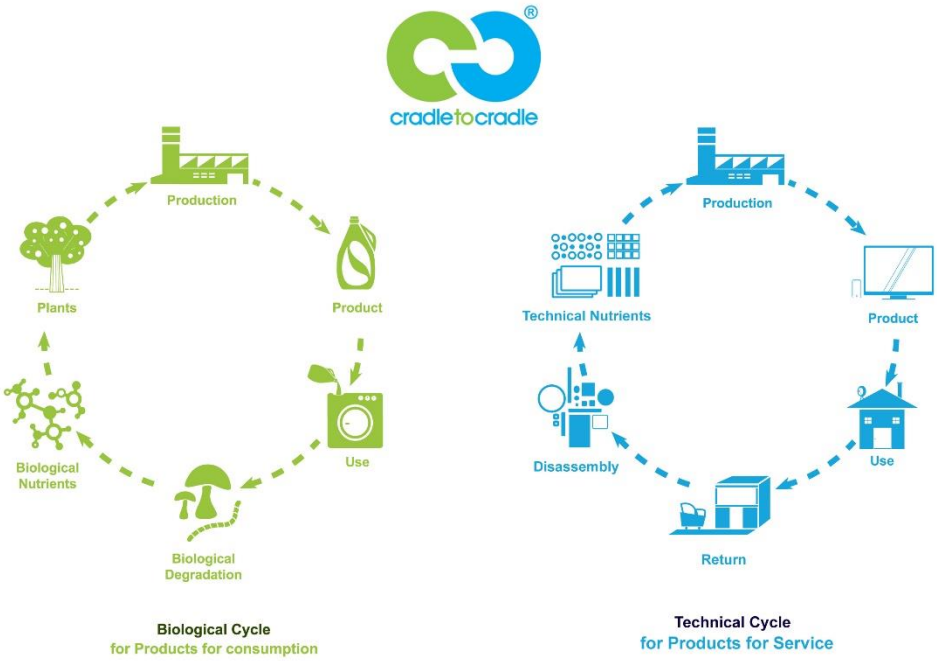


Figure 1: Distinction between biological and technical cycles (source: Cradle to cradle)

Cradle to cradle departs from the general agreement around eco-efficiency. According to Braungart, most recycling is downcycling, which limits usability of materials and maintains the linear, cradle-to-grave dynamic of the material flow system (Braungart, McDonough and Bollinger, 2007). In contrast to eco-efficiency, eco-effectiveness proposes the transformation of products and their associated material flows so that they form a supportive relationship with ecological systems while ensuring future economic growth. The goal, state the authors, is not to reduce waste production anymore, as the very notion of waste disappears in favour or resources and materials constantly circulating. If eco-efficiency measures look at strategies such as volume minimization, design for repair and durability, eco-effective approaches pay less attention to these factors, providing materials constantly maintain their status of productive resources over their multiple life cycles. The goal of eco-effective strategies is to generate cyclical, cradle-to-cradle ‘‘metabolisms’’ that enable materials to maintain their status as resources through upcycling.

C2C design principles rely on three principles: Waste is food, rely on renewable energy sources, and celebrate diversity. By getting inspired from natural ecosystems, the ultimate goal of the Cradle to Cradle approach is to eliminate the amount of waste resulting from industrial and commercial processes. The three principles are described below:

Waste is food

The perceived limitations of Eco-efficiency pushed Braungart and McDonough to define further the approach developed within the cradle to cradle framework to design products and industrial processes that turn materials into nutrients by enabling their perpetual flow within one of two distinct metabolisms: the biological metabolism and the technical metabolism. Here, the concept of waste is eliminated for the profit of nutrients. In the biological metabolism, biological nutrients are biodegradable materials (natural/plant-based materials). They are products of consumption, as they can be ‘consumed’ in their life cycle (through physical degradation or abrasion). At the end of their life, they can safely return to be used as input for living systems. On the other hand, a technical nutrient is a material (synthetic or mineral) that has the potential to remain safely in a closed-loop system of manufacture, recovery, and reuse, while maintaining its highest value through many product life cycles. As in the concept of industrial ecology, the effective management of these two distinct nutrient flows associated with the biological and technical metabolism necessitates the formation of collaborative business structures with the role of coordinating the flow of materials and information throughout the product life cycle (Braungart and McDonough, 2007). One management

approach favoured by the authors is intelligent materials pooling, which allows companies to pool material resources, specialized knowledge and purchasing power relating to the acquisition, transformation and sale of technical nutrients and their associated products.

Use renewable energy

Living organisms thrive thanks to solar energy. As this energy can be considered to be an eternal overabundant energy source, In the Cradle to cradle framework, McDonough and Braungart promote the use of this renewable energy source for heating, electricity and day lighting within buildings and for manufacturing processes within the industry. Other sources or renewables (geothermal, wind, hydro or biomass energy) should also be widely used. The use of renewable energy as such is an accepted broadening of the second Cradle to Cradle principle. Based on its vision of being entirely supplied by solar energy, Cradle to Cradle design is not limited by any constraints on the energy use during the life cycle of a product. As long as the energy quality meets the requirements (current solar income) the energy quantity is irrelevant.

Celebrate diversity

C2C departs from the "one size fits all" type of solutions and, inspired by nature's diversity, encourages to value diversity of species, cultures, and solutions. The framework focuses on using local surroundings to develop tailored solutions adapted to the challenges of the locations.

If the concept of C2C has gained lots of interest among large businesses (Nike, Desso, Shell among others), it is however regarded with a certain degree of scepticism in the academic environment. LCA practitioners have claimed that it does not include all life cycle stages and therefore cannot be considered a serious concept for sustainable design. Danish researchers Anders Bjørn and Maria Strandesen have summarized other inherent critical points of the concept, synthetized below. One first critic is that absolute closed loop recycling as advocated by Braungart and McDonough are in fact not always possible. Thermodynamically, it has been shown that the work required to separate ideal mixtures of two or more substances increases without bounds as the separation process proceeds .Thus the last bit of impurity of one substance diluted in another substance requires infinite amounts of energy to separate (Gutowski, 2008). In some cases, impurities can only be removed down to a certain level in current during the recycling processes. Some impurities may persist in low concentrations in the recycled materials. Therefore while it may be useful to separate biological from technical nutrient, this alone does not guarantee closed loop recycling. Second critic, according to Bjørn

and Strandesen, the addition of biological nutrients to the environment will not necessarily result in a benefit unless the specific ecosystem has been degraded by human impacts as a starting point. First, many materials that qualify as biological nutrients do not in fact contain any macro- or micronutrients, making it pointless to be returned to the soil. The C2C principles do not take into account the level of concentration of nutrients brought back to the soil and some species might react differently according to the new input. This ecosystem manipulation might in some cases have some negative consequences. Finally, it is also pointed out that even if the C2C principles are fully applied in society, as long as our economic approach is based on constant growth, we will still experience resource scarcity and loss of biodiversity. As history shows that direct material consumption (DMC) per person is well correlated with the income and thus with economic growth, this means that even though 100% closed loop recycling is to be achieved it does not eliminate the need for virgin resources nor the problem of resource scarcity.

The sometimes dogmatic Cradle to cradle framework, despites its critics, bring along key principles that form a strong foundation for a circular economy. The distinction between technical and biological nutrients as key elements of a closed loop model, the reliance on renewable energies and diversity as a condition for resilience are three key principles found in the various attempts trying to define a circular economy. The principles are applied at product level or company level but also help shaping the way organisations can interact at territorial level.

2.3.4 Performance Economy

Closely associated with cradle to cradle principles is the notion of performance economy. How can we create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible? As a response to the environmental challenges of high waste volumes related to mass consumption, and in order to address the structural issues of rising public debt, persistent unemployment and slow economic growth, Walter Stahel - often labelled as the father of circular economy- challenged businesses to operate a shift from traditional manufacturing to what he calls the Functional Service Economy (Stahel, 2010). The objectives of this “performance” economy are to exploit science and knowledge as drivers to uncouple revenue and wealth creation from resource throughput, by focusing on smart materials, smart goods and smart solutions.

With Stahel contributions, the Functional Service Economy is translated into a set of innovative business models that integrate products and services into solutions to create wealth and jobs with considerably less resource consumption. Following the same line of thought than Cradle to cradle authors, Stahel's approach departs from the traditional sustainable development of "*doing things right*" (i.e. looking at end-of-pipe recycling technologies) to '*doing the right things*'. In the "*Doing things right*" approach, the focus may be on clean tech processes, or eco-design solutions. The main aim is to reduce environmental impact such as the release of toxic substances or the waste generation. If this approach has led to the emergence of green economy principles and the improvement of recycling, Stahel states, it somewhat ignored the social potential of wealth and job creation. By widening the scope to systemic solutions, Stahel goes a step further and provides a roadmap to rethink resource efficiency at a system level. In contrast to conventional recycling, strategies for higher resource efficiency aim at reducing the volume and speed of resource flow through the economy (Stahel, 1997). According to Stahel, businesses should go beyond recycling and explore solutions that enable the use of remanufactured and upgraded components and goods, and develop commercial innovations to keep goods in use as long as possible. Among the strategies for a higher resource efficiency are those for a longer and more intensive use of goods, those for dematerialized goods, and those for innovative system solutions (Stahel, 1997). According to the author, the preference of sufficiency over efficiency and a focus on systems solution over product/manufacturing focus are key to the shift towards performance economy. As these two strategies can be seen as the core of the circular economy, they are explained below.

Sufficiency over efficiency

One key principle behind the performance economy is to adopt sufficiency strategies. "*Sufficiency solutions can mean turning a problem into an opportunity or a virtuous loop, in the sense of finding solutions that do away with unwanted environmental and social effects but without renouncing or reducing needs*" (Stahel 2010). In the Functional Service Economy, sufficiency solutions act as an economic driver, because the minimisation of resource inputs directly increases profits. Receiving the same amount of revenue for delivering the desired performance with fewer resources increases the competitiveness and profits of the supplier. Examples of this approach can be Zero Energy Homes (in which a combination of good insulation and structural design requires little or no energy to heat the building), or non-sticking cleaning surfaces in which cleaning products become unnecessary. In the gardening sector,

sheep use to replace herbicide and mechanical mowers, or in the hygiene sector, waterless urinals are other examples following a "sufficiency" strategy.

Selling performance instead of products

One major contribution from Stahel is in the formalisation of what a performance economy would mean at business level. In a performance economy, object of the sale is not the product itself but rather the performance it provides, and the benefits offered to the user. It necessitates a major shift in the roles, tasks and responsibilities of the provider of the solution. The liability of the provider is related to how well the solution performs instead of its manufacturing quality only. Payment is due when performance is delivered instead of at the transfer of property rights. The goods at the origin of the services may also remain property of the solution provider, which bears strong consequences in terms of design and management: the provider has to care for its products. He is incentivized to produce long lasting and durable products with fewer resource inputs as compared to selling goods only.

Examples of business models selling performance are plenty: chemical management services and rent a molecule in the chemical industry, rental and operational leasing in the real estate business, selling indoor climate for energy companies, textile leasing in the hospitality and hospital industry, and all recent examples affiliated to collaborative consumption and sharing platforms (Airbnb, Uber, etc.). When the business model of selling goods as services started to be recognised as a general research topic, new terms were developed, such as "Product-Service-Systems" and "servicizing" in the late 1990s, early 2000s (Mont, 2002, Halme et al, 2007). These terms are synonyms for selling goods as services, which form a key strategy to meet the objectives of a circular economy.

2.3.5 Biomimicry

Biomimicry is another school of thought which has strongly influenced how the circular economy is currently understood. Biomimicry is an innovation method that seeks sustainable solutions by emulating nature's patterns and strategies. The goal is to create products, processes, and policies that are well-adapted to life on earth over the long haul. Scientist and author Janine Benyus popularized the term *biomimicry* in her 1997 book Biomimicry: Innovation Inspired by Nature. The core idea is that nature has already solved many of the problems we are coping with. Animals, plants, and microbes can be seen as the consummate engineers. Benyus (1997) suggests shifting one's perspective from learning *about* nature to learning *from* nature as a way

to solve human problems. Studying a leaf to invent a better solar cell is an example. The author distinguishes three guiding principles. Nature as model (1): biomimicry studies nature's models and emulates these forms, processes, systems, and strategies to solve human problems. Nature as measure (2): biomimicry uses an ecological standard to judge the sustainability of innovations. Nature as mentor (3)**:** biomimicry is a way of viewing and valuing nature. It introduces an era based not on what we can extract from the natural world, but what we can learn from it. Using an owl´s feather example, Benyus (1997) defines further three levels of biomimicry. The first level of biomimicry is the mimicking of natural form, for instance, mimicking the hooks and barbules of an owl's feather to create a fabric that opens anywhere along its surface. Copying such feather design is just the beginning, because it may or may not yield something sustainable. Deeper biomimicry adds a second level, which is the mimicking of natural process, or how a thing is made. To keep the bird example, the owl feather self-assembles at body temperature without toxins or high pressures, by way of nature's chemistry. In the industrial world, green chemistry attempts to mimic these types of approaches. At the third level is the mimicking of natural ecosystems. The owl feather is part of a larger system — it's a part of an owl that is part of a forest that is part of a biome that is part of a sustaining biosphere. In the same way, the owl-inspired manufactured fabric must be part of a larger economy that works to restore rather than deplete the Earth and its people. A bio-inspired fabric using green chemistry, but weaved by workers in a sweatshop, loading it onto pollution-spewing trucks, and shipping it long distances, will not be perceived as sustainable, concludes Benyus.

Practical nature-inspired solutions are plenty and have been collected by various biomimicry practitioners. In architecture, the Eastgate Building, an office complex in Harare, Zimbabwe, has an air conditioning system modelled on the self-cooling mounds of termites. It maintains the temperature inside their nest to within one degree, day and night (while the temperatures outside swing from 42 °C to 3 °C). In Japan, The Shinkansen Bullet Train, one of the fastest train in the world, was encountering strong noise issues as air pressure changes produced large thunder claps every time the train emerged from a tunnel. To address the issue causing residents one-quarter a mile away to complain, Eiji Nakatsu, train's chief engineer and an avid bird-watcher, modelled the front-end of the train after the beak of kingfishers, which dive from the air into bodies of water with very little splash to catch fish. The bio-inspired solution resulted not only in a quieter train, but 15% less electricity use even while the train travels 10% faster. In the medical equipment sector, materials researchers and engineers at Kansai University in

Japan saw amazing potential in mimicking the structure of the mosquito's mouth to design a nicer needle. They used sophisticated engineering techniques that can carve out structures on the nanometre scale. The result was a needle that penetrates like a mosquito, using pressure to stabilize and painlessly glide into skin. Based on the increasing amount of examples in which businesses learn from nature principles, the Biomimicry Guild and the Biomimicry Institute (both now Biomimicry 3.8) have studied, compiled, and distilled scientific research to create a collection of fundamental principles now known in biomimicry as Life's Principles. Life's Principles are intended to represent nature's strategies for sustainability, that is, how life has sustained on earth for 3.85 billion years. By following the principles life uses, companies can create products and processes that are well adapted to life on earth. The following life's principles are introduced in the table 2 below.

Table 2: Life Principles (source: biomimicry guild)

Evolve to survive: the goal is to continuously incorporate and embody information to ensure enduring performance

- Replicate strategies that work: repeat successful approaches
- Integrate the unexpected: incorporate mistakes in ways that can lead to new forms and functions
- Reshuffle information: exchange and alter information to create new options

Be resource (material and energy) efficient: the goal is to take advantage of local resources and opportunities

- Use multi-functional design: meet multiple needs with one elegant solution
- Use low-energy processes: minimize energy consumption by reducing requisite temperatures, pressures and/or time for reactions
- Recycle all materials: keep all material in a closed loop
- Fit form to function: select for shape of pattern based on need

Adapt to changing conditions: appropriately respond to dynamic contexts

- Maintain integrity through self-renewal: persist by constantly adding energy and matter to heal and improve the system
- Embody resilience through variation, redundancy, and decentralization: maintain function following disturbance by incorporating a variety of duplicate forms, processes or systems that are not located exclusively together.
- Incorporate diversity: include multiple forms, processes, or systems to meet a functional need.

Integrate development with growth: invest optimally in strategies that promote both development and growth

- Combine modular and nested components: fit multiple units within each other progressively from simple to complex
- Build from the bottom-up: assemble components one unit at a time
- Self-organize: create conditions to allow components to interact in concert to move towards an enriched system

Be locally attuned and responsive: fit into and integrate with the surrounding environment

- Use readily available materials and energy: build with abundant, accessible materials while harnessing freely available energy
- Cultivate cooperative relationships: find value through win-win interactions
- Leverage cyclic processes: take advantage of phenomena that repeat themselves
- Use feedback loops: engage in cyclic information flows to modify a reaction appropriately.

Use life-friendly chemistry: use chemistry that support life processes

- Build selectively with a small subset of elements: assemble relatively few elements in elegant ways
- Break down products into benign constituents: use chemistry in which decomposition results in no harmful by products
- Do chemistry in water: use water as solvent.

While Benyus comes across quite strongly about the eco-friendly nature of biomimicry, this is not always how the practice of biomimicry unfolds (Marshall, 2009). The idea of mimicking nature has resulted in diverse implementations in which the sustainability credentials could be questioned: emulating biological molecules, such as DNA, to create industrial nanomachines or inventing new military technologies based on all kinds of animals and plants are not necessarily bringing out the best in what nature can offer. Biomimicry can also be criticized for carrying out technocentric values, in which nature is utilized instrumentally for its resources (in particular as a supplier of useful information). If biomimicry has not necessarily involved eco-

friendly technological design, critics have argues the necessity to distinguish biomimicry from ecomimicry (Marshall, 2009), the latter being inherently sustainable from an environmental and social point of view.

Circular economy, as a framework for sustainability, works hand-in-hand with the biomimicry approach. The concept of a circular economy aims to emulate the cycles found in living systems. Both approaches prompt new ways of thinking and propose a radically different relationship with our world. Similarly, the Blue economy concept introduced in the next section aims to create value from nature inspiration.

2.3.6 Blue Economy

The Blue Economy report (Pauli 2010) was originally released as a report to the Club of Rome and was created in collaboration with the United Nations Environment Program (UNEP). The report identified a new growth strategy based on sustainable innovation and zero emissions principles and listed 100 innovation cases built on the concept. These cases were identified and studied by the Zero Emissions Research and Initiatives (ZERI) foundation many years before the Blue Economy report was released. Several of them can be found in Gunter Pauli's book Upsizing: The Road to Zero Emissions (Pauli, 1998).

Pauli introduces the blue economy as a new way of designing business using the resources available in cascading systems, where the waste of one product becomes the input to create a new cash flow. To demonstrate its concept, Pauli first looks at previous major economic constructs: In the prevailing model, what Pauli calls the red economy, entrepreneurs and industries generally focus on one core business, one niche product that absorbs all the attention. This logic of a unique core competence requires low production costs, monocultures to scale up, outsourcing and eliminating labour to produce more of the same. In this economy, progress is measured in cash-flow and companies depend on banks in order to invest in production. The approach relies extensively on the improper use of natural resources and bears strong environmental and social consequences. Departing from the red economy is the recent green economy: in this approach, many new business models emerged for green technologies, renewable energies and alternative production methods and materials. One flaw though, Pauli states, is that these models focus again on one single advantage without necessarily looking at the global picture and the potential harmful effects. Pauli takes as an example the use of palm oil for the production of biodegradable soaps in Europe which has led to the destruction of primary rainforests in Indonesia. Another critic of the green economy is that the new green

solutions require extensive investments and public subsidies to work, while being generally more expensive to consumers. According to Pauli, the future economy should be blue, like the blue colour of planet earth: an economy inspired by ecosystems that tackles issues causing environmental problems in new ways, by connecting environmental problems with open-source scientific solutions. "*Blue economy wishes to assure the possibility of evolutionary path of the ecosystems so that everyone can enjoy the eternal flow of creativity, adaptability and abundance of nature*" (Pauli, 2010). Pauli's models cover a number of very different processes based on natural ecosystems and weave them together in production systems that can restore the environment, provide many jobs, enhance skills and produce high quality and cheap products.

The central idea of the Blue Economy is the concept of cascading nutrients and energy. A cascade is a waterfall: It requires no power because it flows with the force of gravity. It transports nutrients where all absorbed minerals feed the microorganisms, which further feed the plants which the animals eat. The waste of one living being becomes nourishment for another. According to Pauli, cascading nutrients and energy lead to sustainability because they reduce or eliminate the need for energy and also eliminate waste and its cost. Building on this cascading idea, the Blue Economy aims at creating decentralized clusters of various industries that today are unrelated and work separately. The key to this dramatic shift is to evolve from a core business based on a core competence to a portfolio of businesses that generate multiple benefits for business and society. Pauli takes as an example a coffee company, which can generate income from the coffee, its core business, and can also generate revenue from the mushrooms farmed on the coffee waste, and whatever is left over after harvesting the protein rich fungi is used as animal feed. In this cascading approach, one revenue model is transformed into a three revenue mode. This cascading approach share similitudes with industrial ecology in which waste as a by-product in maximised within the company or through other business partnerships.

2. 4 Integrated principles for a circular economy implementation

As perceived in the multiples definitions of the concept, circular economy has many different dimensions and can be envisioned through different approaches. Stahel (2010) argues that the circular economy should be considered as a framework: as a generic notion, the circular economy draws on several more specific approaches that gravitate around a set of basic principles. Table 3 summarizes the various principles drawn from related circular economy schools of thought and synthetises them into eight circular economy principles.

Table 3: Overview of Circular economy principles based on related schools of thought

	Circular Economy Principles	Biomimicry (Benyus, 1997)	Cradle to cradle (Braungart and McDonough 2002)	Performance economy (Stahel 2010)	Industrial ecology (Erkman, 2001)	Blue economy (Pauli, 2012)
1	**Clean materials principle**	Use life-friendly chemistry	Waste is food		Loss caused by dispersion must be minimized	
2	**Resilience principle**	Evolve to survive	Celebrate diversity			Be abundant (satisfy all basic needs)
		Adapt to changing conditions				
		Integrate development with growth				
3	**Use Renewable energy principle**		Use current solar income		Energy must rely less on fossil hydrocarbon	
4	**Systems thinking principle**					Be systemic (mimic nature)
5	**Resource-efficiency principles**	Be resource (material and energy) efficient	Waste is food	Optimisation of existing stock	Waste must be valorised	Be efficient (substitute something with nothing)
				Extend product life		
6	**Cascading principle**					Be profitable (optimize & generate multiple cash flows)
7	**Act local principle**	Be locally attuned and responsive				Be local (use what you have)
8	**Performance principle**			Focus on performance	Economy must be Dematerialised	Be innovative (create change, seize opportunities)
				Sell goods as services		

Ellen MacArthur foundation (2013) also used related school of thoughts to make a first attempt to summarize 6 interconnected general principles: (1) Design out waste; (2) Build resilience through diversity ,(3) Rely on energy from renewable sources , (4) Think in systems , (5) Waste is food and (6) think in cascades. If circular economy as a framework is to rely on all key principles of its predecessors, two extra principles should be integrated: think local (7), and focus on performance (8).

The first general principle - Design out waste - states that when the components of a product are effectively designed to fit within biological or technical materials cycle and manufactured to allow for future easy disassembly and refurbishment, waste becomes inexistent. Biological materials are non-toxic and can be simply returned to the biosphere (through composting or other approaches) while technical materials are designed to be used again with minimal energy and highest quality retention (Braungart and McDonough, 2002).

The second principle - Build resilience through diversity- highlights that modularity, versatility, and adaptivity are the features that create resiliency (Benyus, 1997, Pauli 2010). Diversity however needs to be balanced with efficiency to result in an effective system: if on one side, most efficient systems have fewer nodes, fewer connections and greater throughput, they are however more vulnerable to the effects of shocks. On the other end of the spectrum, less efficient system have more nodes, more connections, more scales but prove to be more resilient when under external shocks. The second principle aims to seek effectiveness, a balanced spot where resilience and efficiency interplay.

In a circular economy, the third principle states that systems should ultimately aim to run on renewable sources (Braungart and McDonough 2002; Erkman, 2001). In practice, relying on renewable energy can only be achieved with a reduction of energy consumption.

The fourth principle – think in systems- is the ability to understand how parts influence one another within a whole, and the interrelationship of the whole on the parts. This principle is crucial in developing circular models (Pauli, 2010). It includes considering elements in relationship with their infrastructure, their environment and their social contexts and involves understanding flows and stocks at stake.

In the fifth principle, we shift from a notion of waste - a material with no or little value, to a notion of a by-product, no longer directly useful to its last user but potentially a valuable resource for other actors in the system (Braungart and McDonough, 2002; Erkman, 2001). Biological materials (in the form of products or materials) are reintroduced into the biosphere, through non-toxic, restorative loops, while technical materials can be addressed in various ways: either through new high quality product creation (upcycle), or through a circulation of by-products within a network of businesses (industrial symbiosis).

The sixth principle – think in cascades- value creation for biological materials lies in the opportunity to extract additional value from products and materials by cascading them through other applications (Pauli, 2010).

Principle seven – think local – focuses on generating value with the resources already at hand. As ecosystems only make use of the resources at hand, sustainable businesses must do the same. This means taking advantage of underused resources, considering local resources and the full range of outputs produced (Benyus, 1997; Pauli, 2010). Organisations, projects and communities like natural ecosystems, are influenced by their local context. To take advantage of these local opportunities one must be willing to increase local participation and adapt to the local context.

Principle eight -focus on performance - achieve synergies by profitably exploiting the three objectives of value creation and job creation and resource consumption reduction by selling performance instead of goods (Stahel, 2010).

These eight principles provide general objectives in terms of end goals to meet to reach a circular economy. It however does not clarify at what level each principle should be fulfilled to transform an economy into full circularity. Should a company only use 100% of renewable energy to be fully circular? What is the level of acceptable waste generated in a circular economy? Should all the principles be fulfilled to state that an economy is circular? These questions highlight a set of challenges to put the concept into practise. The next section introduces recurring questions and critics around the concept.

2.5 Critics and challenges of the circular economy

Despite its growing popularity amongst, politicians, businesses and academics, the concept of circular economy and its underlying principles are not without critics and challenges. The following sections summarizes the main arguments of its detractors and details challenges faced by the concept: its achievability and desirability, its weakness to include the social dimension, its lack of strategic guidelines and standardisation.

2.5.1 Achievability and desirability

Is a circular economy 100% achievable? One challenge faced by the circular economy framework is related to the achievability of the concept. At the core of the framework, is the idea of designing out waste. If in certain sectors, such as manufactured goods, the vision can be globally implemented and materials be used longer, reused, before being dismantled and remanufactured, in other sectors however, existing limits might make it difficult to close the loop indefinitely: paper recycling is for instance limited to a certain number of cycles. Specific hazardous waste, such as mercury or asbestos might also reach a dead end as they cannot be recycled but must be contained off the cycle. As the second law of thermodynamics states, "all spontaneous processes irreversibly disperse energy (and as a consequence, matter) into ever more chaotic states", resulting in loss of quality and quantity of substances and making a complete closure of loops hardly achievable (Robèrt et al. 2010 cited in Bechtel, 2013). In today's recycling processes impurities of used materials can only be removed to a certain extent. These limitations have well been perceived by legislators: the European Commission for instance, in its first attempt to frame a Circular Economy directive, set long term recycling objectives up to 70%, the remaining 30% beings considered as non-recyclable materials.

Beyond the question of achievability is the notion of desirability for businesses. In the current situation, trying to reach a 100% recyclability rate might prove counterproductive, if for instance, the price of recovery remains higher than the value of the materials recovered. Lack of incentives in the existing regulatory landscape does not necessarily make it desirable for all to pursue a circular economy objective.

The certain pursuit of circular economy objectives, i.e. using 100% renewable energy, may also be in contradiction with other principles related to resource efficiency. Using today's technologies – the expansion of solar energy for instance uses more scarce resources. *"Without*

effective usage of produced energy, [it] might also further increase the resource scarcity"(Bjørn and Hauschild, 2011).

2.5.2 Social sustainability, the missing element in the circle

Strongly rooted in environmental sustainability, the circular economy framework lacks an elaborated description of the social dimension of sustainability (e.g. the fulfilment of human needs, territorial implications). Its principles are primarily formulated from a business point of view that strive equally for environmental and economic benefits. Social benefits are often lacking. Stahel has shown that additional manufacturing processes in a Circular Economy - e.g. refurbishing or recycling - demand more human labour, as these processes cannot often be standardized. If this can create employment opportunities (EMF, 2013) it is not sure that the jobs are created locally – a centralized recycling facility based on the other side of the world might also be the outcome of a circular economy strategy, lacking the potential of local job creation. Moreover, people's basic needs at a global level may still be further undermined by abuses of power, unhealthy or unfair labour and living conditions or a disrespect of human rights. As such, the circular economy framework does not necessarily fulfil all the dimensions of sustainability.

2.5.3 Lack of strategic guidelines and standardisation

Currently, the circular economy framework does not provide specific criteria to support the selection of actions nor specific guidelines on how to implement the concept. As the implementation of circular economy varies significantly for different products and markets, the need for individualized or sectoral approaches makes it difficult to provide general guidelines (EMF, 2013). Moreover, engaging in a circular economy strategy may bring in difficult trade-offs. When selecting materials in a production process, circular economy principles might exclude not fully recyclable materials. However, the environmental benefits of certain materials (e.g. lightweight components, less corrosive materials) could outweigh the disadvantage of non-recyclability (Schmidt et al. 2004). On the same line of critics, despite the recent publication of measurement tools to assess the circularity of one organisation (EMF, 2014), there is not yet any international recognized standardisation with regards to circularity performance (in the form of an ISO, for instance).

2.5.4 Bridging the circularity gap

Despite all these challenges, the principles carried out by the circular economy offer lots of promises. First, it allows to reconcile environmental stewardship with business concerns, stating that value creation can still be achieved within strong planetary boundaries. While being inspired by nature principles, the advocates of circular economy have achieved to materialize the benefits of the circular economy into clear business opportunities (Lacy, 2014), making it much more attractive than the concept of sustainable development, a notion often criticized for lacking balance between environmental and economic objectives. As the notion still bears weaknesses, it makes it worth studying from an academic perspective in order to understand how at the practical level, the notions and principles of circular economy can effectively be implemented in current business practises.

In order to understand better the processes involved when transitioning to a circular economy, it will be relevant to use an approach that is multidimensional, taking into account how resources are managed, how new value proposition is created and marketed, how new sources of revenues are generated from the circulation of goods and services. In that respect, addressing the shift to a circular economy using business model as a framework of analysis might bring in useful insights. This is the purpose of the next chapter.

3. Business model as a tool and process to analyse circular economy transition

The business model approach offers a comprehensive way of understanding how value is created captured, and delivered. Because of their complex and systemic nature, business models can be perceived as a relevant unit of analysis to describe the changes happening when a company shifts towards a circular economy approach. In the next sections, the concept of business model is introduced. Its relevance as a tool to analyse circular economy is also highlighted.

3.1 Defining business model

Despite the growing amount of literature around the concept, there is no unique definition nor understanding of the business model. According to Osterwalder (2010), *"a business model describes the rationale of how an organisation creates, delivers, and captures economic, social, and other forms of values".* It covers a broad range of informal and formal descriptions of the mains aspects of an organisation, from its core purpose to its operational processes and organisational structure. Hence, it offers a holistic approach towards explaining how firms do business (Zott et al., 2010).

Business models have been considered in multiple ways: as a conceptual framework of the firm's current and future plans; as a bridge between business strategy and actual processes, as a tools for managing a company or as an intangible asset for supporting strategic decision-making (Technopolis, 2012). According to Zott et al (2010) the business model *"is centred on a focal organisation, but its boundaries are wider".* From a structural viewpoint, the business model can be seen as a system, combining a company's business strategies with concrete operations that create and deliver value to the customers as well as to the firm. At the core of its construct, a business model seeks to characterise both value creation and value capture.

Shafer et al (2005) uncovered 12 different definitions of business models in a review of papers published between 1998 and 2002. The review resulted in the identification of 42 different components, or building blocks of a business model. These different components were organised by affinity in four major categories: strategic choices, creating value, capturing value,

and the value network. Based on this review, Shafer et al defined a business model as a "*representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network*". In that respect, a business model embodies a set of strategic choices.

Johnson (2010) defined that business models "*consist of four interlocking elements that, taken together, create and deliver value"*. The four elements described are customer value proposition, profit formula, key resources and key processes. The business model can be described as the blueprint of how a company does business. It is the translation of strategic issues into a conceptual model that explicitly describes how the business functions (Osterwalder, 2005).

Business models can also be defined at four levels: industry level, company level, business unit level and product level (Wirtz, 2011). The industry level is somewhat generic and can generate insights on how a firm operates in a specific industry. The company level focuses solely on the firms operations. The business unit level describes the distinctive business elements a specific business units may interconnect, as part of a larger corporation. The product level illustrates all the aspects related to one product.

3.2 Business models constructs

Several authors have looked into developing business models constructs with the idea of identifying the domains, concepts and relationships addressed in the business model field to create a common language (Hamel 2000, Chesbrough and Rosenbloom 2000, Amit and Zott, 2001).

Osterwalder's (2005) business model construct, even if not unique, have been one the most used construct by practitioners around the world. It is organised around four pillar and nine building blocks: Product (value proposition), Customer Interface (customer segment, distribution channel, and relationships), Infrastructure Management (value configuration, partner network, core competencies) and Financial Aspects (cost structure, revenue model). The value proposition provides an overall view of a company's bundle of products and services. The target customer describes the segments of customers a company wants to offer value to. The distribution channel describes the various means of the company to get in touch with its customers. The relationship explains the type of links a company creates between itself and its

different customer segments. The value configuration describes the arrangement of activities and resources. The core competency outlines the competencies necessary to execute the company's business model. The partner network exposes the network of cooperative agreements with other companies necessary to efficiently bring value to the customers. The cost structure sums up the monetary consequences of the resources employed in the business model. The revenue model describes the way a company makes money through a variety of revenue flows.

When addressing business models having circularity in mind, the relevance of Osterwalder's approach might however be lacking key elements. Specific distinctions in the resources block may be highlighted, for instance between material (energy, raw materials) and immaterial resources (skills, competences). Aspects related to the materials flows returning to the company are also lacking in the existing canvas. These first limitations call for an adapted canvas designed to highlight the specific features of a circular business model. This point will be addressed in the section 3.5.

3.3 Relevance of business models as a concept and tool

Business models can help manager to capture, understand, communicate, design, analyse, and change the business logic of their firm (Osterwalder, 2005). As one of its goal is to create a common language based on an accepted ontology, it can be helpful as a communication tool. Business models can be quite complex and representing visually the interactions between all aspects of a business activity can facilitate the understanding of relationships among them. As a unit of analysis, business models can also improve measuring, observing, and comparing the business logic of a company, over time or in relation to competition. When a company decides to adopt a new business model or to change an existing one, capturing and visualizing this model can improve planning, change and implementation. Business models may also facilitate the description of possible futures for a company.

3.4 Business model innovation

The transition from a linear approach to a circular one will generally require business model innovation; Santos et al. define business model innovation as "*a reconfiguration of activities in the existing business model of a firm that is new to the product/ service market in which the*

firm competes" (Santos et al. 2009). This business model reconfiguration can take distinct approaches, either focusing on internal aspects of the business model, or by shifting its position in the industry. In their IBM Global CEO study, Giesen et al. (2007) proposed three categories of business model innovation: Industry model innovation – Innovating the industry value chain by moving into new industries (diversification), redefining existing industries or creating new ones, by identifying and leveraging unique assets. Revenue model innovation – innovating how revenue is generated by changing or re-configuring the offering: the product, service and value mix in addition to the pricing models. Enterprise model innovation – Changing the value chain position through the value network with employees, suppliers, customers in addition to capability/assets configuration.

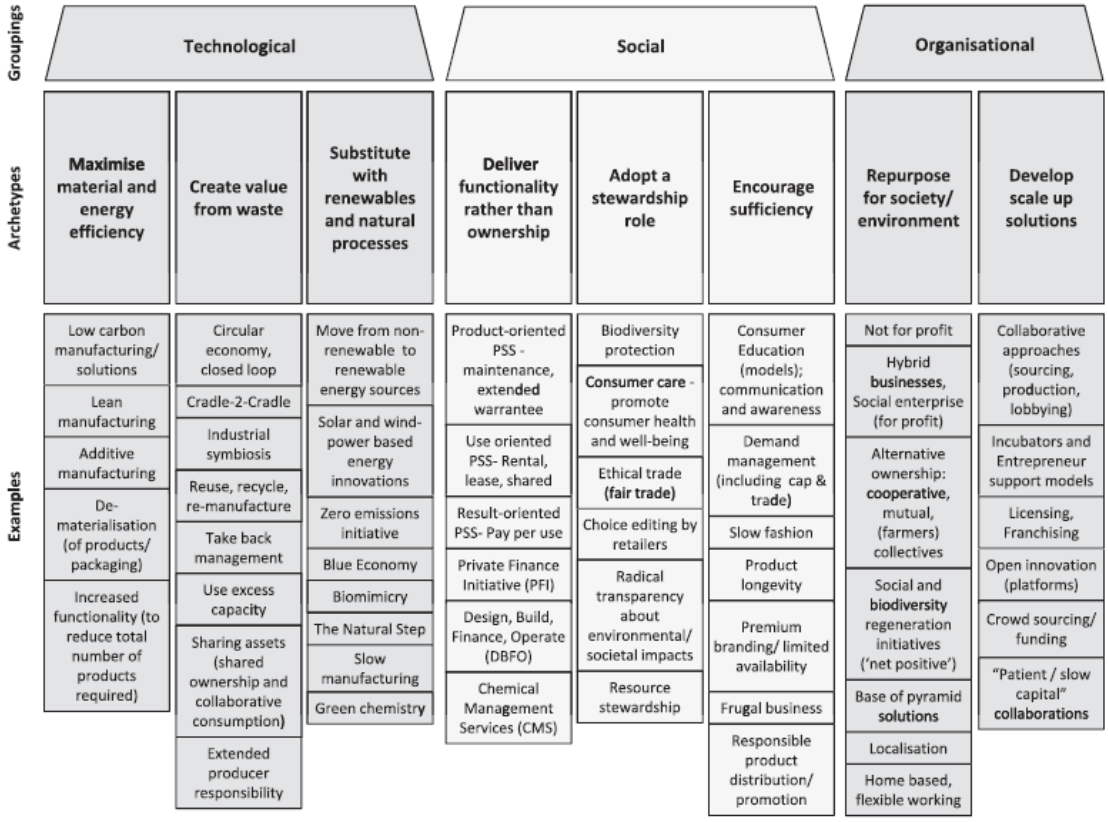
Lindgardt et al (2009), state that an innovation becomes a business model innovation when two or more elements of a business model are reinvented to deliver value in a new way. Lindgardt categorized business model innovations into three main categories: value proposition, operating model, and business system architecture. This distinction may apply to sustainable business model innovation, a general labelling of business model innovation in which circular business models can be categorised.

3.5 Sustainable business model innovation

Since the business model gains increasing attention as unit of analysis, various agents of sustainability have started to consider its role in their contexts (Luedeke-Freund, 2010). Sustainable business model innovation aims at integrating social and environmental features at the core of the value proposition. From a strategy perspective, sustainable business models help creating competitive advantage through superior customer value while at the same time contributing to the sustainability of both the company and society (Luedeke-Freund, 2010). In that respect, sustainable business model innovation extends the notion of customer value through a triple prism (value for the customer, value for the company, value for society).

First attempts have been made to formalise sustainable business models (Bocken, 2014) and specific categories have been developed to classify business models. In Nancy Bocken categorisation (see table 3), the business models archetypes are classified in higher order groupings, which describe the main type of business model innovation: Technological, Social, and Organisational oriented innovations.

Table 4: Sustainable business model archetypes (Bocken, 2014)



The four first archetypes (maximise material and energy efficiency, create value from waste, substitute with renewables and natural processes, deliver functionality rather than ownership) bear strong connections with circular economy principles as defined earlier and could be considered as circular business models. In the categorisation however, circular economy is mentioned in a very restrictive way, only as a sub business model example of value creation from waste. This contradicts the general definitions of circular economy encompassing more features than smart waste management (from nature-inspired strategies such as biomimicry and blue economy to product-service systems). These essential contradictions highlight the need to clearly understand how all these concepts interrelate and are different from each other. In chapter 4, an attempt to describe a first taxonomy of circular business models is developed.

3.6 Towards a generic circular business model canvas.

Several practitioners have attempted to go beyond Osterwalder's business model construct to facilitate the analysis of circular business models. The table below provides an overview of recent constructs.

Table 5: Overview of recent development of business model canvas including circular economy

Canvas Name	Author	General approach	common feature with BMC	distinctive feature
Upcyclo	Wiithaa	A canvas inspired by Cradle to cradle principles	partners, resources, value proposition, distribution channel, customer segment costs, revenues,	Positive impact, negative impact distinction between 'biological' and 'technical' resources 'After use' block 'Function' block
Circular business model	Moonfish	Based on the butterfly model by Ellen MacArthur foundation. Inspired by service design terminology	Resources, activities, partners, cost, revenues	Value proposition is divided into 'value' for company, 'value' for user 'Customer segment' is changed into 'user' distribution channel is changed into 'touchpoints' the design of the canvas takes a loop shape and aims at addressing options of circular models (maintain, reselling , remanufacture, recycle)
Flourishing business model canvas	flourishingbusiness model.org	Follows a holistic approach Value-process-people-outcomes. Integrates external dimensions of the company (environment, stakeholders). Uses an extended definition of value (societal).	Costs, resources, activities, governance, partnerships	External aspects are addressed: ecosystem actors, needs, ecosystem services, biophysical stocks. Value proposition is reshaped as: value cocreation and value destruction governance, stakeholders are added
triple layered business model canvas	Joyce, A., Paquin, R., Pigneur, Y. (2015)	Adds two layers to the original business model canvas: social and environmental layer	Economic layer follows the original canvas	Environmental layer includes: environmental impacts, environmental benefits. Life cycle approach: functional value, materials, production, logistics, use phase, end of life

Each approach bears advantages and complement the existing framework with specific aspects related to the circular economy. Wiithaa's circular canvas, inspired by specific features of cradle to cradle principles makes a relevant distinction in the resources, separating technological resources from biological resources. The "after use" block allows to highlight how products are handled at the end of its life cycle. The "function" block, clarifies the value proposition by focusing on the service the solution provides rather than on the product itself. It is clearly based on the concepts of functional economy (Stahel, 2010). Impacts (positive and negative) allow to address possible environmental or social consequences related to the business model.

Moonfish canvas, developed at university of Delft, is clearly inspired by the butterfly model designed by the Ellen MacArthur Foundation (EMF, 2012), to describe the key building block of the circular economy (maintenance, reselling, remanufacture, recycle). An interesting feature of this canvas is related to the terminology that embraces service design concept. The customer is named as a user; channels are name as touchpoints. Value proposition is extended to both the user and to the company, societal benefits are however left behind. The visual design of the canvas departs from the traditional block approach to follow a closed loop design which unfortunately take more time to understand.

The flourishing business model canvas, drawn from the work and research from the strongly sustainable business model group, a multi-disciplinary applied research *group* within OCAD University's Faculty of Design aims to use a triple bottom line approach to engage with sustainable business model innovation. The approach is holistic, including strong environmental aspects (ecosystem services, biophysical stocks) as well as a wider governance and multi-stakeholders focus, aiming at including both positive and negative outcomes resulting from the business model. If the canvas isn't directly focusing on circular business models, it includes interesting features that may help understand circular business model: an approach that includes external aspects (environmental stocks, social needs), and the notion of value creation/value destruction, that is central to the circular economy.

Another relevant business model canvas iteration is the triple layered business model canvas which was presented at the first Artem Organizational Creativity Conference in Nancy, France in 2015. The research was co-authored by Yves Pigneur (who is at the origin of the business model canvas and the famous book business model generation with Osterwalder), Raymond Paquin and Alexander Joyce. In the approach, two new layers are added to the original canvas.

The second layer is built with life cycle thinking approach to the environment and the third la**yer** fosters a stakeholder approach to social issues. Business leaders can use this canvas to better understand and visualize the relationships between the economic, environmental and social aspects of their business model. The triple approach allows to find new dynamics for analysis and new relationships for innovation.

The overview of the various canvases allow us to draw specific features that should be included in the generic circular canvas to form a new framework of analysis. In the process/infrastructure blocks, the distinction in resources, between material (energy, raw material) and immaterial resources (skills, competences) is added. The extension of the partner's block to address all entities of the value network is highlighted. In the value proposition block, the inclusion of the "Function" block of the product/service allows business model practitioners to facilitate the departure from a traditional product sales approach and enhances service development. In the customer interface, the inclusion of "End of use" phase allows to understand how the material loop is closed. Finally, in the outcome block, the environmental and social impact (whether positive or negative) are added to the financial outcome of the business model, in order to address the core notions of circular economy (restorative by design). The circular business model board (figure 1) integrates these changes in the original business model canvas and will be used as the framework of analysis for the field work of the thesis.

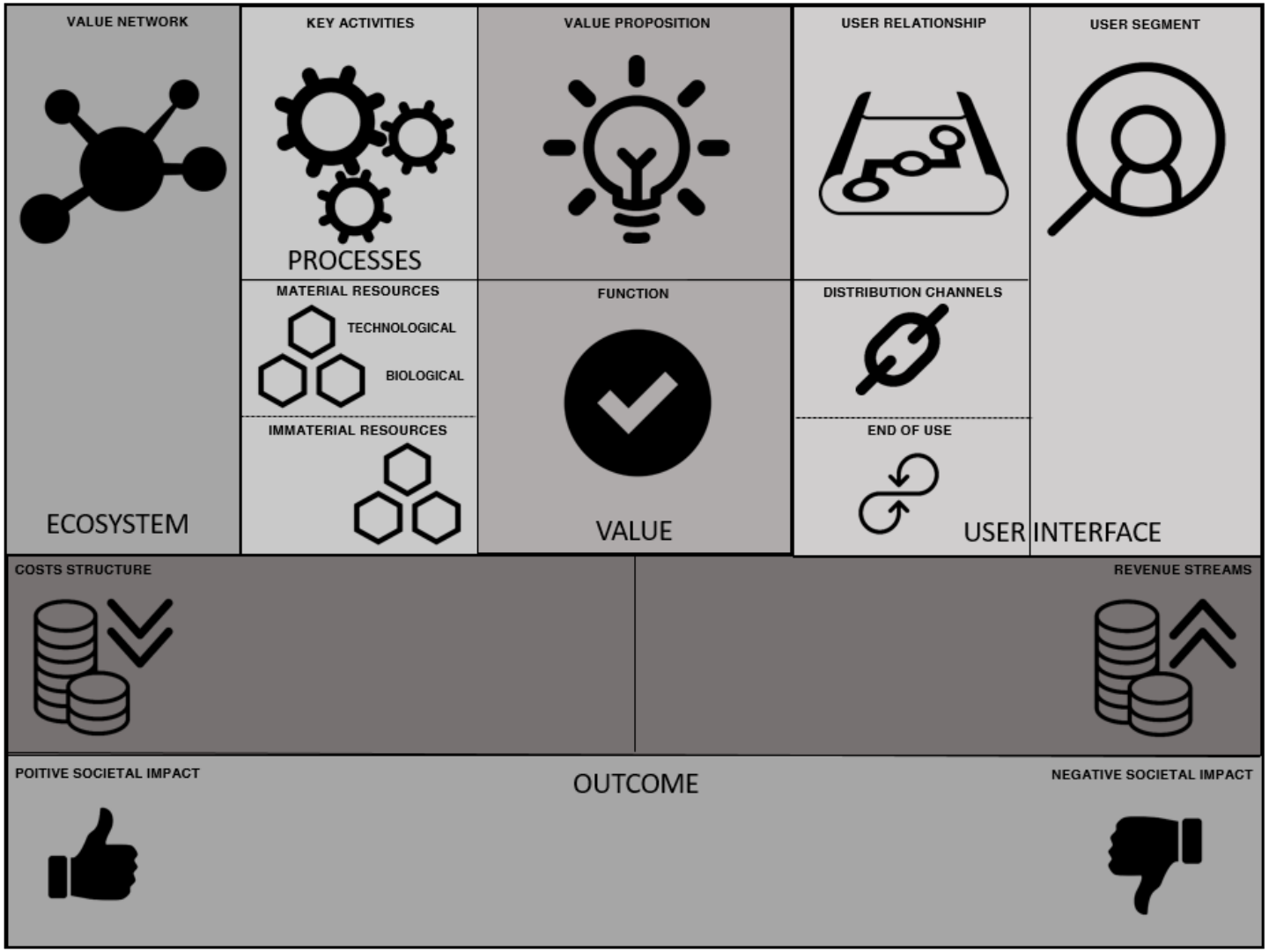


Figure 2: Circular business model board, adapted from Business model Canvas

4. Circular business models: towards a generic classification

To shift from linear to circular business models, companies need to revisit existing strategies, structures and operations and design business models free of the constraints of the linear thinking. How do circular economy principles translate into practical business model categories? Can we find clear distinctive business model approaches? According to Planning (2014), so far there are no clear cut, generally valid, categories of business models aimed towards the transition to a circular economy. However certain clusters of categories have been revealed in practitioner-oriented publications dealing with business model innovation in a circular economy. The following section introduces the different categories as well as a new typology for circular business models.

4.1 Overview of existing business model innovation towards circular economy

In their publication for the European commission, Stahel and Reday-Mulvey (1981) described the multiple advantages of a circular economy from an environmental and economic point of view. In the report, they advocated two distinctive approaches to develop circular business models: the first one focuses on product life extension via re-use, re-manufacturing, and maintenance. The second focuses on recycling on a material level. In Performance Economy (2010), Stahel extended its thinking further: the shift from selling product to selling services is presented as the ultimate approach to close the loop. The section uses these three distinctions to introduce the diversity of business strategies existing in the circular economy framework.

4.1.1 Circular Business model innovation with a focus on product life extension: short loops and long loops business models.

The aim of these two first circular business models is to extend the lifecycle of products and assets. Value is maintained through repair, upgrade, remanufacturing or remarketing of sold products. New value can also be generated through extended usage. Damen (2012) and Mentik (2014), following work from Parlikad (2003), have classified key approaches companies can introduce to extend the lifetime of products: Maintenance, Repair, Reuse, Redistribution, Refurbishment, Remanufacturing, upgrading, Recycling, Energy recovery and at the last resort, disposal.

Within this set of options, Stahel (2010) made a distinction between **short loops** (in which the ownership of the product remains in the end of the user) and **long loops** (in which the product goes back to the manufacturer).

Maintenance is the "Servicing of products with the goal of prolonging product lifecycle" (Mont, 2002). It extends the product's lifetime by preventing faults or break down. Since faults are not present yet and cannot be seen, maintenance is often done a scheduled activity or routine. Maintenance can also involve cleaning or other aesthetic measures. **Repair's** purpose is to return used products in working order. Repair extends the product's lifetime after a fault or break down and restores to the original performance of use state, or less. Repair can also involve cleaning or other aesthetic measures. The quality of the repaired products could be less than that of the new products" (Parlikad et al., 2003). **Reuse** is the second hand trading of product for use as originally designed (Rose et al., 2002). **Redistribution** can be done when a product reaches an end-of-need phase. It capitalizes longer on the product's value by finding users with different needs which (still) match the original product. Usually a platform is needed to connect products to users (web marketplace, second hand shop). **Refurbishment's** purpose is to bring the quality of used products up to a specified level by disassembly to the module level, inspection and replacement of broken modules. Refurbishing can also involve technology upgrading by replacing outdated modules or components with technologically superior ones (Parlikad et al., 2003). **Remanufacturing's** purpose is to bring used products up to quality standards that are as rigorous as those for new products by complete disassembly down to the component level and extensive inspection and replacement of broken/outdated parts" (Parlikad et al., 2003). Remanufactured products have equal or higher performance than the original the same warranty and therefore customers can consider them the same as new product (Bakker and Hollander, 2013). **Upgrading** replaces outdated modules or components with technologically superior ones (Parlikad et al., 2003). Examples in this category can be Google new modular phones (in which specific parts can be replaced to improve product performance without changing the whole device). The approach reduces the production of e-waste, while offering better value to the customer. Development of services such as an online marketplace in which phone modules are traded are other key examples of this circular business model. **Recycling** reclaims material streams useful for application in products. Disassembly into material fractions increases the value of the materials recycled by removing material contaminants, hazardous materials, or high value components. The components are separated mostly by manual disassembly methods. With recycling without disassembly the material is

shredded to "reduce material size to facilitate sorting. The shredded material is separated using techniques based on magnetic, density or other properties (Rose et al., 2002). **Energy recovery is** the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of so-called waste to-energy processes, including combustion, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery" (EMF, 2011). **Disposal** must be regarded as the last resort for a material flow. It is recommended to have considered all other CE loops for possibilities to capture value.

One subcategory can also be added and formalized before the product is even marketed: **Designing for endurance.** In this business model going against the trend of planned obsolescence, new approaches to design are explored in which goods that consumers can use for longer than normal are created. In Google's Project Ara phone, for instance, instead of regularly upgrading to a new model, consumers swap out various modules when improved components are available.

4.1.2 Circular Business model innovation with a focus on resource sourcing, resource recoverability and resource efficiency: Clean loops and cascading loops.

Business innovations may focus on the resources used to make a product, rather on the product lifetime itself. Lacy (Lacy 2013, 2014) describes specific business model innovation focusing on material sourcing (circular supplies), product transformation and resource recovery.

In the **Circular supplies** business model (Lacy, 2014), inputs supplied are fully renewable, recyclable, or biodegradable. The use of scarce resources is phased out. Inefficiencies and waste are removed. If not all products can be reconditioned in their entirety, it may still be valuable to explore opportunities with some of the components that carry a high value. Often, materials have an embedded energy component that makes them more valuable than their virgin source. With the right design and remanufacturing capabilities, these components can be put together to form new products, that the aim of **Product transformation** business models (Lacy, 2014).

In the **Resource recovery** strategy (Lacy, 2014) the goal is to recover the embedded value remaining at the end of one product lifecycle to feed into another. Following industrial ecology principles, waste is transformed into value through innovative recycling and/or upcycling services. At the core of the business model is the notion of reverse supply chains, and the technical capability to recover resource output at a level of value equivalent or above initial investments. These business models aim to avoid material leakage and maximise value of product return flows. **Industrial symbiosis** solutions, in which by-products and waste materials

are recovered and reprocessed (or converted into energy input) fall in resource recovery business models. More challenging but ever more rewarding are solutions that allow for the recovery of post-consumer product waste to be turned into the same product again. Prime example is carpet manufacturer Desso, who, after recovering used carpets, uses its Refinity separation technique to separate yarn from other fibres, before being returned as new input in the production of new carpets. In order to be able to recover enough volumes of used product, specific aspects of the business model need to be addressed, namely take-back systems, and contractual relationships related to ownership.

British association wrap, in their circular business model overview also includes approaches aiming at reducing volume of resource used. In the **Made to order** strategy, production is managed to minimise material requirements and avoid potential losses from over-stocking products. (e.g.; made produce furniture designs to order, grouping requests from its online catalogue and placing orders directly with the manufacturers, reducing stock, wastages, materials and cost.)

4.1.3 Circular business model innovation with a focus on Product-Service Systems: the access loop.

Several authors have been advocating the opportunities of Product-Service Systems (PSS) in the circular economy framework (Lacy, 2013, Lacy, 2014, Evans, 2013, Bakker and Hollander, 2014). Product as a service, focus on performance and access, developments of sharing platforms in the collaborative consumption and dematerialisation are strategies falling in the category. In the **Product as a Service** approach, companies keep the ownership of the product, and focus on delivering access to the customers, through **renting, leasing or pay per use** schemes for instance. In this approach, product longevity, reparability, reusability are seen as value creating benefits rather than loss making threats. Advantages of Product as a Service business models include enhanced customer relationship and increased upsell. Bakker et al (2014) distinguished two models falling in the PSS category: **The access model**, which provides product access rather than ownership. Main revenue stream from payments for product access (e.g. the Dutch company GreenWheels' shared car use). **The performance model** which delivers product performance rather than the product itself (e.g. hours of thrust in a Rolls-Royce, 'Power-by-the-Hour' jet engines). Primary revenue stream from payments for performance delivered. Chemical management services (CMS) in which the performance of a chemical solution is sold rather than a volume are examples of Product as a service models. In

the **Sharing platforms** business model (Lacy 2014) the promotion of platforms and marketplaces allow consumers (c2c) or organizations (b2b) to collaborate around the sharing of underused resources. At the core of the approach is maximization of utilisation. Companies in favour of this business model do not necessarily manufacture the products that are shared. Examples of these circular business models include car-sharing solutions, ride-sharing solutions (Greenriders), room-sharing (AirBnB) or heavy equipment sharing (Floow2.). The rental of products between members of the public or between businesses generates an income for the product owner and provides cheaper access to a product for the renter. **In the dematerialised services** model, a service offers product benefits where the 'physical' product does not exist at all at the point of use (e.g. answerphone services). The model changes consumption patterns and delivers potential material saving through not producing a physical product for consumers. However, this must be balanced against the materials used in the service infrastructure. (e.g.: Cloud Computing: Email and document management services on virtual software platforms running on out-of-house hardware). The table 4 and figure 3 below offers an overview of the various circular business models currently experimented or implemented. The classification distinguishes five main circular business models: the clean loops, the short loops, the access loops, the long loops, the cascading loops.

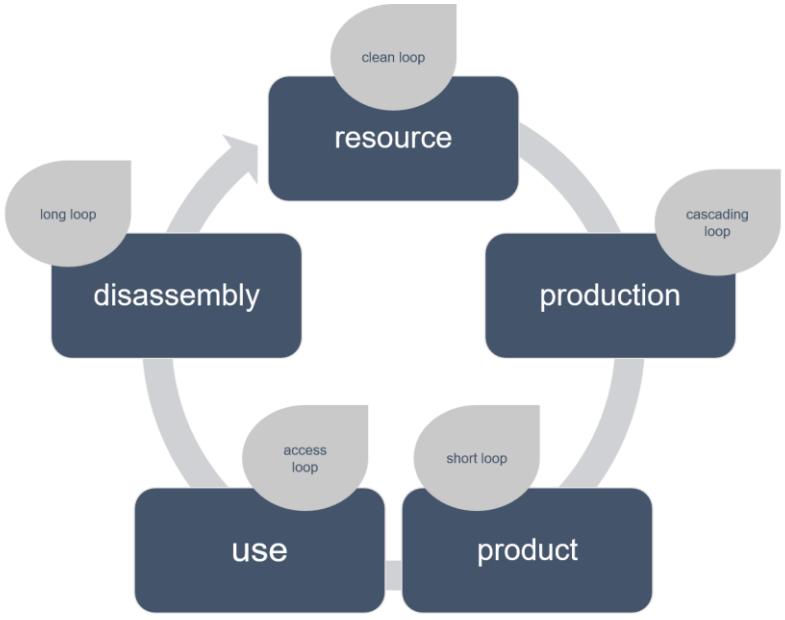


Figure 3: Circular business models

These five categories will be used in the field work to understand the dynamics of its circular business model.

Table 4: circular business model typology

circular business model typology	Description	description of key strategy	sub strategy	value creation	innovation focus	ownership	business model element involved
1. clean loops	Product is designed not to harm the environment (toxic free). Designed to be fully recyclable. Product does not rely on scarce materials	use of clean and renewable resources	use of bio-sourced materials	Value creation in resource recovery and upcycling. Cost reduction in being independent from price fluctuation of scarce resources	Material/resource	_	key resources, process
		product is 100% biodegradable/recyclable	Green process. Separation of biological and technical nutrients	Value creation in resource recovery and upcycling	material/product	_	key resources, process
2.short loops	Product remains in user hands, but is maintained, repaired or upgraded to extend its lifetime.	extend life of product	maintenance	Value creation in offering services to extend lifetime of product	product	same user	value proposition, activities
		extend life of product	repair	Value creation in offering services to extend lifetime of product	product	same user	value proposition, activities
		extend life of product	Upgrade	Value creation in offering services to extend lifetime of product	product	same user	value proposition, activities
3. access loops	product is used by several users, maximization of use	maximization of product use	reuse/redistribute	value creation for each new use/change of user	system	different user	value proposition, distribution
		maximization of product use	rent/lease	value creation for each new use/change of user	system	company	value proposition, activities, distribution
		maximization of product use	product as a service	value creation for each new use/change of user	system	company	value proposition, activities
4. long loops	resource is reused for same or different product, for same of different function	extend material use	refurbishment	value creation in resource recovery	system/product	different user	key resources, processes, distribution channels
		extend material use	remanufacture	value creation in resource recovery	system/product	different user	key resources, processes, distribution channels
		extend material use	Recycle	value creation in resource recovery	Material/resource	different use	key resources, processes, distribution channels
		extend material use	energy valorisation	value creation in resource recovery	Material/resource	different use	key resources, processes, distribution channels
5. cascading loops	product is designed with a view to create multiple value creation	extend material use	Cascading	value creation in resource recovery and multiplication of product from same resources	Material/resource	different use	key resources / multiple business models from resources and by-products
	Product is using resources that can be recovered for another use	Extend material use	Industrial symbiosis	Value creation in resource use		Different use	Key resources

5. Multiple case study as a research design

5.1 Framing the research question

In the literature review chapter, we have acknowledged that circular economy, as a conceptual framework, is multi-faceted and somewhat fuzzy. Recent publications around circular economy show that there is not one commonly accepted definition. According to the focus of the author, the term encompasses several notions: articles and publications highlight its restorative character (Aldersgate, 2012), emphasize the notion of value creation through effective use of resources (Hislop and Hill, 2011), or its functioning based on natural ecosystems and life principles (Ellen MacArthur Foundation, 2012).

Scholars also agree that it is not a new concept per se, business processes aiming at closing the loop have been used for decades for various reasons. Most recently, with the raising awareness around environmental issues and the strong implication of businesses in these alarming issues, several schools of thought have aimed at rethinking how economic practises could be more in balance with our environment. These schools of thought (biomimicry, industrial symbiosis, cradle to cradle, performance economy…) constitute the basis how what could constitute a circular economy and help us understand its general principles.

How do these principles translate into business activities? One approach to understand the dynamics at stake is to explore circular economy through business model innovation. The research in business model innovation related to circular economy is still in its infancy, but several authors are working on formalizing circular economy from a business model point of view. New archetypes are designed and attempts to categorise business models were made.

When specifically looking at existing businesses having applied circular economy principles into their business management, it is possible to draw five distinct business models approaches, as defined in the previous chapter:

- Clean loops business models (in which the manufacturing of products relies on bio-based materials and easily recyclable resources)
- Short loops business models (in which a focus is drawn on the reusability, reparability upgradability features of the product)

- Access loops business models (in which product is sold as a service through access platforms)
- Long loops business models (in which resources recovery is made possible to allows manufacturers to remanufacture products with returning materials)
- Cascading loops business models (in which by-products can serve as additional input for a new product or service).

If the general strategies are understood (i.e. use remanufacturing as a way to become circular), there is a clear research gap in understanding what are the conditions that allow for the transition to happen, from a linear model to a circular one. Hence, the research question of this thesis: *What are the drivers and conditions explaining the successful transition of companies towards circular business models?*

When focusing on companies having started their transition towards circular business models, research areas to investigate are as follow: *"Which aspects of circular economy have been implemented?" What drivers initiated the shift to a circular business model? What are the conditions facilitating the transition? What are the barriers preventing successful transitions?*

When focusing on circular economy from a micro level, using business model as a unit of analysis can bring insights on how companies can operate at a practical within circular principles. With the help of a circular business model taxonomy and the development of a circular business model canvas, the goal of the study is to understand more specifically the conditions facilitating change towards circular business models. Are the drivers, barriers, and process methods different according to the selected business model approach? Can we identify specific patterns inherent of companies having successfully transitioned toward circular economy business models?

5.2. A research context rooted in Finland

The circular economy is becoming high on the business agenda at international and European level. European Green Week held in Brussels made it its yearly theme in 2014, and the World Economic Forum held dedicated sessions on the topic in Davos in the last two years. In Finland, the interest for the topic is also increasing, as proven by the recent events organised by Sitra and Tekes in 2014 and early 2015.

Ympäristöteollisuus ja -palvelut YTP ry (the Trade Association for Environmental Industry and Services) was present at the Suomi Areena event in Pori on Tuesday 15 July 2014 to publish a joint statement, prepared in cooperation with various associations, companies, public actors, and Sitra during the spring of 2014. The joint statement stipulates that the next government of Finland incorporates the circular economy as one of the key themes of its programme. As Sitra states, the public sector needs to create a motivating operating environment for a circular economy, but the industry and population play a key role in making it happen. According to the innovation agency, the transition to a circular economy might very well help Finland become one of the most competitive countries in the world. To achieve that position, [Finland] needs to establish a common vision for the public sector, business life, and citizens.

It is within this context that the research is rooted. Emerging cases of companies having transitioned towards circular economy are starting to be identified and presented as inspiring examples (Sitra, 2015). However, little is researched and displayed on the change processes that occurred for these companies. The research aim is to focus on these internal processes while remaining aware that the general public policy schemes in place at Finnish level may influence the outcomes of the process. If Finland is to transition towards a more circular economy, the issue on how concretely companies can do it successfully is of high importance.

Circular economy is getting a strong interest in other European countries (Netherlands, UK, France, Belgium…). If the research has acknowledged the respective development in these countries, the focus will however remain on Finnish companies operating in a Finnish context. Conclusions will therefore being linked to this specific sociotechnical system.

5.3 Ontological and epistemological perspectives of the research

Ontology is the nature of reality (Hudson and Ozanne, 1988) and epistemology can be defined as the relationship between the researcher and the reality (Carson et al., 2001). The following research is rooted in the ontological and epistemological tradition of interpretivism. Reality is multiple and complex. Understanding the change phenomenon occurring when companies transition to a new paradigm (i.e. Circular Economy) will therefore rely on existing social construction (the understanding of the author of the phenomenon, blended with existing subjective knowledge of sustainability transition).

The research question as stated above is somewhat comprehensive and allows to capture several meanings and make sense of the studied phenomenon. Theory building will occur through the interaction of the subjects (managers of Finnish companies having shifted to a circular business models) and the author.

Existing insights from the author around the research context will serve a basis to develop, test and challenge new knowledge through the discussions and interactions occurring in the field work. The unpredictability of the expected findings forces the author to be opened to new knowledge and let it grow on the way. A key aspect of the research will be to understand motives, meanings, reasons and other subjective experiences of the informants, which are by essence time and context bound. In order to do so, the perspective taken by the author will be to focus on understanding the studied phenomenon before interpret it. Feelings of the interactions will be included, and the influence of the personal experience of the author will not be ignored.

5.4 A qualitative research design

The research is designed taking a qualitative approach. Qualitative research addresses business objectives through techniques that allow the researcher to provide elaborate interpretations of phenomena, without depending on numerical measurement. Its focus is on discovering true inner meanings and new insights (Zikmund, 2010). Qualitative research offers flexibility in design and applications which are more sensitive to the complexities of social phenomena than quantitative methods, which offer clearer, directly observable indicators.

5.4.1 Case study as a selected research approach

The objective of this qualitative research is to produce detailed and holistic knowledge: it is expected to gain a better understanding of circular business practises, through detailed data collection. The purpose is to develop, test and refine theory related to business model innovation through an iterative process. The choice of case-study as an instrument to develop theoretical propositions is favoured. Indeed, case study research is seen as relevant when addressing complex organizational, managerial, and other business issues, which are considered difficult to study with quantitative methodologies (Ghauri and Gronhaug, 2005). According to Bromley (1990) cited in Zucker (2009), a case study is a "*systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest*". Case studies are rich, empirical descriptions of particular instances of a phenomenon that are typically based on a variety of data sources (Yin, 1994). The research is developed using an extensive case study design as the aim is to find common patterns and properties across cases, and allow for the comparison specific features. Literature review has shown that existing theory has gaps that need further elaboration. Taking an extensive case approach will allow to elaborate, test and generate theoretical constructs by comparing a number of selected cases (Eriksson and Kovalainen 2008).

5.4.2 A multiple case study approach

If single-case studies can richly describe the existence of a phenomenon (Siggelkow, 2007), multiple case studies however provide a stronger base for theory building (Yin, 1994). As Yin states, multiple cases are discrete experiments that serve as replications, contrasts, and extensions to the emerging theory. They also allow to eliminate alternative explanations (Yin, 1994). Multiple cases also enable broader exploration of research questions and theoretical elaboration (Eisenhart, 2007). By sampling and studying several Finnish cases of companies integrating circular economy principles in their strategy, it is expected to construct specific patterns and start building theory. This theory-building process will occur via recursive cycling among the case data, emerging theory, and later, extant literature (Eisenhart, 2007). The similar kind of data will be gathered for all cases, with the aim of comparing processes and outcomes and generate patterns.

5.4.3 Case study design

According to Yin, the case study design must have five components: the research question(s), its propositions, its unit(s) of analysis, a determination of how the data are linked to the propositions and criteria to interpret the findings. Research question focus on the innovation at play when transitioning to circular business models. As the approach focused on the research is explorative, no tangible propositions are yet formulated at the beginning of the study other than shifting to circular business models entails a global reformulation of existing business models due to the systemic and disruptive nature of change at play. The unit of analysis will be the business model of companies and its intertwined elements (value proposition, customer relationships, customer segments, distribution channels, end of use, key material and immaterial resources, key activities, key partners in the value network, revenue streams, cost structure, positive and negative societal impact). Data will be linked to proposition through pattern matching and explanation building.

5.4.4 Qualitative Methods used within the multiple case studies approach

Qualitative interviews, as used in scholarly research, are research vehicles, the purpose of which is to produce empirical materials for the study in question (Eriksson and Kovalainen, 2008). Interviews are indeed a highly efficient way to gather rich, empirical data and therefore, this method was selected as a primary approach to build the different cases. More precisely, semi-structured interviews were favoured as the primary source of data collection for this research. An outline of topics, issues, and specific themes is prepared beforehand but the loose structure of the interviews allowed to vary the order of questions or to explore specific questions in details, according to the responsiveness and availability of the interviewee. Tone of the interviews remained fairly conversational and informal.

5.5 Selection of cases

5.5.1 Case sampling approach

Patton (1990) has described five different ways of sampling cases. Selecting extreme or deviant case sampling can be used to identify a subgroup within a culture Observing typical cases provide a cross-section of a larger group. Maximum-variation case sampling identifies units that are able to adapt to different kinds of contexts and conditions; critical case sampling looks for units representing the most ‘critical’ or relevant cases for transfer of findings to other related

cases. Sensitive cases are used to investigate important issues through the use of individuals or groups who have particular viewpoints.

In practice, the focus of the sampling first looks at addressing theoretical requirements. Cases were indeed selected through theoretical sampling because they have the opportunity to be particularly suitable for illuminating and extending relationships and logic among constructs. (Eisenhart, 2007).

In order to sample relevant cases, a set of criteria were defined: First, the cases must fit within the selected context (i.e. Finnish companies operating in Finland). Second, the selection should be based on theoretical aspects defined in the previous chapter and carry the potential to illuminate the research questions. Selected companies should fit exactly in the circular economy because their business approach is in line with some of the circular economy defined principles. It is also expected to have a sample of cases representing the 5 circular business models approaches defined previously (clean loops, short loops, access loops, long loops, cascading loops). Cases should provide examples of polar types and allow for theoretical comparisons. Last but not least, researcher should have access to the potential data (availability and time of the companies to discuss circular economy strategy during an interview).

How many cases should be selected? Eisenhardt (1989) suggests limiting the number of cases to the point where the incremental contribution of extra cases is only marginal (e.g. 4 to 10 cases). She also suggests retaining flexibility to add more cases if necessary. In this study, 5 cases were selected.

Table 5: overview of case studies

NAME OF COMPANY	SECTOR	BUSINESS MODEL	B2B/B2C	SIZE
Nurmi clothing	Clothing	Clean loop and access loop	B2c	Small company
L&T	Waste management	Long loop	B2c and b2b	Large company
3 Step it	It equipment	Access loop	B2b	Sme
Valtra	Agricultural equipment	Short loop and long loop	B2b	Sme
SYBIMAR	FOOD TRANSFORMATION	Cascading loop	B2B	SME

5.5.2 Limitations related to sampling

In order to make more valuable generalisation per business model category it would have been more valuable to extend the number of studied cases per category. In the framework of this thesis, time, resources constraints and the level of ambition required for a master's level research limited the number of cases to 5 cases.

Another limitation could be drawn as to the selection of companies are not only limited to one sector in particular. It is therefore difficult to generalize possible learnings and new insights of a case embedded in one sector to others.

The number of cases of Finnish companies having truly embraced the concept of circular economy in its comprehensive understanding is finally the last limitation. There is very little cases that fully meet the criteria of a circular economy. The author of this research is however aware that the number of cases is growing and that further research on the topic should be made easier in the coming years.

5.5.3 Identification of cases

Cases identification was realised following an initial web search. Key words such as circular + economy + Finland + Companies were first used to develop of first list of possible candidates. Search was refined combining additional key words such as Cradle to Cradle, Biomimicry, and Product-Service Systems. Secondly, a more thorough search on intermediary agencies addressing the topic in Finland helped identifying new cases. Finally, personal conversations with academics at Aalto and national experts (Sitra) helped identify other interesting cases.

5.6 Data collection and data management

In contrast to the conceptual and theoretical discourse explored in the literature review, learning through case studies can provide deeper insights into how and why the transition towards circular business models has succeeded or failed and the nature of factors that have facilitated or hindered this process. The case study activities were planned as face-to-face interviews with company representatives (CSR managers or environmental managers) using a questionnaire as a guide for discussion.

Case studies are usually considered more accurate, convincing, diverse and rich if they are based on several sources of empirical data. In business research, in-depth interviews are often

used as the primary source of empirical data, whereas other sources are used as complementary. The present research does use interviews as a primary source of data but they are complemented by secondary sources which include: annual reports (when available), digital materials including various types of web pages (company websites, media texts articles in online newspapers and professional magazines, online print, advertisements, brochures).

In-depth questionnaire development

In the framework of this research, an in-depth questionnaire was developed for the interviews. The questionnaire is organised around general themes/issues. The first part of the questionnaire covers general features and inquires specific information on historical business model and subsequent change using a systematic analysis of all business model components. A second part focuses on the processes that changed to allow for a new business model structuration, covering stages of idea generation, testing, business development and commercialisation. A third part looks at the impact and benefits including diffusion level, environmental, social and economic impact now and in the future, as well as negative impacts. Finally, a systems view on factors that influence the transition such as market conditions, organisation and networks, knowledge and skills, finance and resources, policies, value chains, enabling technologies and infrastructure. The interview is concluded with overall lessons including determinants and plans.

Data recording

Interviews were all recorded electronically either through the use of a mobile phone application or through the use of mp3 recorder software for Skype interviews. The researcher took complementary written notes to highlight key sentences and prepare for further coding. Interviews were then transcribed.

Use of secondary data

When interviews were done at the physical locations of the informant, additional observations were made by the researcher with regard to the informant (key role in the company, interactions with other colleagues, location of the office in the building, etc...). Secondary data sources were also used to analyse the phrasing and wording of circular economy concepts as understood by the organisations (in annual reports or in websites).

5.7 Data Analysis and interpretation

Yin (2002) distinguishes to main strategies to analyse collected data. Either the starting point of the analysis is based on pre-formulated theoretical propositions. If this is the case, the coding system is developed accordingly. The alternative approach first describes the case and only then, emerging patterns allow to develop a structured framework to organise the case. The interpretation of the materials forms the basis for the analysis, rather than a coding procedure.

In this research, the latter approach is favoured and a more inductive-oriented strategy is developed. As stated earlier, specific themes and categories are explored without precise pre-propositions. Issues questions are used to define the case at a conceptual level.

First, each case is analysed individually (within-case approach). A general description of the organisation is drafted and then structured according to the specific themes and issues described earlier. The information in the case studies captures several key aspects, such as novelty of business models, value proposition, target users, marketing efforts…Then, follows a cross-case analysis. This approach allow to draw comparison between cases, to search similar patterns or differences. The iterative process also confronts the findings to existing theory.

More precisely the analysis involves the following three components: Using the developed typology and grouping the cases according to the business model considered in each case; Analysis of each identified circular business model and the system as it is described in the Circular business model framework. Analysis of the implications of each type of business model from the perspective of facilitating change.

5.8 Reflexivity on the design process

Credibility

By recording electronically the interviews, discussing the interviews internally afterwards and gathering respondent validation on the translated synthesis it is believed that a degree of credibility has been ensured.

Transferability

The number of interviews is somewhat limited in order to transfer the findings to all Finnish sectors. In order to increase the transferability we purposely asked experts their opinion about findings, for triangulation purposes.

Dependability

Recordings and transcripts from the interviews are not attached to this thesis for several reasons. In order to increase the dependability, the author has used his supervisor as an auditor by reporting on progress and discussing findings related to the interviews.

Confirmability

In order to increase the confirmability of the study interview synthesis are structured and presented in a way that clearly separates the interviewees' statements and the interpretations.

6. Case studies: five Finnish circular business models

The chapter six presents the findings of the five case studies. Case 1 introduces Valtra, a company operating in the agriculture sector and offering on top of its brand new equipment a line of remanufactured equipment. Case 2 presents L&T, a waste management company reorganising its activities to fit within circular economy principles and exploring how value creation can occur through maximisation of resource use. The third case, 3 Step IT, highlights how the IT leasing company can embrace a circular business model with a leasing model. Case 4, Nurmi clothing, explores the challenges of a responsible clothing company striving to become truly circular from the right choice of materials to the business model selling access to fashion. Case 5, Sybimar, describes how circular models can be built from a cascading value perspective and allow multiple flows of material and energy to be circulated in a close loop system. Each case follows a similar structure: a first section provides background information on the company; drivers leading to the implementation of the new business model are introduced, the new circular business model is described and finally obstacles and conditions for successful implementation are synthetized.

6.1 Valtra: a user-driven tractor company bringing extended value proposition through remanufacturing

Valtra is a Finland-based manufacturer of tractors and currently one of four tractor brands of the AGCO Corporation. In 2012, Valtra introduced remanufacturing as a new business model: through the rebuilding of gearboxes using a combination of reused, repaired and new parts, Valtra explored how the circular economy could become beneficial for its business model.

Remanufacturing A circular process

Remanufacturing, as a circular business model is the process by which products are restored to original manufacturer's tolerances and working specifications. Remanufactured products go through a rigorous process to ensure they perform as good as or better than the original part.

A remanufactured part fulfils a function which is at least equivalent compared to the original part. It is restored from an existing part (CORE), using standardized industrial processes in line with specific technical specifications. It is given the same warranty as a new part and it clearly identifies the part as a remanufactured part and states the remanufacturer. A remanufactured part is different from a reused, repaired, rebuilt, refurbished, reworked or reconditioned part.

Valtra's mission is to develop tractors and provide services that make the daily work of its customers easier. Beyond the sales of tractors, Valtra offers its clients an extensive set of dedicated equipment (combine harvesters, seeding, hay & forage, application equipment, implements, attachments & material handling) and support (including sales of parts). The new business model, centred around remanufacturing, falls in the last category and offers an extended support to customers in need for repair services.

6.1.1 Emergence of a circular business model

One specific business unit of Valtra - Valtra Parts - focuses on promoting after-sales services. The unit is for instance in charge of activities related to retrofitting; it provides guidance on how to upgrade existing tractors and drives the sales of Valtra's genuine parts. In early 2012, the company started exploring the possibilities to offer its customers remanufactured gearboxes.

Following the trend of its mother company AGCO, who had been remanufacturing engines for several decades and had recently started to market these parts under the "REMAN" brand name, Valtra's marketing manager in charge of Valtra Parts discussed with former parts and service director at AGCO Engine factory (at Nokia facilities) about the possibilities to test the development of remanufactured equipment at Suolahti's transmission factory. The local facilities had the in-house capabilities to provide the right expertise to remanufacture gearboxes. After receiving the green light from top management, it was decided to research further the viability of a business model related to remanufacture gearboxes. Several months of benchmark, various discussions with dealers and distributors, completed by a set of tests with warranted gearboxes to investigate main general damages and easily reusable parts, it was decided to launch Valtra Reman in early 2013. One technician was hired to be the first Reman employee, while the marketing manager of Parts extended its workload to launch the new business unit.

6.1.2 Drivers to implement circular business model

If business model innovation is generally driven by the will to generate added profits, other drivers may influence the intention to explore new business models. In the case of Valtra, the new business model implementation was driven by the will to reinforce the attraction of the brand and meet customer needs. By extending the range of solutions offered by the company to the customer when having to deal with negative aspect, (i.e. having to repair a part of the tractor), the company extended its value proposition. The circular business model extends the alternatives offered to the client (buy a new gearbox, repair the old gearbox at dealer, offer remanufactured gearbox). By doing so, the company also reinforces its strategic mission to be a reliable partner for the tractor owner. The negative aspect related to the need to repair a defect product is transformed into a positive message: "*we do have the most efficient solution to fix your problem. Chose the most effective one to meet your needs*".

6.1.3 Transformation of the existing business model

The section highlights the changes within the existing business model of Valtra due to the launch of the circular business model. Organisational changes, changes in the customer interface, in the activities and use of resources are presented. The consequences on the company's value proposition are highlighted.

Organisational changes

The implementation of the business model followed a gradual growth. First, one technician was hired in 2013 to focus on Reman activities, soon a second and a third employee followed. 2,5 years following the initial launch, the manager is looking at employing a fourth employee. The manager in charge of the Reman activities is also managing the marketing activities of the Parts department and thus combines both activities (pricing, benchmarking, etc.…). The remanufacturing facilities started in a small area in the Valtra Unlimited factory. Space was doubled after a year to reach 120 square meters but remains a smaller fraction of the large factory space.

Customer interface

The Remanufactured solution used the same **distribution channel** than the initial business model. As part of Valtra's value network is an extended set of dealers and distributors which are the main contacts with the tractor customer. When a tractor's gearbox needs repair, the new business model allows the dealer to offer two solutions to the customer. Either the gearbox is repaired at the dealer location: following an initial diagnosis, broken parts are identified, and a first estimate of the works that need to be done is given to the customer. The second alternative is to replace the defect gearbox by a new model. The new alternative (Reman) offers the client to replace the used gearbox by a remanufactured one. It is cheaper than a new one, and provides a full warranty on the whole part, in contrast to the repaired gearbox which will receive a warranty only on the replaced subparts of the gearbox. This extended set of alternatives reinforces the perception of the customer that there is an appropriate solution for him. Depending on the works that need to be done on the broken gearbox, depending on the available stocks to replace some parts or the whole gearbox, depending on the number of repair orders currently schedules by the dealer, the customer will be able to choose the most time and cost efficient solution.

In terms of **reverse logistics,** when the customers opts for a remanufactured gearbox, based on the reference of the gearbox, a set in stock is directly shipped to the dealer. The dealer in exchange keeps the used gearbox and sends it back to the remanufacturing facilities. In some specific cases, if there is not stock of the gearbox's core at the facilities, then the dealer sends first the defect gearbox which is then used as a basis for the remanufacturing process. This happens in 10% of the cases.

Increased relevance of immaterial resources

The successful implementation of the business model relies on the expertise of the technician team. The 3 Reman technicians at Valtra are experts in their field. They have been rebuilding hundreds of the same part each year. Having the expertise in-house, and a complete control of the remanufacturing process have been essential factors in deciding to implement the new business model.

A new business line fitting existing design and engineering practises

Remanufacturing a product may causes issues if most recent product lines are designed in totally novel way. In the case of Valtra gearbox, new product developments are actually used and applied to the old gearboxes. The results is that often, remanufactured gearboxes are better than the original models. Intuitively, the design of gearbox follows a modularity approach, which is key to circular design practises. As a result, many new gearboxes designed today are made so that they can fit some very old tractors models (30 years old). The same gearbox can also fit several models, which facilitates replacement, maintenance, reuse and remanufacturing.

The Reman activities follow strict procedures. Reman parts are produced in a closely controlled environment according to strict procedures. Each part is completely disassembled, cleaned, and inspected. Their individual components are brought up to the latest OEM specifications, if possible, or replaced with new components. All wear items are also replaced. Older cores are brought up to date with the latest engineering specifications, when possible. Doing so provides even better performance on older equipment.

Consequences on the value proposition

The launch of Valtra Reman business unit allowed Valtra to strengthen its **value proposition.** The table below summarizes the improved perceived benefits by the customer when offering a remanufacturing solution for the gearbox equipment.

Table 6: Overview of benefits offered by the new business model

BENEFITS	DESCRIPTION
Economic benefits	Ownership of equipment is expensive. Choosing a Reman gearbox is 60% cheaper than purchasing a new gearbox. When looking at the option of repairing the defect gearbox. Reman is a valuable alternative as it helps by reducing parts and labour costs for equipment repairs.
Technical benefits	When choosing a Reman product instead of a repair, the customer benefits from recent upgrades — Reman are always brought up to the latest engineering specifications.
Time benefits	Choosing a remanufactured gearbox often means reduced repair time compared to replacing defect parts of used gearbox (as often broken parts are not directly identified during repair diagnosis).
Environmental benefits	The Reman process requires 80% less energy and material than manufacturing a new component.
Reliability benefits	Every remanufactured part comes with the same warranty as genuine original equipment parts. When doing a simple repair, only repaired parts have a warranty. Choosing a remanufactured gearbox provides a warranty on the entire part.

A business model with positive societal impact

Remanufactured activities, by reusing old cores and parts allow the company to save on resources, energy and costs. Energy is saved when parts are recovered instead of being produced. Non reusable parts, after being collected are sent to the dedicated recycling chains

(for metal essentially). Currently though, there is no data collected by Valtra on the exact material and cost savings provided by the business model. This information has not been vital to facilitate the support of the top management in the launching of the activities. The information would support the sales pitch but given time and resources constraints this assessment has not been performed yet. The positive impacts, even if not measured, are however being used as a small marketing add-on, i.e. “by choosing for the Reman option, you help saving energy and resources, thus you help the planet”.

On the social sid**e** of the model, it is acknowledged by the marketing manager of the business unit that employees working at Reman get a strong satisfaction and pride in their jobs. As tasks are more complex and require a stronger commitment than in the usual factory production, the employees get more responsibility throughout the whole process, which results in a stronger sense of pride with the end product. As the employees get recognized for their skills, new activities are being developed based on their expertise, such as ad-hoc gearbox training for the network of Valtra dealers.

The figure below summarizes the key features of Valtra Reman business model

Name of company: Valtra | **busines model innovation level :** Business unit level | **type of circula business model**: remanufacturing

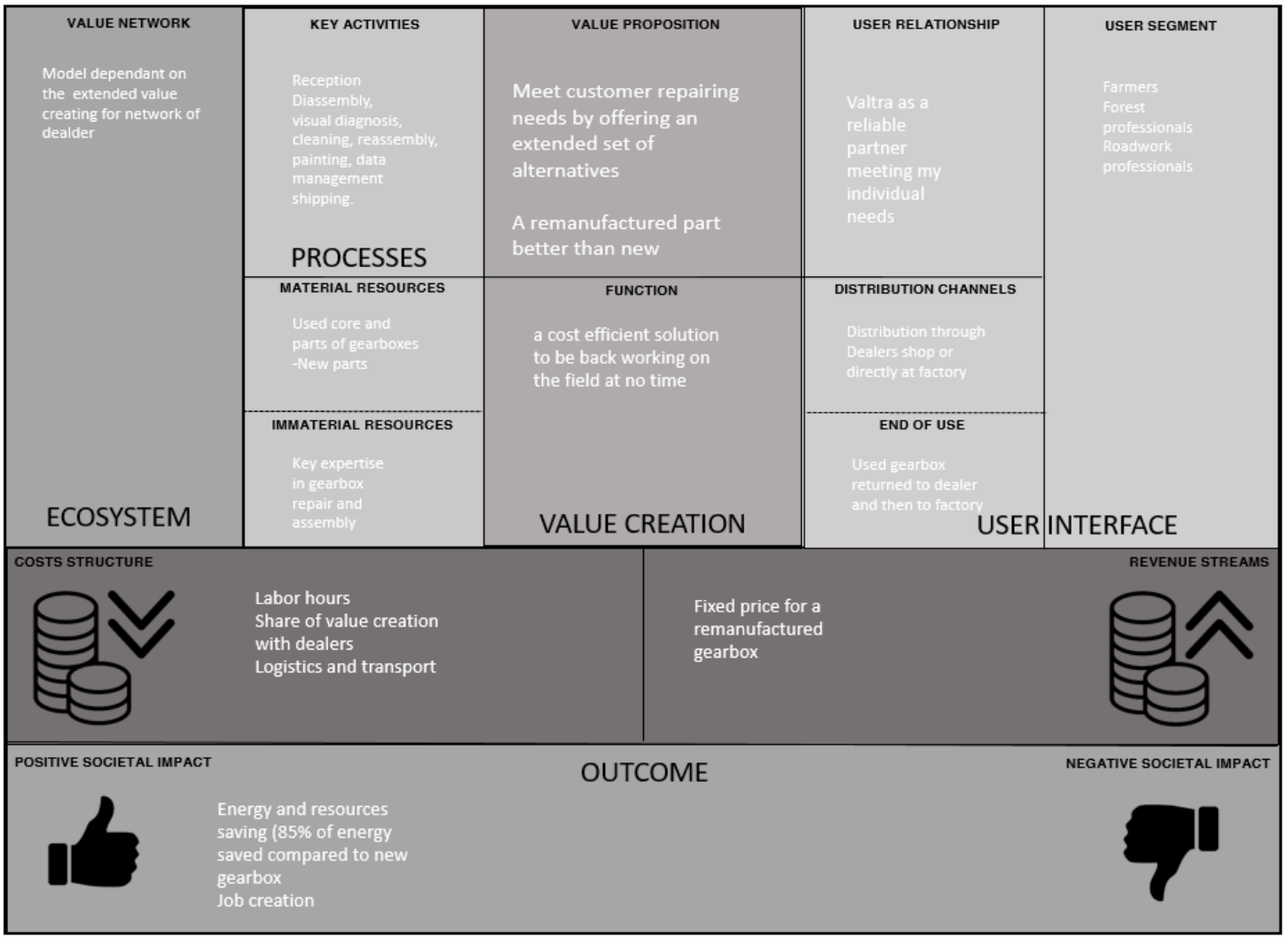


Figure 4: Valtra business model

6.1.4 Barriers in the implementation of the circular business model

The section presents the obstacles that occurred during the implementation of the new business model. In the case of Valtra, two obstacles occurred; the fear of cannibalisation and the convincing of the new business within the value network of the organisation.

First, there were initial worries of cannibalization of existing products. If one product already sold gets more chances to be repaired, it may reduce the sales of new products. When dealing with these worries, the company stated that so far there has not been any negative impact on sales of individual new parts. The new business model is rather seen has complementary to the existing one than a pure threat. As Reman is not always the best option for all repair, it is not expected for remanufactured activities to replace all existing activities. According to marketing manager, the average percentage of Reman activities should reach between 4 and 5% of the turnover related to the total parts and service business.

A stronger obstacle in the implementation of the business model was to create shared value for the network of dealers. Few barriers arose from the launch of the project. The main one was the scepticism from dealers or distributors. Many first thought there was no demand for this on the market. The one way to overcome this key obstacle was to provide the right win-win arguments for them to be part of the new service solution. From a business point of view, dealers generate their revenue from the labour hours spend repairing defect tractors. If Valtra offers a remanufactured gearbox as a solution, the first feat for the dealers is that they'll charge less working hours as the repair activities are just replaced by disabling the old gearbox and replacing it with the Reman one. However, Valtra identified several advantages from the dealer perspective that could be beneficial for everybody. First of all, if dealers are generally well trained to perform a repair on gearbox, some of them might do it very seldom (once a year). Thus it might take them longer to do a repair than expected, with a negative influence on the scheduling of other repairs. Having the possibility to order a remanufactured is a way to avoid this type of scheduling delays. The time to reassemble a new gearbox is well known and can be more easily scheduled than a repair. Second of all, from a warranty perspective, dealers might have more responsibility if another problem comes up with a repaired gearbox. Placing a remanufactured gearbox provides a full warranty to the owner that is taken care of by Valtra itself, not the dealer. When a remanufactured gearbox is shipped, the dealer receives all necessary documentation with regards to the parts implemented (reference of materials, etc...). Finally, the business agreement (discount on the gearbox) between Valtra and the dealers is

quite beneficial for the dealer and allows for relevant profit making. All in all, offering the possibility to the client to choose a remanufactured gearbox provides benefits for all, which is essential as an enabling condition for success.

6.1.5 Successful conditions for the implementation of the circular business model: key learnings

Several conditions have facilitated the implementation of the new circular business model at Valtra. These can be divided into two categories: internal conditions on one hand, for which there has been an active managerial contribution (commitments from top management, alignment between company values and new business model, internal know-how, capacity to convince the value network..) ; external conditions, on the other hand, which have indirectly facilitated the transition process (general momentum around remanufacturing, successful examples)

Internal conditions

Commitments from top management

Without the initial green light from the management, no project would have started. Management was directly aware that developing such a solution could improve the current value proposition. Resources devoted to the project were however light to start with, and increased over time as project proved to be financially self-sustainable. Without top management commitment though, there would not have been any new business model.

Alignment between company values and new business model

According to Valtra communication material, the company has a strong will to be a reliable partner; a company that can offer practical solutions to the individual needs of the tractor owner. This has been translated into business in the past by focus on customization of tractors models. By launching a remanufacturing solution, Valtra reinforced its objective to be close to the customer needs by developing complementary alternative.

The new business model allowed to reinforce customer relationships through an improved storytelling. Marketing managers did not have any hard time selling the Reman story to dealers or end users. Feedback was really positive. By being able to turn a negative event (having to repair a damaged product) into something positive (we offer you extended customer support and increase your alternatives), the Reman business model reinforces customer relationship, and offers truly shared value.

A good expertise and knowledge in transmission components

Because of its strong in-house capabilities around transmission manufacturing, it was easy for Valtra to implement the new solution. Had this know-how been external to the companies, the implementation would have been less fluid. Being aware of the immaterial resources available within the company have been a key driver in launching the new business model.

A win-win solution within the value network of the company

The Reman solution offers various advantages from the dealer point of view. When choosing a remanufactured gearbox, it's easy to assess the time to change the whole gearbox. There is no bad surprises in detecting the defect parts. Also, the pricing of the repair is less risky than repairing parts by parts, as a first investigation in the workshop might only detect half of the parts to be replaced.

External conditions

A general momentum around remanufacturing

The general climate around recycling issues, climate change has created a momentum that suddenly puts remanufacturing as a win-win solution both for the producer, the client and the planet. The company thinks they have started their operation at the right time, where these issues may indirectly influence customers' decisions.

Awareness around successful similar business models

Valtra is part of ACQO Corporation. ACQO has also developed some Reman activities for several years and started marketing them under Reman, three years ago. It's been a strategic decision to highlight this set of activities (at the same level of other key departments). At Nokia facilities where ACQO engine factories are manufactured, this type of remanufacturing activities for engines has been done for decades. It had never been promoted as a Reman until a few years ago. Valtra was aware that such a business model can be successful in their gearbox branch, which facilitated its implementation.

A business model more easily deployable in a B2B context

Remanufacturing processes are not easily adapted to every business model. In the business to consumer sector, several factors may hinder the adoption of Reman practices (wrong perception

of safety issues, not as good as new, etc...). In the B2B sector, and more precisely in the agricultural equipment industry, customer acceptation has not been perceived as an issue. In this industry, the customer is well aware that the products are put in heavy use. The parts that have to endure the most are known to be engines and transmission. There is thus a better understanding and acceptation that damage may occur. Valtra explored the opportunities of circular business models with the launch of a new unit. How can circular thinking influence a global strategy? The second case, in the next section highlights a larger shift in company's management to meet the principles of circular economy.

6.2 L&T: the resource flow facilitator.

The second case study focuses on Lassila & Tikanoja (L&T), a Finnish waste management company who shifted its entire business approach to fit with circular economy principles: instead of positioning itself as a traditional recycling partner dealing with waste at the end of stream, the company now adopts a pro-active approach aiming at generating value throughout the whole life cycle of materials.

6.2.1 From a wholesale business to a waste management and recycling company

Lassila & Tikanoja (L&T) is a 110 years-old company which has known throughout its history several transformations. First established in Vaasa in 1905, the enterprise was then a wholesale business selling fabrics and only invested the waste management sector 75 years later. First by investing in companies manufacturing paper bags, and later expanding its operations through corporate acquisitions into waste collection, cleaning services, industrial cleaning and maintenance, and damage repair services. In the late 1990s, development work on environmental products focused especially on products related to waste recovery. L&T assumed its present form in 2001 when Lassila & Tikanoja plc split into two separate companies (Lassila & Tikanoja plc and Suominen Corporation). At the same time, the company launched the L&T brand name for all of its operating divisions: Environmental Services, Property and Office Support Services and Industrial Services. Today, with operations in Finland, Sweden and Russia, L&T employs 8,000 persons.

In the 2000s, waste management companies were perceived as the "guys in the background", dealing with the unwanted burden of waste, a by-product of our consumer society. At that time, Lassila & Tikanoja was introducing itself as a company that specialises in environmental management and property and plant maintenance (L&T annual report, 2004). Its Environmental Services covered the collection, transport and treatment of waste and reusable material and the supply of processed recycled materials for reuse. Property Services offered cleaning, property maintenance and services at customers' premises while Industrial Services specialised in heavy-duty cleaning and damage repair for industry and other types of property that require special expertise. The company relied on an increasing network of sorting stations, secondary material production facilities and a fleet to collect and transport waste. If environmental management was at the core of L&T business model, the perception of environmental issues were more addressed in terms of responsibility than opportunities: "*L&T is the biggest company in the environmental management sector in Finland, so its responsibility in environmental issues is*

particularly heavy" (annual report 2004). Historically regulation-driven, the company's core activities had indeed a lot to deal with environmental regulation and directives which in turn impacted its various range of customers (business premises, industry, private property owners and municipalities). In 2005 however a shift appeared in the positioning of the company which embraced the concept of sustainability: "*L&T stands for sustainable development*". As the company kept on investing in the processing of waste into secondary raw materials, the company value proposition discreetly changed and highlighted that the company's environmental services allowed to turn waste into useful materials. That shift however took a grand new direction when the new CEO Pekka Ojanpää was appointed in 2012 and decided to revise the company's strategy.

6.2.2 Transformation of L&T business model

The creation of a new strategy was paramount to L&T in 2012. A large number of L&T employees from across the organisation took part in the strategy process. The strategy was built based on an assessment of the megatrends currently shaping the world: rising prices of raw materials, climate change, and the need to be more cost efficient in the face of a structural financial crisis. "*The consumer society we live in today has reached a point of no return, and L&T wants to lead the way in transforming it into a sustainable and efficient recycling society. We plan to do this by improving our customers' material, energy and cost efficiency.* » wrote the CEO in the 2012 annual report introduction. In terms of concrete changes, the new strategy separated industrial services into a division of its own, and merged the cleaning and property maintenance services into one division: Facility Services. L&T's new business operations were now divided into four divisions: Environmental Services, Industrial Services, Facility Services and Renewable Energy Sources.

By reshaping the divisions based on the challenges faced by its customers and by clarifying key customer benefits for each of the services, L&T managed to clarify its value proposition and aligned it to its core mission: L&T's strategy, the annual report writes, is based on a mission to change the consumer society into an efficient recycling society. Its goal is to "*build a society where existing materials and buildings are used as efficiently as possible, efforts are made to optimise energy consumption, and jobs and well-being are created through sustainable growth*". This mission is to be achieved through a shift in the value proposition offered to customers: by improving the material, energy and cost efficiency of customers through a win-win partnership.

6.2.3 A new circular value proposition: from selling waste management services to selling sustainable customer benefits

Lassila & Tikanoja defines itself a "*service company that is transforming the consumer society into an efficient recycling society by offering its customers material, energy and cost efficiency*" (annual report 2012). In this renewed approach, L&T repositions itself more as a partner than a mere subcontractor of waste management services. The cooperation with customers is seen as essential to create value. Through advice and proper management and practical actions, the goals are to reduce waste volumes, expend the lives of properties while reducing the overall consumption of customer's raw materials and energy. L&T wants to support its customers in their efforts to improve material efficiency by offering the full environmental management value chain, from the sorting of waste at the point of origin to the processing of recyclable raw materials and waste. L&T offers solutions in term of reporting and monitoring so that customers can track their environmental actions and reduce their costs. The energy efficiency solutions are based on knowing where energy is consumed at properties, and taking action on problem areas. The company offers energy audits and implementation plans to increase the efficiency of the use of business premises and optimise technical systems. L&T also offers solutions to control material, energy and labour costs.

The recycling society as a transition path towards the circular economy

2014 is the first year in which L&T mentions circular economy in its annual report: *"Over the coming decades, we will see a transformation to a circular economy in which waste becomes raw material and existing resources, such as properties and energy, are used more efficiently. The circular economy provides us with a direction for future growth and business development, and we want to be an important contributor to it*" writes Pekka Ojanpää. According to L&T, the recycling society as described in the 2012 strategy can be seen as an interim phase in the move towards a circular economy. In that respect, and in co-operation with its customers, L&T is not looking at recycling used materials only, but also aims at being active all along the waste hierarchy: by reducing waste volumes, by extending the useful lives of properties, by recovering materials and by decreasing the use of raw materials and energy.

6.2.4 Drivers to implement a circular strategy

Specific drivers explain the transition of the company. Beyond the generic motivation to extend profit generation at internal level, at external level, the growing pressure from global

megatrends and the anticipation of legal changes supported the change. These two drivers are inherently connected to the opportunities offered in terms of business generation.

Global megatrends: As a driver for its renewed 2012 strategy, L&T has identified key external trends impacting the business of its customers. By realising that historical L&T services are at the core of the solutions that meet these challenges, it allowed the company to clarify its value proposition and translate it into clear customer benefits. These key trends analysed by L&T are generally the same found in the literature about circular economy: Key raw materials are becoming more expensive and as reserves dwindle and demand grows, the prices of these key raw materials will keep on rising. At the same time man-made pollution puts the very future of our planet at risk. These two challenges force companies to see waste as a material that cannot simply be disposed of but instead should be reused to create sustainable value, benefiting both costumers and the planet. As the climate is getting warmer**,** L&T understands the growing need to be more efficient with the use of energy and gradually replace fossil fuels with renewable energy sources.

Anticipating legal changes: L&T being a strongly regulation oriented business, the scanning of currents trends at EU policy level has also been key to position itself in the upcoming business trends. As the EU is setting long-term targets to promote the circular economy, it creates a better operating environment for the development of new technology and waste management solutions. Recycling targets are becoming more ambitious. Companies face greater demands related to transparency and reporting and the demand for business solutions that support responsibility increases. All these signals strengthen the position environmental and waste management companies hold on the market. Aware of these trends, L&T also plays an active role in shaping the policies toward more circular practices. As an illustration, Lassila & Tikanoja participates in the initiative as one of the leading companies in the bioeconomy and circular economy sector in Finland -the Koli Forum- which seeks to support the bioeconomy and sustainable use of natural resources, both in Finland and internationally.

6.2.5 Strategic steps towards circular economy

The strategic shift towards circular economy happened through the implementation of specific concrete approaches: the search of value creation by climbing up the waste hierarchy, the structural cocreation of circular business models with customers, the acquisition of existing

companies fitting the new models of the circular economy, an open innovation strategy to nurture new circular ideas.

Sustainable value creation by climbing up the waste hierarchy

Circular economy changes traditional value chains by moving up in waste hierarchy. If the traditional roles of waste management companies generally fit at the bottom of the waste hierarchy (collecting waste and disposing of it through landfill and incineration activities without energy recovery), the trends in the last 20 years have shifted towards an increase of practises related to energy recovery of waste (anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy from waste..). With recent technological developments in material recovery, turning waste into a new product has become the new priority among recycling companies. Hence the general increase of investments in recycling facilities.

Figure 5: Waste hierarchy

As circular economy seeks to create value that go beyond the recycling activities by focusing on higher level of the waste hierarchy (through for instance repairing, refurbishing), L&T is also shifting its business developments towards these business models. Damage repair services for instance, support customers in putting back their properties back into condition. The ultimate approach focuses on the higher level of the hierarchy: waste prevention. L&T currently has a team six experts offering consultancy services to companies with the active role of reducing waste volumes. That consultancy unit operates a lot more like a *start-up* than a corporate division. Its role also goes in the active cocreation of sustainable business models with their customers, finding new ways to create value from used material.

Circular business model development through organic growth and acquisition

L&T wants to provide its customers with comprehensive environmental management solutions to support the priorities of waste management and the maximum recovery of materials. One way to move up through the waste hierarchy is also to offer reuse solutions. In 2014, L&T acquired the business operations of J. A. Tauriainen Oy, a company specialised in the recycling and material recycling of pallets. In the current system, woods pallets when used, are generally discarded and incinerated for energy recovery. However, the repair and reuse of the pallets can provide higher value than the waste to energy process. Located in Järvenpää, Tauriainen is one of the leaders in the recycling and repair of pallets in Finland. Through this acquisition, L&T has expended its business operations to a whole new area that has strong synergy potential with its existing activities. The new business unit goes beyond recycling and offers a step forward allowing the company to create value through the re-use of existing pallets.

Circular business model innovation through open innovation

The rapid digitalisation of our society is an important driver for the development of circular economy solutions (EMF 2012). Having built a new set of skills with the launch of an internal start-up team focusing on new digital solutions, L&T has started making use of the lean methodology (Ries, 2011), often used in the start-up world. Using open innovation and collaboration as a fuel to create circular business model, L&T has organised in June 2015 a start-up pitching event to gather start-ups around digital solutions or products that may help accelerate the transition towards a recycling society. Ideas focused around clean-tech solutions, Internet of Things, b2b software and other complementary areas of expertise.

In the same approach, L&T hosted the recycling-themed IndustryHack Hackathon event on 25–27 September 2015. The event attracted a number of coders, designers and recycling enthusiasts for a weekend to develop new digital recycling solutions. During the weekend, the participants visited Finland's largest recycling plant in Kerava, after which they went to Gustavelund Hotel in Tuusula to work on their own ideas. L&T's specialists coached the teams throughout the weekend. The Hack the Recycling event was a logical continuation of the start-up pitching evening arranged earlier in the spring. The 14 applications and services created are associated with the creation of new recycling services for consumers, the collection and analysis of data, the monitoring and visualising of the recycling plants or equipment or process optimisation.

Kimppanouto concept for instance, created by the winning team SC5, is a social application that allows consumers to build a list of items they wish to recycle. When the volume of items in the same neighbourhood reaches a sufficient level, L&T collects them for recycling. The competition jury stated that the solution created by team SC5 was an excellent combination of customer needs and L&T's current business activity while also utilising the current trend of community involvement. The ideas presented by the winning team and other participating teams were comprehensively reviewed after the competition to assess their business potential. The objective is that ideas with the best potential will be turned into pilots and developed to create products and services that support L&T's recycling business.

Creating circular business models with existing customers

In its research and innovation strategy, L&T regularly collaborates with research agencies and universities to test new concepts. With rapid experiments easily deployable throughout its large network of customers, L&T is able to test new business models at a larger scale, with the help of its existing infrastructure and ecosystem of partners and clients. A recent collaboration with VTT project Aarre, focusing on developing user-centred circular business model, is a good example of cooperation with academia in which L&T is able to test new business ideas.

6.2.6 Barriers in the implementation of the circular economy strategy

Despite its success, L&T circular strategy has faced some challenges: One barrier faced currently by L&T is rooted in the perception of waste management as a business activity focusing principally on recycling waste, rather than a sector creating new value from a smart use of resources. This perception is still present in the workforce of the sector, which has yet to understand the opportunities of new value creation.

Another challenge is related to the concept of circular economy itself, perceived as a high-level strategy lacking practical implementation. If Finland at policy level is currently developing roadmap and action plan towards the implementation of a circular economy, L&T fears that there is still a strong gap between the vision and the concrete implementation steps currently taking place on the ground. As an example, strong public investments are still made in incineration plants to burn the waste for energy recovery, rather than to look at smarter ways to create value from resources.

Another concern relates to the fear of business cannibalization on the path towards a zero waste society. If circular economy ultimately seeks a zero-waste state, it is coherent to wander about

the future of waste management companies, whose traditional profit-making is based on the high volumes of waste collected and reprocessed. One should go beyond the fear that circular economy is cannibalizing initial business model and see the shift as an opportunity rather than a threat, argues CSR manager Jorma Mikkonen, providing the company remains in an active role mode. When waste becomes a resource for a new product or function, the demand for logistics remains high, and so is the capability related to cycle the resources towards its new use. As the value chain is becoming more complex and sophisticated, waste management companies have a central role to play in the new model, providing they acknowledge the new opportunities rising.

6.2.7 Successful conditions for the implementation of the circular business model: key learnings

Several factors can explain the company's success in its transition towards circular economy. At internal level, the historical position of the company, its existing infrastructure and its capacity to translate global challenges into business opportunities have also been key to the success of the company. At external level, being strongly positioned in the B2B sector has influenced the success of the transition, the business clients being more easily convinced by the benefits offered by various solutions offered.

Internal conditions

An historical position to become a national material and energy flow orchestrator

"*We have always done it, it's our business"*. L&T's core operations, since the acquisition of Säkkiväline, have historically been in the collection and management of waste. As the smart use of resources becomes a business priority, the position held by L&T allows the company to be a central element of the transition and act as an orchestrator of material and energy flow, thanks to its logistics fleet, its recycling facilities and the know-how accumulated over the years.

The infrastructure to become a testbed for sustainable business model innovation

Having a value network of 200.000 clients brings many opportunities to pilot and scale up sustainable business innovation. The capacity of the company to shift its relationship from subcontractor to partner is key in the transition to circular economy.

The capacity to transform global challenges into business opportunities

L&T holds a key position in helping its clients transforming key global challenges into business opportunities. By offering solutions aiming at creating the most value from the materials owned by its clients, by helping customers in saving energy, resources and costs, L&T is able to respond to a real customer need and provide a value proposition that creates value for the client, for the company and for the planet.

External conditions

A transition facilitated at the BtoB level

If one strong barrier towards the implementation of circular business models is related to the customer acceptation of the new value propositions, the business case for circular economy is more easily applicable in a B2B relationship. In the case of L&T, the consumer benefits offered by the new strategy received a very positive reaction, as customers were obviously interested in costs savings, through energy or material efficiency. As most of L&T customers also have to have sustainability goals and specific initiatives aiming at cost reduction and better use of energy and resources, L&T plays a major role in helping its customers achieve the established targets. This new win-win collaboration puts L&T in a very comfortable position compared to other companies willing to shift towards sustainable business models in BtoC contexts.

Name of company: L&T| **busines model innovation level :** company level | **type of circular business model**: long loop

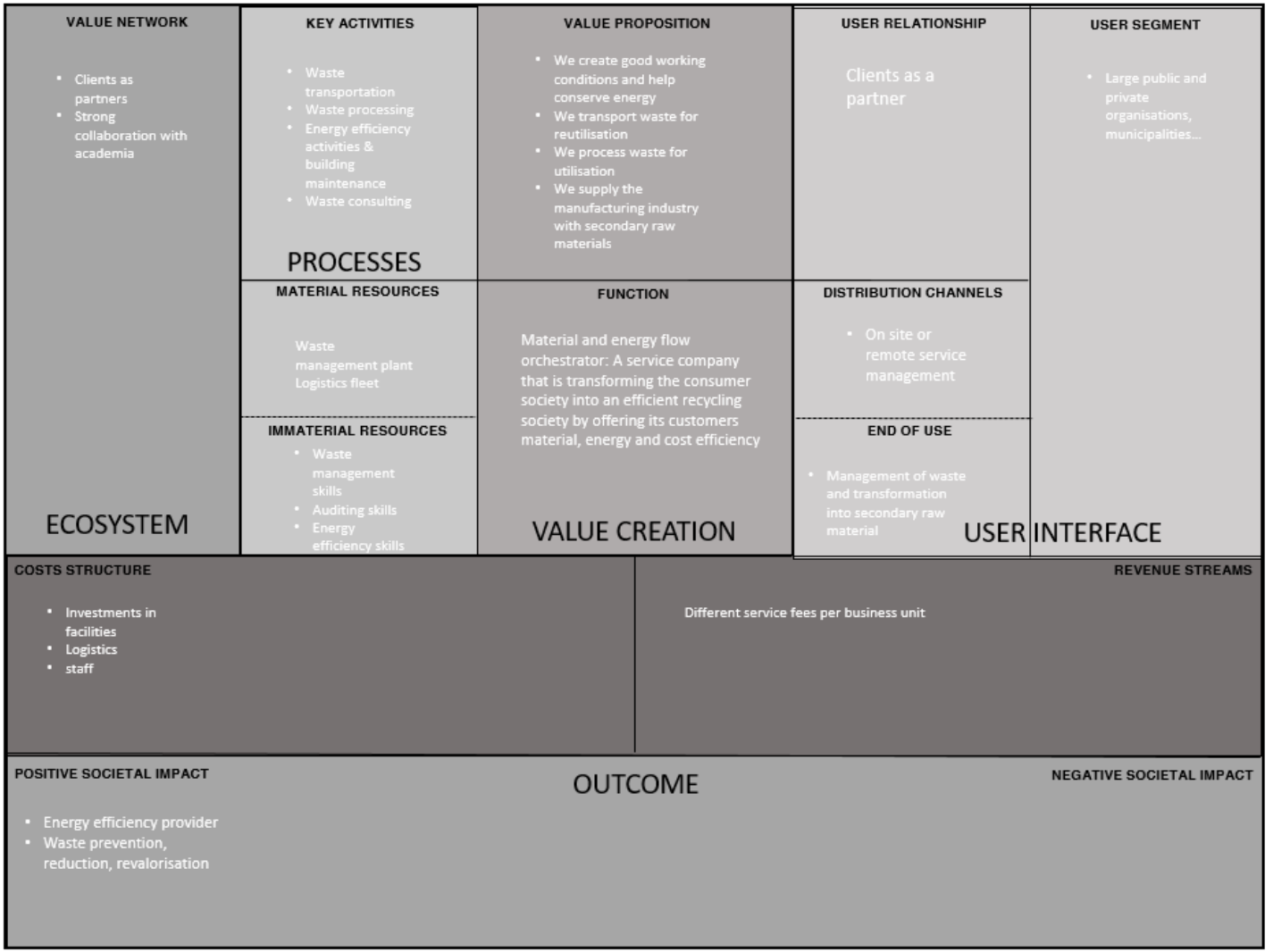


Figure 6: L&T business model

6.3 Nurmi, a sustainability-oriented clothing company.

The third case focuses on Nurmi, a Lahti-based clothing company which has put sustainability and circular principles at the core of its initial business model. The business model innovation taking place, shifting from selling fashion products to selling access to sustainable fashion design, is supported by the will of the CEO to push boundaries and become truly sustainable.

6.3.1: Emergence of the Nurmi concept

Nurmi creates clothes and accessories combining the Nordic tradition of minimalism and long-lasting design with transparency and sustainability. The label was established in 2010 by Anniina Nurmi, a trained fashion designer from Lahti Institute of Design. Being a conscious consumer in her private life, Anniina had soon been critical in her studies with the current industry trends in terms of unsustainability. After reading a book about long-lasting and sustainable industrial design, she realized that these same principles could maybe be adapted to clothing design as well. Combining two fields in which she was passionate about -clothes and sustainability- became a major driver to shape her professional life. After graduating in 2007, the designer gained experience working for L-fashion group, one of the biggest Scandinavian clothing company, owning brands such as sports clothing Ice peak, Luhta or Rukka.

In parallel, Nurmi's interest in sustainability kept on growing. The designer started to write a blog called Vihreät Vaatteet (in English: Green Clothes), compiling information she had read in books about sustainability in the clothing industry. Through that blog she gained a wide readership in Finland and a position as a trusted sustainable fashion specialist. Understanding more about sustainable clothing and willing to promote responsible brands, the blog turned into a webshop selling different responsible labels from Sweden or the UK. A year went by and the designer started to give lectures and teach about responsible fashion. At that time, she started to think: *"I write about other sustainable labels in my blog, I sell clothes made by other sustainable brands in my webshop but as a designer why wouldn't I test how I can develop a truly sustainable clothing label of my own?*" The revelation brought many questions to start developing a transparent brand: "*What kind of material should be used? Where should the clothes be produced?"*

Once established in 2010, the label started with a small collection, focusing on organic cotton dresses and accessories made of recycled materials. The production started in Finland, but soon given the rising amount of local manufacturers going bankrupt, it was decided to produce the

garments in Tallinn, Estonia. From 2011, the label started to design two new collections per year while still making the previous collections available to purchase on the label website. The materials used to design the clothes extended beyond organic cotton and included organic hemp, as well as a new denim partly made of organic cotton and hemp. The company also started to use more and more material from fabrics leftovers. Thanks to a small but steady growing activity, Nurmi started employing a sales manager and a web/logistics manager. The company, first selling online also opened a retail shop in Lahti to combine retail with a place to design and store the new garments.

6.3.2 Nurmi's business model

Nurmi's initial business model, before applying circular economy principles, had already integrated many sustainability aspects. The section highlights key elements of Nurmi's initial business model: value proposition, customer segments, value network, resources and revenue structure are highlighted.

A value proposition focusing on sustainable and long lasting slow design: Nurmi value proposition can be summarized around 'Less is more'. The label wishes to design garments that will last for a long time as the cornerstones of a wardrobe. The Nurmi garments are divided loosely into collections but many of the items continue their life also in the following collections. The design of a new collection is more seen as a continuous process where the existing styles are improved and the design of new items complements the older ones.

A community of eco-friendly customers: thanks to its strong sustainable values and its set of ecological clothes, Nurmi targets eco-consumers and retailers sharing the same philosophy.

A transparent and ethical supply chain: In terms of infrastructure, the materials used are sourced from many different countries around the globe: Turkey, India, China, Romania and Finland while the garments and accessories are produced locally in Finland and Estonia. When it comes to the supply chain, it's crucial for the company to know everything about it and in that respect, the information should also be shared with the customer. Following this requirement, the website is transparent about the list of its suppliers. Nurmi believes in the ethics of fair trade: as it is stated on the website, "*clothes aren't pretty if the people who made the clothes aren't treated well*". According the company values, all the people involved in the production process need to be paid fairly, have safe working conditions and reasonable working hours. Animal welfare is also of concern for the brand: the Nurmi products manufactured in

fall 2014 and onwards do not contain leather. The only animal-based material used currently is recycled yarn which contains recycled wool.

A diversified set of sustainable resources: Nurmi recognizes that the production of textiles always has an impact on the environment but wishes to minimize that impact by choosing sustainable fibres of high quality. The company uses materials that are produced ecologically and ethically but at the same time are durable and of high quality. The materials used are hemp, organic cotton, recycled fibres and upcycled deadstock fabrics. Organic cotton is cultivated without using synthetic agricultural chemicals such as fertilizers or pesticides. The production enhances biodiversity and biological cycles. The use of GMOs is prohibited. The organic cotton used by Nurmi is cultivated in Turkey and in India. All of it is certified by an external audit (GOTS, IMO). As Nurmi is aware that that the cultivation of organic cotton can be as water-intensive as conventional cotton, the label constantly seeks to find more ecological fibre alternatives and explores other material, such as hemp which became an obvious choice to have it in Nurmi's material assortment. Nurmi also uses recycled materials that are made 100% out of recycled pre-consumer waste. By using discarded waste as raw material of fabrics Nurmi aims to significantly reduce the environmental impact of the material production. Nurmi collaborates with Pure Waste textiles, a Finnish company which is responsible for the waste sourcing, processing, spinning and weaving. The supplier sources textile clips and yarn waste from clothing factories and fabric manufactures and cooperate with fabric manufactures specialized in producing recycled fabrics to make high-quality pure waste fabrics. Finally, Nurmi also uses leftover materials. There can still be found a lot of dead stock fabrics which are leftovers from Finnish textile industry. Rolls and rolls of fabrics which have been laying around for years in warehouses untouched. This material is used by Nurmi to create limited edition styles.

A traditional revenue model spread between designer, manufacturer and retailer: Nurmi's revenue model, if very transparent, remains standard to the garment industry. For the production of a cardigan for instance, 4% of the retail price is related to the cost of materials, 15% goes to the manufacturing. If the labels keeps a 20% share, another 40% goes to the retailer, while the remaining is VAT.

6.3.3 Drivers to implement a circular business model

Two main drivers can be highlighted in Nurmi's case. On one hand Nurmi's will to change is driven by the need to include more sustainability aspects to fit its values. On the other hand, the company is facing strong financial sustainability pressure and needs to explore new ways to generate revenue in order to remain on the market.

As Anniina Nurmi writes on her website, "*Sustainable clothes are not just about changing a material to be a bit less harmful or being able to produce a garment with a little bit smaller carbon footprint.* Following the Cradle to Cradle slogan "*Less bad is not enough*", Anniina has recognized that there is a need to change the way the whole fashion industry works. *"In order to be truly sustainable we need to think the whole fashion system in a new way: How to build a world where we cherish our garments, treat them as valuables and not disposable commodity? How to move towards a circular economy? How to build new ways to consume based on more than just on buying new?"* With these thoughts in mind, Nurmi started rethinking its current activities to explore how disruptive innovation could be used as a strategy to transform its industry. One approach materialised through the concept of a clothing library, explained in the next section.

Beyond the will to truly embrace sustainability values, another major driver pushing the company to explore business model innovation is the will to expand profitability, as the initial revenue model did not allow to create a sustainable profit to meet the growth objectives of the company.

6.3.4 Circular business model innovation: the clothing library

"I like clothes but I don't like my wardrobe to burst with excessive amounts of stuff. So what to do?" Starting from this customer statement, Nurmi explored possibilities to rethink the way we use clothes. How can we extend the use rate of clothes? Do we need to own them all? Could we rent a garment just as we rent a movie? In Finland, several bottom-up initiatives have been developed allowing to loan clothing in Tampere, Jârvenpää and Riihimmäki. These "libraries" are mainly operating online, functioning through dedicated Facebook groups. Nurmi though it might be interesting to combine an online approach with a real physical space – since the label had its own store in Lahti, this would not be an issue. How would a clothing library work if it was only developed by one label? As the idea of selling garment as a service fit the ethics and value of the brand aiming at being a provider of sustainable lifestyles, it was decided to test the

concept further. During half a year, the store dedicated a specific space for rentable garments and accessories. Based on a subscription mode of 30 euros/month, customer could access two different garments for two weeks at a time. The new idea created strong interest from the existing clients and allowed customers who did not necessarily have the money to buy new collections to access some items at a reasonable entry price. The experiment raised key issues to develop the idea further: *What happens if we spoil the garment? What are the washing instructions?* The learnings from the rapid experiment are still being processed by the store but created interesting insights on how Nurmi could operate in the near future. Several strategic changes are already acknowledged: the combination of physical and online access should be reinforced; a larger amount of items should be made available through collaboration with other local brands, partnerships with other actors in the product-service system should be implemented (with cleaning services providers for instance.). From a marketing perspective still, the experiment reinforced the brand image as really anchored in circular economy principles. It is yet to be implemented at a scale that can be financially sustainable.

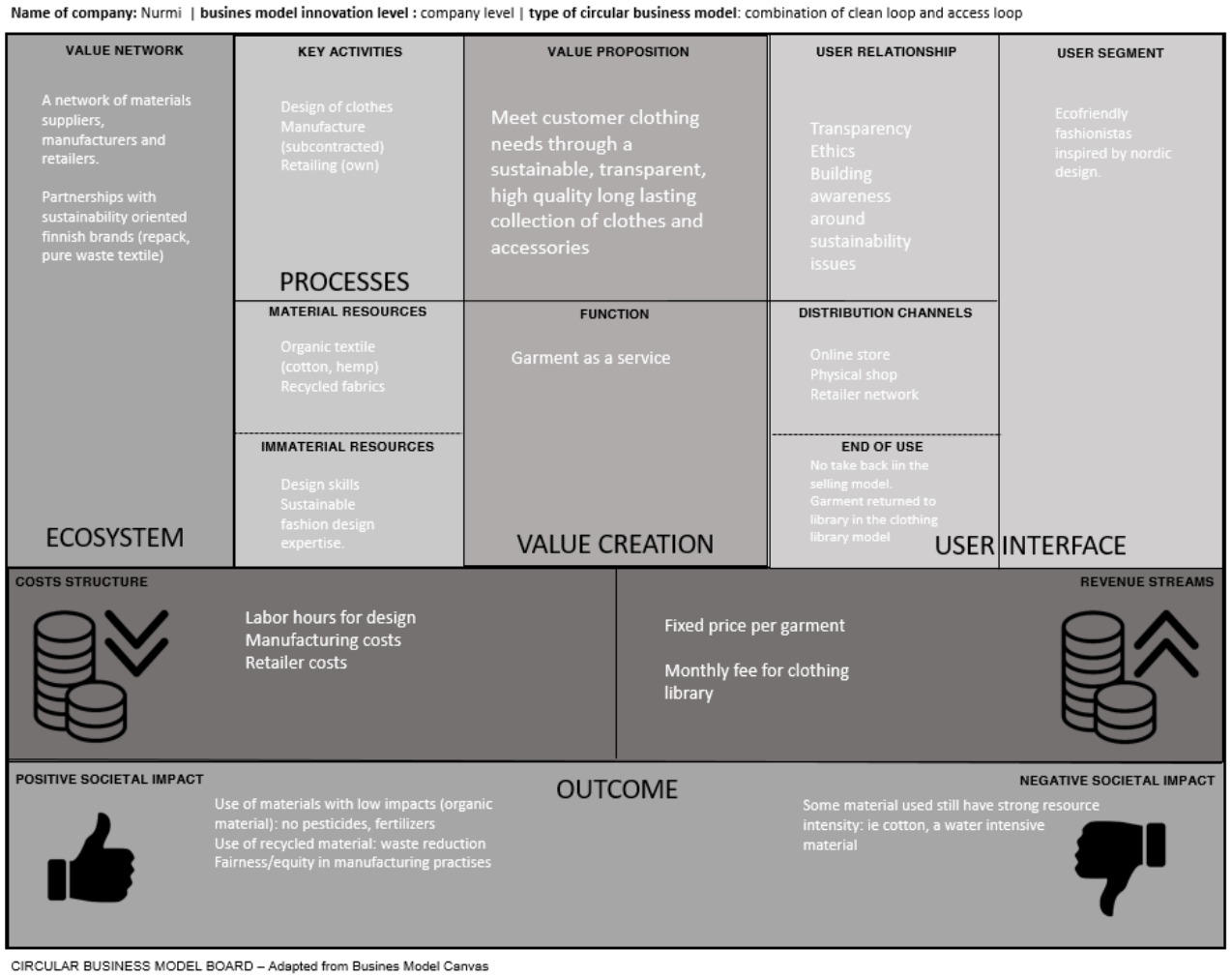


Figure 7: Nurmi business model

6.3.4 Barriers in the implementation of the circular business model

The clothing library experiment revealed many issues to be addressed when offering a circular solution in a B2C market. A central aspect is inherent to the customer benefits offered by the new solution. With respect to clothing, specific issues related to ownership and perception of used products (hygiene, quality) need to be clarified in order to offer a clear value to the customer. Anniina Nurmi is convinced that business models around renting/leasing will be growing, but companies might still offer in the transition phase the possibility for the customer to have the flexibility to choose around owning or buying or a combination of both.

Nurmi, as it is currently rethinking its entire concept, aims to move a step further. Even though the company has always had strong sustainability components, the founder believes that the company has still been operating within the given principles of the current fashion industry: the business logic of creating yearly collections, present new models at fashion fairs, meet the retailers… The new brand concept should explore the notion of long lasting clothing and rethink its value proposition around renting/repairing/reselling, to make it more circular.

"We have to focus on what the customer wants while still making sure it is profitable" notes Anniina. *"The new concept of Nurmi will maybe have more narrow collections, with less different styles and material, but a stronger focus on being attractive*."

Nurmi aims to transition from a customer niche of eco-friendly fashionistas to a financially sustainable international company. Another challenge for Nurmi today remains to keep its strong sustainable value proposition while at the same time scaling up to become a truly profitable venture. This will require the brand to extend its customer base to the less eco-friendly customers still interested in long lasting high quality Scandinavian design, while geographically extending the brand's presence to other markets. Nurmi will have to find a balance between the need to sell at higher volumes to generate enough profits while at the same time keeping the same consistency with regards to the use of sustainable materials and processes and pushing further the way the fashion industry operates.

6.3.6 Successful conditions for the implementation of the circular business model: key learnings

The Nurmi case highlights interesting learnings related to circular business model innovation: Innovation at system level, co-existence of circular and traditional solutions under the same value proposition and user-centred design are key aspects to take into account.

Transition towards circular economy needs to happen at multiple levels at the same time through the collaboration of actors in a network, to reach a certain plateau. In the case of Nurmi: to succeed in its transition, the company needs to adopt a system level approach to rely on other brands to develop a successful library concept, collaborating with companies having complementary skills. At the same time, the customer needs to be educated to new behaviour practises.

Co-existence of circular and traditional solutions: the clothing library experiment showed that product-service systems approaches can have a positive impact in improving the brand image but might not yet be financially the best solutions. Allowing customers to have the flexibility to choose both approaches (owning and/or renting) might be the best way to transition towards a circular economy: while reinforcing its image of being circular and sustainable, having a dual approach may allow the company to balance profits and costs in a more flexible way.

A circular value proposition designed with the user in mind: B2C transition offers stronger challenges when the new value proposition requires the customer to completely adapt its behaviour (the need to wash a clothes and return it, versus buying it and avoid the burdens of returning it). A user-oriented solution, designed to lower the barriers to change is a prerequisite to facilitate the success of the new model.

The next case highlights how a PSS approach (offering the use of a product rather than its ownership) can be handled with success.

6.4 3 Step IT: A service business logic towards circular economy

3 Step IT is a Finnish service company offering its customers a highly cost-effective, one-stop-shop solution for leasing, renewing and responsible disposal of IT assets. The company embraces the circular economy by offering an integrated IT service solution and creates value from IT usage rather than the sale of IT products. It also aims to close the loop by allowing used equipment to have a second life, once equipment is refurbished. The first section briefly introduced the company's historical development in the IT leasing sector.

6.4.1 3 Step IT: from leasing computers to offering an integrated it solution

Jarkko Veijalainen and Marko Sjöman founded 3 Step IT in 1997 under the name Computer Rental CR Oy. The current name was adopted in 2001 to reflect the company's business concept. The company initially focused on leasing and managing computers. The basic idea was to lease computers to companies and other organizations with competitive price and sell the equipment after the contract period. The general philosophy though differed from the traditional competition approach. In the leasing sector traditionally, unrealistic residual values[2] are often used as a way of reducing rental costs, which leads to customers making decisions based purely on cost and then being penalised for this at the end of the lease period. Lessors have for too long made end-of-lease management a prohibitively complex process in the hope that customers will simply give up and be forced instead down the road of either expensive lease extensions or having to purchase the equipment outright. 3 Step IT founders decided to depart from this traditional practice to bring more transparency and long-term thinking into the client decision-making. For a start, the management thought that costs should be transparent so customers can best compare the benefits of leasing over buying. In this way there are no nasty surprises and the customer always knows what the lease is costing. To follow on this distinctive approach, 3 Step IT didn't merely lease out hardware. From the very beginning, the concept covered the replacement and resale of computers after their lease period. Traditionally, 20% of the leased equipment is getting back to the lessor at the end of the contract. As lessors do not want to manage the end of life of the leased equipment, return conditions are often made very strict (obligation to use the same packaging material, fixed return date, etc...). Tapping into the

[2] *Residual value is the* future value of a good in terms of absolute value in monetary terms and it is sometimes abbreviated into a percentage of the initial price when the item was new.

economic potential of reusing the equipment if the process is carefully managed, 3 Step IT raised that level to 90%, making it a key component of its business model. Environmental performance and security, both for computers and mobile equipment, have very soon played a key role in the company's development. In 2000, 3 Step IT acquired Smålandsbörsen AB, a Swedish refurbishing centre for computers and set up a first refurbishing plant in Finland in 2005.

In the next section, a closer look at the company's business model highlights how the company implements its circular thinking.

6.4.2 3 Step IT circular business model: towards an integrated servitization of IT equipment

The following section highlights key elements of the current company business model. Value proposition, customer segments and relationships, value network, activities and resources, as well as financial and societal impacts are presented.

Value proposition: an integrated service solution with customer benefits and environmental value

Traditionally, companies either purchase IT equipment with cash, use an overdraft facility, or tie themselves to a lease agreement that forces them to use a specific IT equipment provider. According to 3 Step IT, both of these approaches can cause difficulties down the line. Paying for IT investments outright can cause organisations to keep equipment for longer than the life of their optimal performance, as there is often no set date for a refresh. Similarly, keeping equipment for a longer period may seem like a good idea but the hidden operational costs of extended warranty and support can be extremely high, and there can be other costs in lost productivity too. On the other hand, cash purchases will mean that the organisation will probably have to use a significant amount of its working capital to support a long-term investment in IT infrastructure, thus reducing the amount of working capital available for day-to-day use.

To avoid these challenges, 3 Step IT offers its customers a more transparent, cost-effective and sustainable way to manage financing, use and replacement of IT equipment. Through a flexible one-stop-shop approach aiming at saving the customer time by eliminating the hassle of working with multiple suppliers (IT sales, financing, recycling), 3 Step IT empowers its clients

by letting them be in full control of their budgeting and purchasing, making long-term planning much easier. 3 Step IT facilitates closing the loop in the IT sector: as a reseller of refurbished computers and mobile devices, the company extends the life-time of IT equipment that otherwise would be recycled or, in the worst case, simply thrown away. Before being sold again, the data on the equipment is securely erased, cleaned and tested at their refurbishing centres. Thanks to these centres, lifetime of IT equipment extended and the amount of generated waste is reduced.

Customer segments: large organisation with high IT needs: 3 Step IT service offering is aimed at large businesses and other organisations with high-volume IT needs. 3 Step IT customers include both public organisations and companies representing a wide range of industries and service areas. Public administration customers include municipalities and cities, municipal federations, universities, government ministries, public corporations and healthcare districts. Used computers after refurbishment processes are sold to a network of certified resellers. The company does not deal directly with end consumers.

Distribution channels and reverse logistics: *"Remarketing is for us an important core activity that distinguishes us from our competitors*," tells CEO Artti Aurasmaa from 3 Step IT. When designing the value proposition, the end of a lease has been an essential aspect to be considered. 3 Step IT, through its Remarketing unit offers services that allow asset disposal to be simple and hassle free. Adapted logistics services are provided to return the leased equipment at the end of the contract. 100% of returned equipment are accepted and transferred to one of the logistics centre of the company in Finland or Sweden. A remarketing online platform provides information on organizations willing to sell used IT equipment, and resellers willing to acquire the second-hand units. Resellers are scanned and selected based on specific conditions from the partner's program.

Key activities centred on life-cycle management of it products: 3 Step IT first set of activity is related to the Leasing of the IT solutions. Client choose their preferred IT supplier and the IT equipment they need, and 3 Step IT establishes a finance limit and leases the equipment based on the agreed term. Second key activities are related to IT management: the company collects all the necessary data on the client equipment and use it to create an asset register. The online asset management tool makes it possible for the client to track the leased assets, generate on-demand reports for cost monitoring and budgeting. 3 Step IT also deals with returning and replacement activities. Once the equipment reaches the end of its lease, the customer can notify

the company (through the asset management tool) on its future decision: Either the computer are bought back by the client, or then 3 Step IT arranges a collection. Finally, 3 Step IT manages activities around Refurbishing and resale of used equipment: after undergoing our thorough data erasure process, returned equipment is either resold (95% of equipment) or responsibly recycled (5% of returned equipment).

A value network constituted by partners sharing similar values: In order for its product service system solution to be efficiently implemented, 3 Step IT relies on an extensive value network. As 3 Step IT CEO, states it, "*It is not the end in itself that we invent and do everything by ourselves. We are continuously developing our service offering so that we can add value for our customers and make their everyday lives easier*." The company's ecosystem include finance providers, IT vendors, software companies and refurbishment and resale companies. 3 Step IT positions itself as a brand-independent service provider. By partnering with 3 Step IT, clients keep the freedom to choose the brands and suppliers that best suit their needs. The company also co-operate closely with its IT vendors to ensure a flexible delivery process, a smooth transfer of its management service and a smooth and effective replacement process at the end of the lease period. When it comes to ensuring the secure erasure of data from all returned equipment, 3 Step IT partners with Blancco Oy, a global leader in data erasure and computer reuse solutions. In order to securely erase all equipment data of its customers, 3 Step IT uses its own refurbishing centres in Finland and Sweden. In countries where they do not yet have their own refurbishing centres, they work with local partners. Sales of IT equipment for the secondary market are organised through authorised partners. Selected reseller partners are invited to join 3 Step IT partner channel programme, which rewards partners who operate in an environmentally and socially responsible way. One criteria is related to the capability of partners to attain relevant environmental certifications and who make every effort to ensure that equipment buyers are made fully aware of how to properly recycle their devices when they reach the end of their useful life. To ensure proper disposal of equipment that has reached the end of its useful lifetime, 3 Step IT only co-operates with ISO 14001 certified recycling partners.

An Employee-centric resource pool: As stated in its latest annual report, 3 Step IT regards its personnel as its greatest asset and competitive factor. The company strives to be a truly employee-centric workplace. According to CEO, "*We are united by our genuine desire to solve our customers' problems and produce true added value through our actions*". The focus on

employee well-being as part of HR policy resulted in the company being ranked among the 15 best work places in Finland and among the 5 best work places in Sweden.

Social and environmental impact as drivers for the company's success: *"Sustainability is our Business Model: At 3 Step IT, sustainability is much more than just a word. Our entire business model is built to support sustain able business practices within the company and develop a sustainable offering for all our customers."* According to 3 Step IT communication material, environmental, economic and social responsibility are at the foundations of the company's business model. 3 Step IT encourages open and honest dialogue between their customers and employees regarding both the way they conduct themselves as a business and the impact that has on the environment and the markets in which they operate. Concretely, throughout its operations, 3 Step IT aims to reduce the environmental impacts of unnecessary or improper disposal of IT equipment. The business model extends the life of equipment, thereby saving valuable resources and reducing carbon emissions. By making it easy and cost-efficient for our customers to return leased equipment, and by extending its useful lifespan by refurbishing and reselling it for secondary use, the company aims to save resources and minimise the environmental impact of disposal. At the end of its leasing period, 95% of returned equipment is refurbished and resold for a second life, with the remaining 5% – consisting of faulty equipment or equipment at the end of its useful lifetime – being responsibly recycled through its ISO 14001 certified recycling partners.

Environmental impact is also dealt with at internal level. Being ISO14001 itself since 2008, the company regularly evaluates its operations from an environmental perspective and aims to further develop them in order to ensure that it continues to operate in a responsible and sustainable way. The company is continuously developing its methods and processes with the aim of minimizing its impact on the environment. This includes packaging and transportation as well as the reuse and proper recycling of packaging materials. For example, 3 Step IT has developed its own environmentally-friendly packaging methods together with its logistics partner: the company uses recyclable or reusable packaging materials wherever possible, and also aims to minimise the volume of packaging materials used in our deliveries.

At social impact level, beyond its positive internal impact related to steady job creation and strong employees satisfaction, 3 Step IT, with the support of its network of used equipment retailers aims to provide affordable used equipment to educational institutions and markets where cost barriers prevent most consumers from having access to the latest technology. The

geographic selection in which computers are resold are taken into account. Most equipment is resold in Eastern Europe markets, and in specific East Asian regions. Operations in Africa have been reduced, partly because of the lack of proper recycling system in place. The figure below summarizes the business model of 3 Step IT

Name of company: 3 step IT | **busines model innovation level :** company level | **type of circular business model**: access loop and short loop

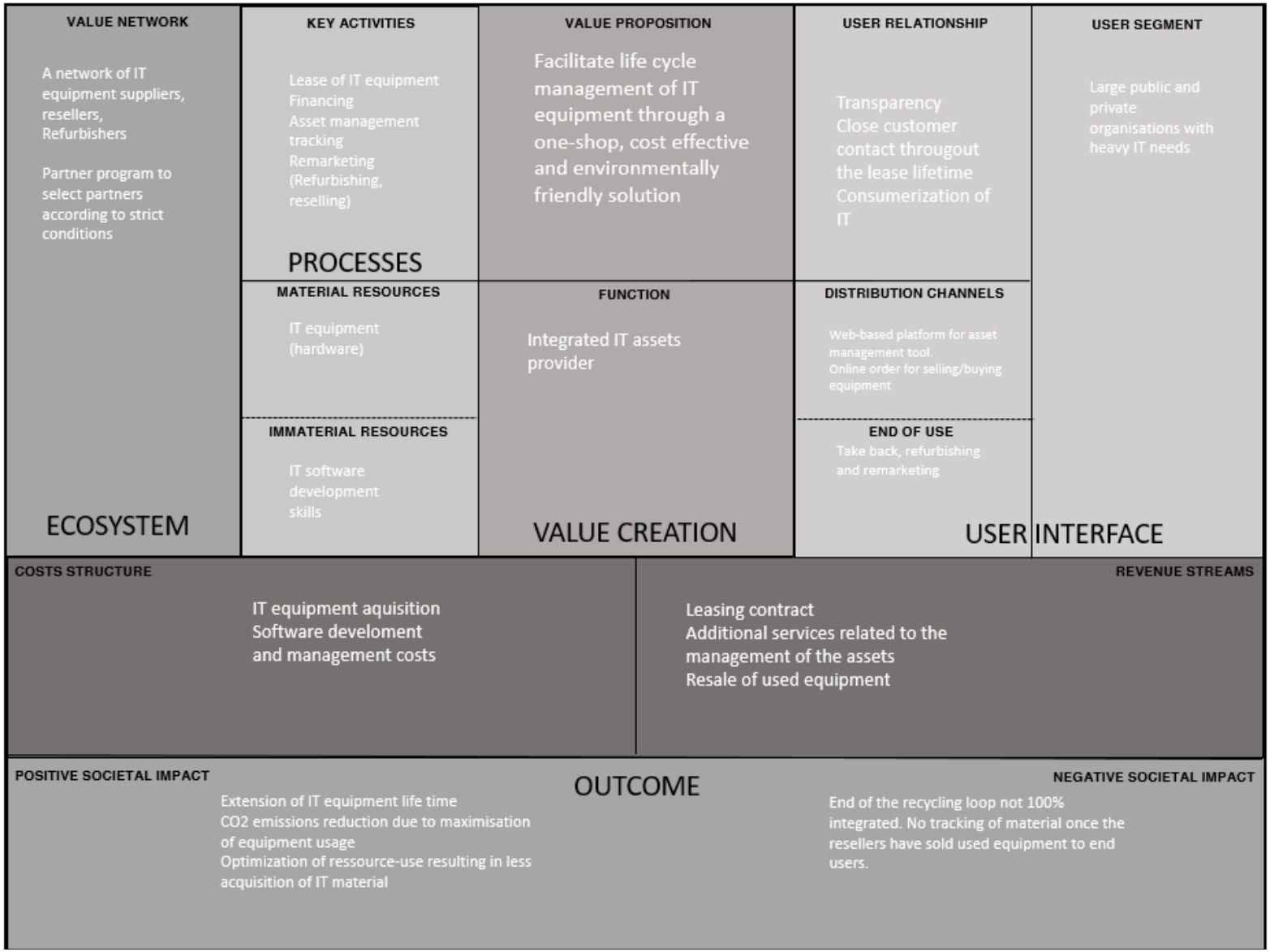


Figure 8: 3 STEP IT business model

6.4.3 Barriers in the implementation of the circular business model

The section highlights specific challenges faced by the company on the implementation of their circular business model. The challenges presented are mainly external: the customer's acceptation of the circular value proposition on one hand, and the IT gap between expectations and current practises.

Short-term thinking and price sensitivity: If the company is globally successful with its innovative business model, 3 Step IT is still facing challenges in specific markets. As the company is trying to educate its clients to life cycle thinking and total cost management, sales representatives are often facing difficulties in convincing customers to adopt a solution which, in short term perspective, may not be the more cost-effective (monthly costs being sometimes less competitive as residual value is handled differently than the competitors). In countries like the USA, in which the managerial culture is often short-termist (*"I won't be working here anymore at the next term so why should I care?*"), selling a long-term solution has proved to be more complex.

Internet of things is a long way ahead: The digitalization of economy and its related concepts (internet of things, internet of everything) is getting higher on the research and innovation agenda, and one should think that IT solutions companies should be the first benefiting from it. The contrast on the ground however is still colossal. Many companies managing a large amount of IT assets have no clear solution at hand to manage or monitor their equipment. They are not able to know the volume, the location or the actual use of their IT resources. If this gap can offer opportunities for a company such as 3 Step IT, it also provides strong challenges in educating the clients towards integrated solutions to manage IT equipment.

6.4.4 Successful conditions for the implementation of the circular business model: key learnings

Several conditions have helped the company to develop a successful business model compatible with the circular economy. At internal level, a multi-level approach to innovation, an effective use of in-house capabilities related to resource tracking and digitalization and the ability to export a business model in other sectors have supported the success of the company.

Innovation at multiple levels: When it comes to building new services, the company is unravelling a triple approach to move forward: at business unit level, company level and end user level. With "Launch and Learn" projects, individual business units are given the freedom

to innovate and develop their own new ideas and drive them forward, with group-level support for issues like systems development and marketing. The goal is to bring a stronger local flavour to the company services and further tailor them to the varying needs of customers in individual markets. One example currently tested internally is related to individual end-user behaviour related to IT equipment purchasing. In this internal project, virtual currency is allocated monthly to each and every employee in order to manage their IT equipment (laptops, mobile phones, accessories). It is up to the employee to decide how the money is used: employee can wait several months to save a bigger amount of currency to purchase a bit better equipment, or use it as soon as possible for a cheap small equipment). The innovation aims to get as close as possible to the end user, improving its personal satisfaction while removing some burden from the centralized IT purchasing department. On top of that, it provides 3 Step IT valuable data on end user behaviour (which brand is favoured at a certain time, which replacement rate is optimal, etc.…). From a group perspective, the company is actively gathering feedback from its business units about what their customers are demanding and searching for ideas that are common across our markets. These initiatives are then pushed forward at the Group level and new services development that can be rolled out globally. At the end user level, 3 Step IT aims to continue developing new services to empower end users by giving them more flexibility and allowing them to influence the leasing options based on their usage needs. At the same time, the company is developing the usability and functionality of its systems so that customers have complete control and visibility over their leasing budgets and asset register.

Effective use of in-house capabilities: In-house resources and capabilities at 3 Step IT have supported the emergence of new services and markets**.** Currently, 1.6 million equipment units are monitored in 3 Step IT asset management tool. In order to help customers manage their assets, the company has developed a tracking device, a piece of software that allow IT management team to monitor the use (and the non-use) of their IT asset pool. The tool allow the production of monthly or quarterly report giving valuable information to the client on the overall usage of its leased equipment. A set of equipment with no activity for several weeks can easily be tracked and help managers figure out why this equipment is not in use. With that information in hand, measures can be taken to reallocate the equipment, or adapt the leasing contract, therefore saving costs and create value both for the company and its clients.

Addressing the opportunities offered by digitalization: new business models in the circular economy are exploring how to optimize resource use, as witnessed by the booming number of

collaborative consumption and platform economy business innovations, such as Airbnb and Uber, to name the most popular examples. In these business models, the use of digitalization and smart algorithms allow to create new market places in which resources are shared or exchanged, resulting in a better optimisation of resource use. Following that trend, and tapping into the existence of its resource tracking solution, 3 Step IT is currently exploring opportunities to offer market place solutions in which existing leasing clients could transfer some of their unused equipment to others clients, allowing for a global resource optimization while offering savings to clients. Multiple use of the same equipment with one client is also explored: One Swedish customer, handling adult education at national level, has an IT equipment usage where IT needs are quite intensive only for short periods during the year. The solution offered by 3 Step IT is to lease the equipment for that short amount of time. Once the course are completed, the equipment is sent back centrally. The equipment is then restored to its initial state (the educational desktop being reinstalled) and resent to another location for another course. The service allows the educational client to avoid buying extra equipment that would be used only on specific periods, and thus provides substantial cost savings.

Exporting circular business model in other sectors: "*We see our third step, finding new homes for used IT equipment, as our key strength in terms of supporting the growing interest in the circular economy and sustainability in both the private and public sectors. Because of this, we are committed to developing our systems, tools and services to match the challenging demands of a more aware market*" writes the CEO in the company 2014 annual report. As the benefits of the circular economy are starting to be identified and explored further, 3 Step IT does not only look at improving its services, it also explores ways to adapt its circular model to other sectors. A pilot project currently underway is exploring opportunities to transfer 3 Step IT know-how on leasing and managing assets to a Finnish furniture OEM. The furniture sector shares interesting features with IT Equipment, as nowadays, office furniture may still keep a high residual value at the end of its first life. Metal structures and electric accessories (to change the height of the tables for instance) may easily be kept and reused while new wood elements replaces the used ones to make it look like new). Being aware of this, 3 Step IT can bring value to its furniture partner by transferring financing solutions and asset management tools to this new sector. Cross-fertilization of circular thinking throughout diverse sectors can be a source of new profit. The fifth and final case highlights how company can create value in a cascading approach.

6.5 Sybimar: designing food and energy circular solutions

Sybimar was founded in 2005 and is based in Uusikaupunkki, Finland. The company offers process equipment for food industry and energy sector and produce biofuels from food industry by-products. In the last years, Sybimar has developed extensive know-how in integrated fish farming and greenhouse farming, and now offers this circular innovative approach as a solution for land fish farms project developments.

6.5.1 Emergence of the Sybimar concept

Sybimar story is closely linked to its founder Rami Salminen, a problem solver aiming to create solutions to practical issues. The man had worked all his life in the fish farming industry. One challenge that stroke Salminen was the amount of waste generated by current fish processing practices. When processing fish, fish guts account for a large part and are generally left unused. Salminen took pride in solving that problem by looking at ways to reuse this side-stream. One option would be to use the fish waste to make biofuel, as fish guts contain a large amount of oil. This pushed the entrepreneur to launch Rovina Ltd in 2005. The company operated as a biofuel producer with the aim of providing sustainable solution for reusing side streams originating from the fish processing industry. In 2010, Rovina and Ramirakenne merged and started operating as Sybimar Ltd. As the company developed this waste to energy process, local companies from Finland and Sweden started to provide their fish waste. In order to treat the food waste, Sybimar developed specific units, allowing the waste to be shredded and acidified for preservation purposes. In order to maximize the use of organic waste, Salminen thought of developing a biogas plant next to the bioenergy facilities. A biogas plant would actually be useless if there is no way to utilize the energy next to it. Because of his background in fish farming, Salminen thought that developing a dry land fish farming facility could be a good way to use this locally-produced energy. As the bio oil produced with the fish waste is also usable in electricity and heat generation, Sybimar completed the scheme with a CHP plant. In 2012 the fish farming facilities (12 alevin tanks and 7 nursing tanks) were opened with an estimated production capacity of 400 tons a year. In order to reduce the amount of nitrogen in the water and lower the volume of water to be treated at the treatment station, the team of engineers thought of adding another element to the concept and designed a 2300 m2 greenhouse ready to grow lettuce and herbs, with the ultimate goal of becoming a giant bio-filter for the fish farm, using the nutrients and CO2 from the fish production as entrant to grow vegetables. Solving one challenge after the other, the closed circulation concept was born.

6.5.2 Closed circulation concept: showcasing the circular economy in the food and energy industry

The gradual development of food production solutions combined with bioenergy production allowed Sybimar to develop extensive know-how in closed loop production to become a Finnish showcase of industrial metabolism and circular economy in practice. Through its closed circulation concept; the energy solutions use and recycles waste, energy, heat, nutrients and carbon dioxide in energy and food production. The whole production chain is designed to be as carbon-neutral as possible and built according to local, prevailing conditions.

The closed circulation concept is based on maximized recycling. Combining of food and bioenergy production brings many advantages: carbon dioxide emissions from the power plant are directed to a greenhouse where the carbon dioxide is collected and used for enhancing biomass growth. Heat coming from the power plant is used in a fish farm for heating the water, and the nutrient rich waste water from the fish farm is again used for irrigation in the greenhouse. The organic waste coming from the greenhouse and the fish farm can further be used as bio fuel or raw material for biogas production. Heat and electricity are generated in a power plant that can use multiple types of fuel. The main source of energy is biogas which is produced of food energy side streams and other organic waste material. Also other types of fuel, such as animal or plant based fuels or wood pellets can be used as source of energy. The figure below illustrates the material and energy flows of the Sybimar.

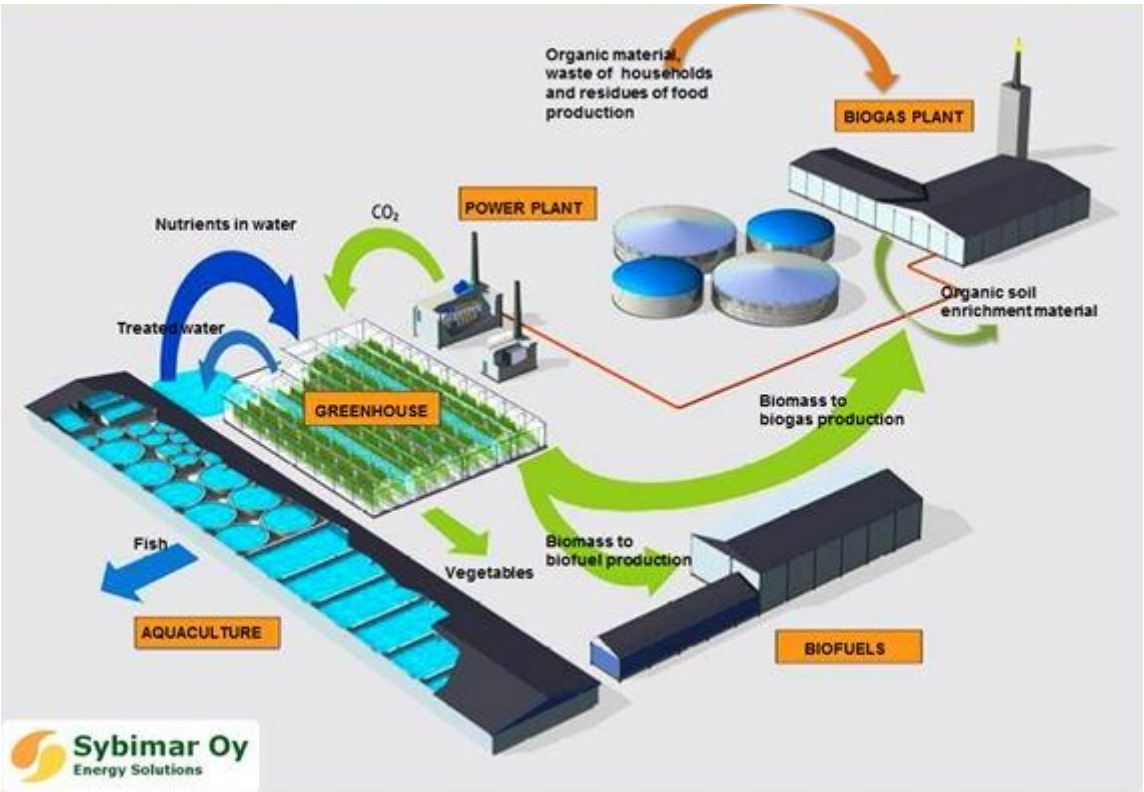


Figure 9: Sybimar circular concept

The closed circulation concept is soon to be applied in another Finnish project. Former Stora Enso's paper mill in Hamina will be used to develop a new fish farming facility producing 200 tons of rainbow trout a year. Synergies with Google data centre are foreseen to reuse the heat of the facilities.

6.5.3 Sybimar Circular business model: ecosystem thinking and cascading use

The section highlights key aspects of Sybimar business model.

Value proposition: Sybimar products help the fish farming industry to improve its performance by offering modular solutions that allow to create side revenues or reduce costs (transforming waste into energy). Dry land aquaculture solutions also allow fish farmers to grow fish all year long at regulated temperature, as opposed to sea farming which is limited to one season in Scandinavian seas.

A diversity of interconnected products: As of today, the company's offerings are divided into specific units: fish processing solutions are related to the production of dedicated processing equipment to be sold in the fish processing industry. The equipment and processing lines can be tailored based on the facilities available or the design can be built on customer's vision. Fish

farming solutions focus on fish production (white fish, rainbow trout) while bioenergy solutions include the production of bioenergy and the development of dedicated equipment to produce energy from organic waste. Finally, the sustainable solution, combines food and energy production into a unit where nutrients, water, waste heat and CO2 are recycled back to the energy and food production.

Customer segments: Customers segments vary depending on the solutions: the fish farming industry on one hand, the fish retailers on the other hand.

Value network: Sybimar has managed to position itself in a strong value network, through several win-win relationships with sister companies and other local companies. VG-Shipping Ltd, which specializes in crew and technical management of ships is managing the local bio fuel facility to produce its fuel for the maritime transport sector. Biolinja OY Uusikaupunkki is in charge of the biogas plant on site. The facility produce biogas from organic waste which can be used for electricity and heat production, as well as purified gas methane can be used as fuel for transportation. The plant uses waste from several neighbour companies, such as L&T, in charge of the waste management of the city who provides some of the waste to be used in the biogas plant, or other food waste providers, such as Hesburger, the fast food chain recycling its cooking oil on site. Local farmers also benefit from some of the side streams of Sybimar (used water being used at fertilizer for a carrot farmer).

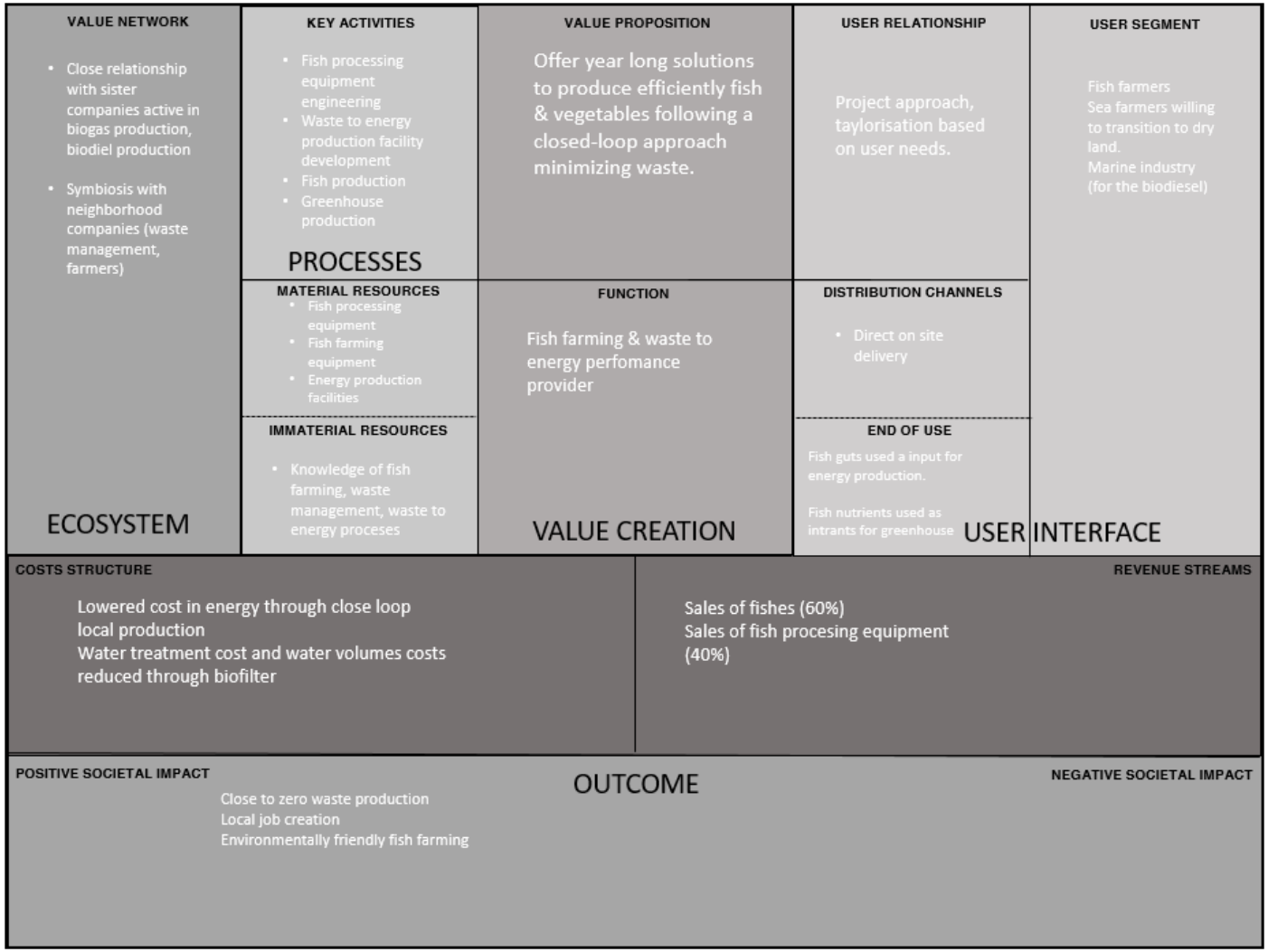
Resources: Sybimar business model is built on maximizing the use of local resources at hand: The biomass available in the neighbourhood is used to feed the biogas plant. The combined heat and electricity generated by the CHP plant is used in the farming facilities. Fish waste from the fish farm is used to generate biofuel. Used water from the fish farm is to be used in the greenhouse. The use of immaterial resources (knowledge of complex integrated projects of food and energy production, management of dry land fish farming facilities, waste valorisation) is translated into product offerings (from training on site to complex project developments).

Revenue streams: Currently fish farming account for roughly 60% of the total revenues from the company, while fish processing equipment account for the other 40%. The closed circulation process solutions are yet to generate profit.

Societal impact: Sybimar develops solution for recirculating aquaculture. Water is circulated by pumping it from fish tanks into cleaning units and back again. The method helps in saving

water, since the volume of new water required is only between 1% and 2% of the volume of the circulating water. Compared to sea fish farming, the volume of nutrient emissions is significantly smaller. With the development of the greenhouse action as a large bio-filter, the amount of water to be sent to the municipal water treatment plant is also reduced and the quality of the water to be treated is less charged in nitrogen due to the greenhouse. The solutions offered by Sybimar also help reducing the amount of waste generated by the food industry by offering ways to transform waste into energy.

Name of company: Sybimar| **busines model innovation level :** company level | **type of circular business model**: cascading loop



CIRCULAR BUSINESS MODEL BOARD – Adapted from Busines Model Canvas

Figure 10: Sybimar business model

6.5.4 Drivers to implement a circular business model

Several factors explain how the company has adapted its business model to a circular one.

Solving internal needs: The complexification of Sybimar business activities and its transition towards a circular economy business concept first came as a way to meet simple needs. First, Sybimar owner thought there was a need at industry level to find a use for fish guts. As the solution developed, internal needs emerged as well: with the energy generated at local level, the need came to use it internal processes, hence the fish farming production facilities. With the need to do something with nitrogen from the fish production came the idea of the greenhouse, and so on.

Anticipating legal change: In parallel with solving the growing complexity generated by the new circulation model, the evolution of the business model is also closely linked with the anticipation of changes in the legal environment of the company. As environmental permits are getting more difficult to get in sea farming environments as compared to dry land farming, developing aquaculture solutions that reduce environmental burden have been perceived as a key opportunity.

Alignment with resource and energy challenges: *"Climate change and our dependency on the diminishing reserves of fossil fuels require new energy solutions. The first and most important step is to reduce consumption. But we also need new forms of sustainably produced energy that will fulfil a significant part of our needs in the future.*" The introduction of the Sybimar circulation concept marketing brochure is clearly connecting the solution with resource and energy depletion challenges.

6.5.5 Barriers in the implementation of the circular business model

Several challenges are still faced the company. From selling complexity to actually create the business case to legislation burdens, the key issues to address by Sybimar are described below.

The challenge of selling "complexity": The transition of Sybimar to a complex integrated cascading circular business model did not come without bump. In fact, the company is still *"Battling around and fighting with different problems"* comments the R&D manager. One clear challenge that yet remains to be addressed is the "selling complexity" issue. The modular circulation concept, currently sold for fish farmers necessitates to be managed not only with

know-how in fish farming, but also requires advanced skills in waste management, energy production and greenhouse food production. Unsurprisingly, this ecosystem of complementary skills is rarely found in one client only. Fish farmers, as described by Sybimar manager, are hard workers, busy battling against the laws, and not necessarily willing to think outside the box and start complex operations in dry land, which necessitates new competences.

If the Sybimar concept has gained a lot of interest in the past year as a well-integrated show case of circular and bioeconomy, the company yet has to translate the award winning approach into a sellable package, appealing to new customers.

Building the business case: Yet, the solution offers great opportunities in terms of cost savings for operators, while generating interesting opportunities at local level for job creation opportunities (in the greenhouse facilities) and practical solutions for local waste and energy challenges. Aware of this, the company still needs to clarify its value proposition, by building a set of clear measurable advantages addressed not only to fish farming customer segments but also to other segments having a say in local economic development policies. At a business unit level, some studies are still needed to make the whole operations profitable. The greenhouse production for instance is estimated to be currently too small to be profitable, if the vegetables produced are sold to traditional distributors. Niche exploration (such as extending the cooperation with local food circles like REKO) are needed to improve the value of the food produced there.

Fitting into current legislation: one important challenge faced by the company relates to the slow pace in which legal compliance permits were delivered. As the concept is built on complexity and integrates different silos (waste management, food production, energy production) the time to receive environmental licenses in order to operate extended over more than a year, creating a strong financial pressure on the company.

6.5.6 Successful conditions on the transition towards circular economy

Sybimar has developed specific features that allowed it to facilitate its transition towards a circular economy.

Sustainability-oriented and open-minded values: Communication-wise, the company positions itself as a sustainability pioneer: "*we combine the old with the new, as we want to be a pioneer in sustainable food and energy production. We believe that long-term thinking and*

smart solutions made from local perspective, are the key to a clean food production and sustainable energy production". Without this long-term thinking approach, the company would never have been able to succeed in building a complex modular solution requiring time and experimentation. "*We cannot be best in all areas, some people will be better than us in specific areas, you need to gather and share*" remind the R&D manager. The company's capability to be opened, share information and build trust relationships with other local players can be perceived as key to design an integrated business solution that cross capabilities through sectors traditionally closed.

Experimentation and hands-on experience: Sybimar hands-on experience has been key in developing the various processes of the modular concept, all the way from handling the raw material to the oil separation technology and biodiesel production. The capacity of the company to build strong connections with the Finnish technical research sector (VTT) has been a key element to facilitate the design of the solutions.

6.5.6 Business model innovation perspectives

Reducing the leaks: from an internal process perspective, Sybimar keeps on exploring innovations to perfect its circular approach. As the greenhouse production is about to start at small level with lettuce and herbs, the company is already exploring opportunities to develop algae production in the greenhouse. The full implementation of the aquaponics approach (combining fish and vegetable production in a closed system) will require some extended trial and errors.

Towards functional sales: Circular business model innovation at Sybimar is not only focusing on internal processes of industrial symbiosis. The company is currently exploring innovative approaches to deliver its value proposition to fish farming customers. One current strategy, related to product-service systems business models, intends to sell the modular aquaculture concept following a functional result pricing model. In other words, Sybimar through a licensing approach, would generate revenue based on the fish production increase of its clients. The scenario includes taking a percentage of its client net sales increase based on the process modifications developed onsite. The scenario requires further study in pricing the overall solution and would necessitate pre-audits of existing client's facilities prior to contractualization. The business model innovation approach, if implemented, follows a growing

trend of companies exploring ways to generate value through servitization, in this case using extensive know-how in fish farming facilities optimization.

7. Findings

The cross-analysis of the five case studies allow us in one hand to reflect around the circular economy principles drawn from the theory to clarify how they are implemented in practice (section 7.1). The case studies also allow us to reflect on the proposed typology of circular business models (section 7.2). On the other hand, the outcome of the field work is helpful to construct a set of common features inherent to each circular business model. These similarities allow us to develop a first proposition towards defining the normative requirements of a circular business model (section 7.3). The outcomes of the research are synthetized in a circular business model transition framework (section 7.4).

7.1 Applied circular economy principles in the case studies.

A first research question of the thesis was to know if there is a gap between circular economy principles in the literature and their implementation in practise (*RQ: Which aspects of circular economy have been implemented?*). The field work brings relevant insights in terms of implementation of circular economy principles. Table 7 below highlights the degree of implementation of the circular economy principles for each company.

Table 7: integration of circular principles in the case studies

	Valtra	L&T	Nurmi	Sybimar	3stepIT
Design out waste	+	+	++	++	+
Use renewable energy	-	+	-	++	-
Think in systems	+	++	-	++	+
Waste is food	++	++	++	++	+
Cascading use	-	++	+	++	-
Act local	+	+	+	++	-
Think Performance	+	+	++	+	++

Legend: -: not applied | +: partially applied | ++: totally applied

The first assertion is that no single company has fully applied all principles as defined in the literature. This allows us to posit that currently, being circular can only be seen as an inspiration, as a journey, for which there is still continuous improvement to do.

Second finding, some principles seem to be more easily implementable than others. In the cases, the "waste is food" principle is the principle that is the most applied. All companies have in their business model the will to use resources more efficiently, and to transform waste as a potential resource for new product development, for refurbishment or reuse purposes. 3 Step IT recovers leased material at the end of the contractual period to refurbish it and allow new customers to reuse the IT equipment; Valtra recovers used gearboxes to remanufacture them and sell them as new equipment; Nurmi designs new fashion items from recycled materials; L&T core business is extensively based on the recovery of waste to be reprocessed, while Sybimar multiplies value creation using multiple side streams as inputs for other processes.

The "design out waste", which focuses on the use of materials that can easily be cycled is not fully applied in all organisations. Nurmi, designing clothes from organic material has a strong emphasis on this principle, and to some extent, Sybimar, recycling biological nutrients (fish guts). However, the distinction between biological and technical nutrients is not fully implemented for Valtra nor 3 Step IT.

The "use of renewable energy" is not perceived as a clear requirement for the interviewed companies. L&T and Sybimar, both active in the B2B sector, have to some extent a use of renewable energy in their business model. Other companies (Valtra, Nurmi, 3 Step IT) do not mention the use of renewable energy sources.

The "think in systems" principle is widely used by Sybimar as a best of class industrial symbiosis case, and to some extent by L&T, given its role of resource orchestrator. If Valtra and 3 Step IT have well understood their position and the need for strong collaborations with partners or retailers, their clear use of the principle is less central to their strategy.

The "cascading use" principle is similarly applied by Sybimar and L&T who managed to produce multiple value propositions from the same set of resources. Other companies do not fully use this principle.

The "think performance" principle drives the business model of 3 Step IT, as a product service system company. L&T by designing its value proposition around three customer benefits has

also started to apply the principle. The emerging consultancy services developed by the company to help customers turn their waste into new resources is also a step towards this direction. Nurmi, in its clothing library has also touched the principle, shifting from selling clothes to offering a modern clothing solution, but its PSS strategy at this stage is not yet mature. Sybimar is also exploring the opportunities behind performance contractualization but has yet to build its case.

The "act local" principle also has different degrees of implementation. At Sybimar, the symbiosis has clearly shown the value generated from using local resources. The approach strongly benefited the local business community. Sybimar also takes into account local biomass availability when setting up its projects. Valtra has generated local employment by extending its local manufacturing activities to the Reman processes. The Reman manager currently considers as a long term strategy to explore the possibilities of setting up local Reman units in Valtra key markets (France, Germany). Nurmi, by setting up a local clothing library in Lahti and by using used material from local textile manufacturers also explored the principle, even though some of its production is not locally developed.

If the companies are indeed implementing some of the key principles of the circular economy, each and every case could improve its "circularity" by addressing more closely the underlying principles of the concept. Nurmi for instance, could address the renewable energy principles when selecting new manufacturers as partners. When designing further its "clothing as a service" proposition, applying a "think in systems" approach could help the company improve its value proposition by creating stronger partnerships in its value network. Therefore, the principles behind the concept can be seen as constituting framework ("*Is the company part of the circular economy or not*?") but also as a set of strategic objectives to rethink new ways of operating the company's business models (*What new value could be generated if I applied this principle?*").

7.2 A circular economy business model typology somewhat porous

The literature review has offered several approaches to classify circular business models. One attempt was made to synthetize the various strategies into a five categories taxonomy (clean loops, short loops, access loops, long loops and cascading loops). The in-depth interviews revealed that most business models do not actually fit entirely in one specific typology. The cases were initially selected as to fit into one of the circular business model typology. However, the analysis showed that businesses combine different hybrid approaches when innovating with

their business model. Nurmi for instance, which has a strong focus on clean loops (using organic material) has been exploring how to shift its business approach towards access loop solutions (offering a fashion library in which the profits are generated from leasing clothes rather than selling them). Sybimar, a clear-cut cascading loop business model is also exploring possibilities to test a performance-based business model in which its solutions would not necessarily be sold, but only used, the profits being generated from a share of the improved performance of the clients (access loop). L&T, whose business model is primarily fitting the long loop approach (by dealing with waste processing at the end of life of products) is also exploring short loops opportunities (reuse of wood pallets) and access loops approaches. This hybridisation trend clearly shows that there is not a "one fits all" solution to apply circular economy in companies. Given the context and opportunities, companies may test and explore a combination of circular approaches that fit their distinct strategies.

7.3 Towards a normative circular business model

If no company is fully implementing all the principles of the circular economy, each business model analysed holds key features that allow us to draw a first set of normative requirements that should be present in all circular business models, as a theoretical construct. The normative requirements are described following the three main blocks of a business model: value proposition, customer interface and infrastructure.

Value proposition

A shared-value proposition designed to benefit all parties: At the centre of the circular business model is an extended value proposition. The value proposition in the circular business model helps customers doing their job in a more effective way - whether it is to drive a resistant and easily repairable tractor, manage IT assets in a stress-less way or access Scandinavian responsible fashion. Most importantly, it is doing so while at the same time reducing the societal impact of the good or service offered. This shared-value proposition is designed to benefit the customer, the company and the planet.

Customer interface:

The customer as a co-creator: In circular business models, the role of the customer - or user - is increasing: The customer bears more responsibility in the value creation either by creating

value through “use” (access loops), by acting as a future resource provider (long loops) or a value supplier (short loops).

Value is distributed and retrieved through a network of channels. Reverse logistics become a central tenet of circular business models.

Infrastructure:

Value creation is happening within network interactions. No “circular” business is an island. Companies operating in the circular economy do not function as separate entities. They rely extensively on their network to create value, whether it is for co-production, distribution or value retrieval.

Value creation is happening through the cycling of material resources in closed-loop chains. Resource maximisation, resource optimisation and resource recovery are driving value creation.

Value creation is driven by immaterial resources: knowledge workers uncovering their knowhow and skills are key to circular business models.

This first set of normative requirements constitute a first attempt to define further how circular business models can be defined. These requirements should be extended and confronted to the reality of the circular business models typology (clean loop, short loop, long loop, access loop, cascading loop). Managing circular business models successfully also require a set of capabilities that should be addressed systematically.

7.4 Implementation of circular business models and theory building

As the main objective of the thesis is to understand the drivers, obstacles and conditions allowing companies to implement successful circular business models (RQ: *What are the drivers and conditions explaining the successful transition of companies towards circular business models?***),** the following framework aims to synthetize the learnings by offering a comprehensive picture of the circular business model transition, including drivers of change, success factors and barriers, as well as a generic transition model. Each building block is discussed in the following sections.

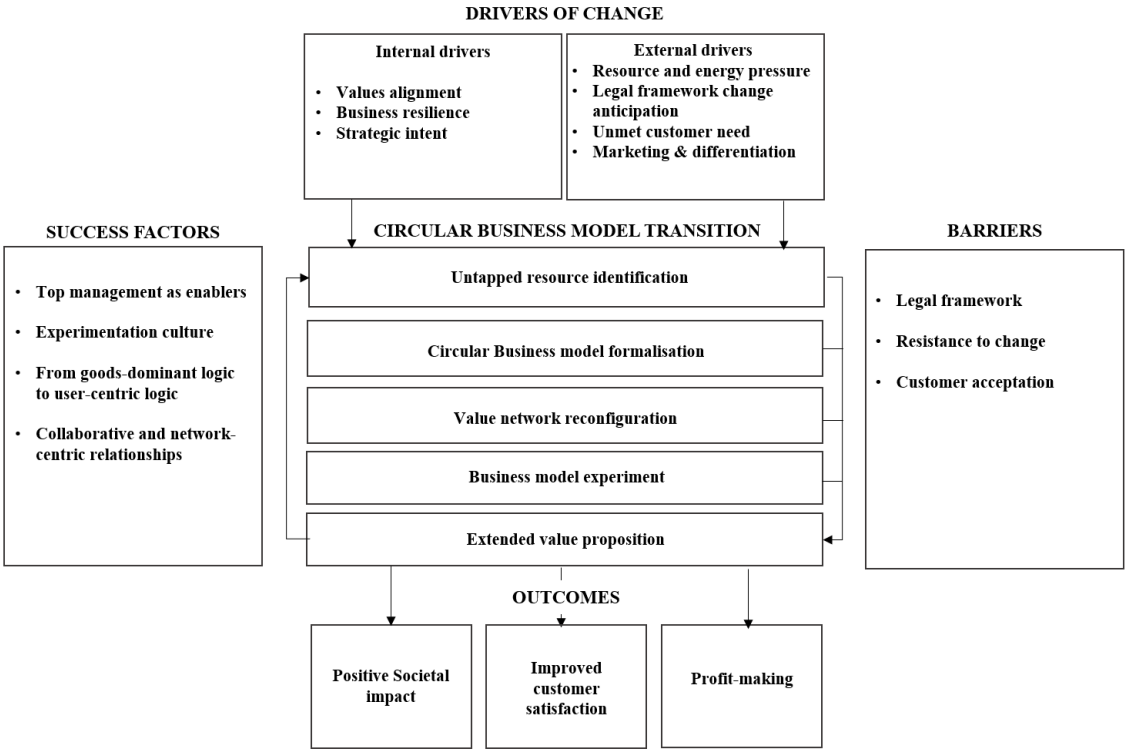


Figure 11: Circular business model transition framework

7.4.1 Drivers of change

When shifting to a circular business model, companies are driven both by internal and external drivers. The case analysis highlighted three internal drivers (values alignment, business resilience, strategic intent) and four external drivers (Resource and energy pressure, legal framework change anticipation, unmet customer needs, marketing and differentiation). The following sections first introduces the internal drivers before extending on the external drivers.

Internal drivers

The motivations explaining the shift to a circular business model are diverse. At internal level, one driver explaining the will to change is the idea of **Values alignment**. Operating in a conventional approach in which the concern for the impact of the products and services sold is lacking may create some tensions between the values of a company and its operations. In the case of Nurmi, a company strongly driven by the will to offer sustainable products, the shift to circular practises comes as a need to be even more sustainable (aiming for instance at zero waste practices). For Sybimar, who believes that long-term thinking and smart solutions made from local perspective are the key to a clean food production and sustainable energy production, developing a closed loop concept is a clear translation of their values into practical solutions.

In the case of agricultural equipment Valtra, offering a new set of options to ensure the equipment of the customer is working efficiently comes in line with the respect and reliability core values of the company. The circular business model development is also directly driven by the "own initiative" company value, which pushes employees to create initiative and innovation. 3 Step IT core values (honesty and openness, passionate and positive, learning everyday) can also justify their will to take full responsibility for the life cycle of the IT equipment used within their services.

Beyond the notion of values alignment is the **business resilience** necessity. Companies currently experiencing with circular business models are aware that business as usual may not be enough to remain competitive in the market. New business models offering extended value to the customers while allowing the company to reduce costs are becoming essential to face adversity and build resilience. 3 Step IT business model built on reusing equipment at the end of the leasing period offers a strong stream of revenues. L&T's portfolio of services are tapping into the financial value hidden behind reusing resources. Sybimar closed-loop concept was built with the idea of maximising the financial value of its side streams.

Shifting to circular business models may also be the result of a clearly defined **Strategic intent.** In the case of L&T, who now defines itself as *"a service company that is transforming the consumer society into an efficient recycling society*," implementing circular business models comes as a clear operationalization of its strategic objectives. Nurmi, currently developing its Nurmi 2.0 strategic concept, an approach aiming at disrupting the current fashion industry practises, will built its approach with the full circulation of materials as a core strategic

principle.3 Step IT, whose core strategy is “to invest in high quality partnerships” has understood how circular thinking can help in implementing this vision.

External drivers

Several external drivers can explain why companies are turned into developing circular business models. The **resource and energy pressure** comes as a strong driver for companies whose profitability largely relies on global prices of materials. Energy-heavy businesses who saw the prices of fossil fuels rising in the last decade have been the most sensitive to explore alternatives. All companies operating in the circular economy mention the global trends of resource scarcity and climate change challenge as a driver to adapt their internal processes in one hand, or offer their clients future climate-proof products and services.

Another driver in the external landscape may fuel the transition to circular practises. The **anticipation of changes in the legal framework** in which companies are operating often drives company to adapt towards circular practises. L&T, a company that has been very dependent on the evolution of waste legislation from the beginning follows with great anticipation the discussions at EU level with regards to the circular economy directive and its implications in terms of waste management. Experimentations around circular business models is a way for the company to meet the current and future legal perspectives related to the management of waste and resources. Sybimar, operating in the fish processing industry, has been anticipating more drastic environmental measures with regards to open sea aquaculture and therefore strategically developed circular solutions adapted to land-based aquaculture that will meet future environmental requirements of the industry.

Another external driver relates to the core mission of businesses to address **unmet customer needs.** Circular business models operating successfully in the market are able to identify an unmet customer need and respond to it by offering an extended value proposition. 3 Step IT facilitated the IT asset management of its customers, L&T helps customers manage their infrastructure and resources in a cost effective manner, Valtra extends the options offered to the customers when the need for repair occurs, Nurmi offers a solution to customers willing to be dressed with clothes designed and manufactured with responsibility in mind… Responding to what the customer wants is a clear driver to explore circular business models solutions.

Finally, from a marketing perspective, the need for companies to **differentiate from the competition** is also driving circular innovation developments. Circular economy business

models may offer a good storytelling to sell on the market (i.e. the innovation behind the clothing library concept of Nurmi).

7.4.2 Conditions for successful transition: success factors

The case studies allow us to define a set of specific conditions that drive the successful implementation of circular business models. The conditions are described in the sections below:

Top management as enablers

In all case studies, the position of the top management has been key to enact the transition. L&T circular transition coincides with the arrival of the new CEO in 2012, who carried a strong vision on the role of waste management companies in the transition to a recycling society. 3 Step IT founders were also leading the transition to a circular business model, making the recovery of material at the end of the leasing period a key strategic part of their business model. Nurmi CEO, has been strongly driven by her will to become a more sustainable business, and is at the heart of every decision towards circularity. If the higher management of Valtra was not directly at the origin of the new remanufacturing business model, the trust and mandate given to the Reman manager allowed him to build his business case. This Leadership with a higher purpose can be perceived key to initiate the transition

Experimentation culture

Business model innovation needs to be tested in almost real-life environment before being fully implemented. Rapid experiments allow to test some of the hypotheses of the new business model at relatively low cost in a timely manner. All case studies analysed here have been exploring new business models through a strong experimentation-oriented approach. L&T is fuelling its business model innovation strategy though open innovation (with the likes of "Hackatons") and rapid experiments in collaboration with academia. Nurmi participates in business model accelerators (retro smart ups accelerator programme) to test innovative business models (fashion as a service). Valtra started its remanufacturing activities employing one person working in one corner of the facilities and tested in real conditions how to make the new service profitable. 3 Step IT uses its own employees' desktops to experiment with new software solutions improving the services of its clients. Sybimar constantly improves its closed-loop concept by adding and testing new elements. This risk-taking attitude in which failure might happen but at low cost, seems to be prevalent in many circular business models.

From goods-dominant logic to user-centric logic

The analysis of the successful cases show that the transition to circular business models goes hand in hand with a shift of perspective at managerial level, from a goods-dominant logic to a user-centric logic. In this logic, the emphasis on the qualities of the products and services offered from the provider's point of view is replaced by a stronger focus on the user needs as the starting point driving the new business model generation.

This shift of perspective extends on the premises developed by Vargo and Lusch (2004) advocating for a transformation of marketing theory from a goods-dominant logic to a service-dominant logic. It is no surprise, as circular economy is partly built upon the new opportunities offered by servitization (selling a performance rather than a product) that the new business models are designed from a "value in use" perspective rather than a "value in exchange" approach.

L&T describes its offerings in terms of customer benefits, describing how its value proposition helps customers achieve their own objectives. Valtra followed closely its customer needs and developed its circular approach to offer better options to its customers. 3 Step IT strongly believes that by focusing on the customer experience, providing dedicated, expert support at every stage of the process they can change the dynamic of the IT leasing industry for the better. This shift of perspective supports the transition to more service-oriented business models in which the exchange of goods is not seen as the end goal of the business strategy, but a step to create value through a temporary use of resources (whether it is a combination of resources taking the form of a fashion item, or a computer desktop used during a leasing period).

Collaborative and network-centric relationships

No circular business is an island. No single company operates in a close system. Companies successfully operating in a circular economy have understood that new value creation is happening at the intersections between members of the same value network. This awareness and the managerial implications it entails allow companies to generate new value from a network-centric approach rather than solely rely on their internal capabilities. Valtra circular business model would not have been implemented without creating value for its network of retailers/distributors. L&T clearly realized that to pursue its growth it needs to rely on an open innovation approach, offering its infrastructure as a testbed for external innovations coming from partners or other emerging start-ups. Nurmi realised that to be successful in its clothing as

a service experiment, it would need to rely on other entities offering complementary capabilities to perfect its product-service system (from laundry services providers to logistics solutions). In the case of Sybimar, the circular concept only came to life because of the strong complementary skills that were offered by partner companies.

7.4.3 Barriers to the transition towards circular business models

The cross-analysis of the cases allow us to draw a set of barriers that challenged the implementation of the circular business models. Companies faced external barriers such as legal environment, or customer acceptation, but also internal challenges, such as resistance to change.

Legal framework enabling the transition to circular thinking

When designing circular business approaches, company may soon realise that the external legal environment is not necessarily ready to embrace the new concepts. Sybimar, when developing a closed loop system to circulate waste, water and energy, faced strong delays in receiving its environmental permits due to the higher complexity and interconnections of the solutions. These delays put strong pressures on the company and threatened the viability of the model. Similarly, L&T highlighted the disconnection between high political motivations to embrace a bio-circular economy at Finnish level and practical actions on the ground to facilitate the transition towards resource efficiency.

Internal resistance to change

Shifting to a circular business model often requires to change the dominant logic that has prevailed prior to the transition. When company L&T shifts its strategy and have an objective to help its consumers reduce the amount of waste generated, it may be seem paradoxical for many employees when the original profit making equation is based on the volume of waste transported and processed. Similarly, when Valtra offers a remanufacturing service to its tractor's gearboxes, some voices may rise up and fear that the circular services may cannibalize the traditional lines of gearboxes production. This internal resistance often appears when the new circular business model emerge while still traditional business approaches prevail (relying on high volume sales rather than on the value generated from a service). This apparent contradiction may be one of the biggest challenge to address if the company is expected to fully implement a circular approach.

Consumer acceptation to embrace the new value proposition

If within the case studies, the general awareness around the circular economy varies, it can also be pointed out that the respective companies' consumers also have a different acceptation related to the circular principles. The customer acceptation can be sometimes perceived as the strongest barrier to the transition towards circular business model.

Companies whose new business model require customers to change their current practices and behaviour are the ones facing the most resistance. In the case of Nurmi, exploring the business model of clothing as a service, major shifts are expected from the consumer: getting free of the notion of ownership related to clothes, learning new behaviour (from cleaning and restitution of used clothes) that may create strong barriers to adoption. In the case of Sybimar, if the value proposition clearly show interesting advantages from a user perspective (costs and resource savings, new revenue creation), the fact that is requires the fish farmer to master both new farming practises combined with waste management and energy production makes it hard to sell the solution to a unique customer. In the case of agriculture equipment provider Valtra, the new value proposition offers improved options for the consumer without creating more burden. The new model has therefore been easily implementable. Similarly, 3 Step IT, also added circular principles to its business model by improving customer relationships and offering more support, making the new solution attractive. Differences in the customer acceptation may be first related to the business model implementation approach (more or less customer-centric) but might also be related to sectoral differences, the notion of ownership for instance in the B2C fashion sector being more influential than in the B2B agriculture sector in which the products sold are first seen more as working equipment than identity building artefacts.

7.4.4 Managing the circular business model transition

The five company cases analysed allowed us to distinguish common drivers, success factors and barriers towards the implementation of circular business models. When looking at the transition pattern that have been taking place in the different cases, it is also possible to draw 5 key processes that define how the transition occurs.

A. Untapping unused resources

The first trigger to translate the external and internal drivers into an effective new business model is to identify internally or within the value network one or a set of resources that are yet to be untapped. In the case of Sybimar, recognizing that fish guts, a side stream of the fish

industry could be used to generate value is at the origin of the new business model. For 3 Step IT, considering the IT equipment at the end of the lease not as a burden to get rid of, but rather as a resource still carrying extensive value drove the business model of the company. Nurmi also saw value in using waste from local textile manufacturers, while Valtra identified in its operations that some immaterial resources were not yet fully exploited: highly skilled employees in repairing gearboxes could be at the origin of the remanufacturing business model.

B. Circular business model formalization

The translation of one untapped resources into a new business model constitutes the second phase. Depending on the context, the formalization can happen individually (3 Step IT), at collective level within an existing network (Sybimar), or with the help of external support (Nurmi participating in an accelerator programme, L&T and the support from academia).

C. Value network reconfiguration

The new business model may change existing relationships in the current external landscape. Some partners may become essential in the transition, while new partners may need to be added in the network. Nurmi, when designing its "clothing as a service" offering realised it should rely on new partners to complete its solution (adding a laundry services provider, or a logistics company for instance). The reconfiguration also necessitates to question its own position in the network. L&T for instance, when shifting its strategy to explore consultancy type of solution offerings, had to rethink itself as a partner of its clients, rather than a mere service subcontractor.

D. Business model experiment

Before being fully implemented, Circular business model innovation is generally tested at a small scale to validate the various hypotheses of the model: Nurmi tested its new service during a first six-months to get some iterative learnings. Valtra started its remanufacturing operation with only one dedicated employee. L&T used rapid experiments in R&D collaborations with academia and clients, while Sybimar developed its proof of concept internally before selling it to external customers. These low-risk approaches allow to assess the market potential of the solutions while refining the whole new model with interactions with end-users.

E. Extended value proposition

If the experiment is successful, the new value proposition is delivered to the market. The extended value proposition offers a triple outcome: improved customer benefits, positive societal impact and extended profits for the company.

In all cases, the process does not necessarily follow a linear pattern. Each new phase may feed the others in a dynamic approach. For instance, the new value proposition of 3 Step IT generated new capabilities in managing assets that are now seen as a new untapped resource to be deployed in other sectors. Sybimar new position in its value network as an energy provider offered the company new perspectives to offer integrated food and energy production.

8. Discussion

This chapter discusses the findings and extends the conversation with the existing literature on circular economy.

8.1 Awareness about the circular economy principles and concept as a whole

Even with cases clearly recognized as circular economy-inspired, the level of awareness around the concept and principles of circular economy varies. Data collection (interviews and other naturally occurring data) shows that the circular economy concept is either unused (Valtra) or exploited as a strong marketing gimmick (L&T). In other words: you can be a circular economy company without being aware of it.

Waste Management Company L&T makes clear references to circular economy in its marketing materials: CEO makes use of Ellen MacArthur foundation famous graphs and diagrams in its company presentations. There is clear mention and definition of the concept in the 2014 company annual report. The concept is used as a strong inspiration to present the company's strategy. At a personal level, the CSR manager interviewed is well aware of the recent publications around the topic and clearly knows the variety of existing circular business models.

Similarly, the CEO of Nurmi has a strong awareness of the concept, as shown in the company's marketing materials. When presenting its perspective on sustainability, Nurmi makes clear mentions of cradle to cradle terminology. The interview confirmed her strong will to explore further circular economy principles and business models.

On the other hand, implementing circular business models does not necessarily mean that the concept in entirely understood or mastered. At Valtra for instance, the term circular economy is not used as such in marketing materials and no clear mentions of sustainability can be found in the website. There is a shared awareness on the challenges related to the concept (resource and waste issues, climate change), and the advantages of the circular solution in place are mastered. However, the interview with Valtra Reman manager did not show a strong emphasis on the circular economy as a concept.

At 3 Step IT, if environmental and CSR arguments are highlighted as strong aspects to convince new customers about the relevance of the solution, there is very little mention to circular economy as a key strategic objective or a driver to operate. 2014 annual report mentions the participation of the company in several research projects highlighting the benefits of the circular economy.

8.2 Sustainable business model innovation and circular economy transition drivers

Are drivers supporting the circular economy business models different from sustainability business models? Several research (ie: Ernst & Young and GreenBiz, 2013; Grant Thornton, 2014) claim that customer and supply chain demands are the main drivers of the move towards more sustainable business practices. Other studies claim that while they appear to be important in exploiting the potential of business models for sustainability, customer and supply chain demand do not initiate the transformation towards sustainability (Rauter et al, 2015). Rauter et al findings, to a certain extent, indicate that the motivating factors behind the pursuance of business models for sustainability are personal, and value-based. They highlight the significance of company leaders in organizing change processes so as to encompass sustainable business practices. Other identified drivers according to Rauter et al include legal regulations, organisational culture, and coherence between corporate strategy and the business model for sustainability. For Kiron et al. (2012), internal drivers are related to operating cost benefits, revenue growth, brand integrity, effective internal champions, and organisational structures that help embed sustainability into business processes.

The results of the case study analysis did not prioritize the importance of each and every drivers, but highlighted that at internal level a combination of value alignment, business resilience and strategic intent support the will to innovate, while at external level, meeting unmet customers needs, anticipating legal changes and differentiate from the competition are the three key drivers pushing companies to innovate. At internal level, findings are thus in line with Rauter et al, with regards to the value-based motivation (Nurmi example), the coherence with strategic intent. However the present study highlights the importance of meeting customer needs as a driver for change. The majority of cases show that the circular business model were designed to improve the customer benefits (Valtra, L&T, 3 step It Sybimar) which as a consequence could increase business resilience. The findings here show that both internal and external drivers are connected and that a combination of all push the company to initiate the transition.

8.3 Circular economy: a complementary model or a real alternative?

The analysis of the cases highlighted different degrees of implementation of the concept. Some circular business models only come as complementary models of a rather traditional linear approach. Valtra remanufacturing process for instance, is a relatively small add-on to the

conventional business model of selling agricultural equipment and its profit share remains clearly below 5%, making it quite anecdotal. Sybimar, which has designed a best-of-class example of closed loop design is mainly making profits from its traditional line of products (selling fish processing equipment or fishes) and still struggles to sell its integrated circular package.

When the concept is applied more extensively (i.e.: Nurmi) and the business model position itself as a real alternative to the existing linear thinking, it is often meeting greater challenges. Nurmi for instance is forced to go in line with existing practices of its industry that push for fast consumption of fashion goods. When designing an alternative, the pressure from the industry is heavy and forces the company to find a balance between circular thinking and practical considerations (such as the necessity to meet enough volumes to remain financially sustainable).

These considerations allow us to question the concept and its possibility to be a true game-changer in our prevailing economic system. If the circular economy business models are fully compatible with existing processes, will they really be able to carry all their promises and invert the trends related to climate change, resource depletion and biodiversity loss? Or are we just experiencing the emergence of a new capitalism-friendly form of economy?

8.4 Bridging the circular economy gap: working towards a circular ecosystem transition

The findings in the previous sections highlighted that no companies was fully meeting the whole set of circular economy principles. One limitation is that even if one solution meets some circularity principles, the company does not have the full control of the life cycle of its offerings. It is indeed difficult to address the circularity of one company without looking at the whole system in which it operates. If companies may include strong circular economy features in their business model, the objectives will be far from being achieved if other actors in the system do not follow the same patterns. 3 Step IT, for instance, by actively seeking to retrieve leased material at the end of the contractual agreement with its clients, may help reducing resource waste, and similarly offer a second-life to used equipment. But once the used equipment is resold to its reseller partner, the company loses control over the resource flow. The new end-user acquiring the used equipment from the reseller may or may not manage the resource responsibly at the end of its second life, putting the circular pattern to an end. Similarly, Nurmi, when designing sustainable clothing from clean organic materials, may not achieve its goals if

the clothes are only worn once and then trashed by the final consumers. These limitations address the need to tackle circularity at a higher level, in which all actors of the system (i.e.: IT equipment system, clothing system), are participating in making the closed-loop objective achievable. The five companies interviewed in this research stressed the importance of their partner's network, whether material suppliers, retailers, distributors or resellers. Yet, the full circularity in each studied system is not fully achieved. This calls for transformation practices to be operated not only at individual company level but also at each company's system level. Literature on sustainable business model innovation has begun to address the concept through a value network perspective (Forum for the future, 2014, Bocken, 2014). The findings in the thesis highlight the relevance of such approach in addressing circular business model innovation.

9. Conclusions

This chapter summarizes the contribution of the thesis, highlights its limitations and suggests new research avenues to carry on the conversation.

9.1 Research summary

The thesis aimed to facilitate the understanding of the concept of circular economy by taking a business model perspective. The theoretical part of the thesis clarified the phenomenon of circular economy. It summarized the development of the concept from an historical perspective, highlighting that several principles have been implemented for several decades already. The theoretical review also helped clarify its position with regards to existing contemporary concepts (biomimicry, industrial ecology, cradle to cradle, blue economy, performance economy). As an overarching framework, circular economy relies on a set of principles borrowed from these existing schools of thought.

By taking a business model perspective on the concept, the thesis attempts to offers a first typology of circular business models (clean loops, short loops, access loops, long loops, cascading loops) It also uses an adapted business model construct to explain and analyse the cases.

Through the field work, the thesis extends knowledge on the understanding of circular business models at a practical level. It highlights the differences between the theoretical underpinnings of the concept (its principles) and its implementation on the ground, showing that there is a gap between the concept and the way companies implement it. The findings allow the author to discuss how circular business models are classified and shows that many hybrid circular approaches can emerge. The analysis of the common features of the cases on the other hand allow the author to draw a first set of normative requirements that define how a circular business model is organised.

The cross analysis of the cases allow us to draw a framework highlighting the current drivers at internal and external level pushing towards the circular economy, addressing a set of conditions allowing for the successful implementation of circular business models, while acknowledging a number of recurrent challenges preventing from a full implementation of the concept. At the core of the framework is set of key processes explaining how the transition occurs.

9.2 Practical implications

The results of the thesis may be useful for practitioners and researchers to help understand how circular business models are constructed. It offers a first typology to help companies position their business models on the circular economy map. It also highlights what conditions should be met if one company is to try exploring new circular business models.

9.3 Limitations of the study

It is acknowledged that findings and contribution to the literature are limited due to time and resource constraints of the thesis. A larger sample of companies per circular business model should have been used to validate assumptions at general level but also to draw specific features per circular business model.

One other limitation is related to the qualitative approach used in the methodology. No quantitative data can explain the relative success of each case in its journey towards a circular economy (from a financial perspective or an environmental one).

9.3 Future research avenues

The research around circular economy is still at an early stage and the present thesis only tackled a few issues that should be explored further. New research should extend the conversation between the theoretical underpinnings of the concept and its managerial implications. The section below introduces specific research issues the author believes should be addressed to extend the knowledge around this new business practice.

On circular principles: The set of defined principles should be challenged with a quantitative study among the existing cases study known in the literature to clarify how each and every principle is understood at practical level, and to what extent they are fully implemented. The result may help prioritize or classify principles and provide clearer connections at practical level.

On circular business model taxonomy: Can we create a comprehensive circular economy business model taxonomy that clarifies per business model category, the precise business model blocks involved, and for each business block the possible options available. The taxonomy should also help in understanding better the challenges addressed by each business model when being implemented.

On progress in circularity: one current limitation related to the concept if circular economy is its lack of measurement. Among the companies interviewed few had clear circular KPIs. How can we measure the advancement of circularity within each circular business model? Are there maximum levels in each business model (i.e.: Is remanufacturing as a business model financially sustainable over a certain percentage of turnover, or does it cannibalize other profit making units?) The same lack of measurement tools is also a challenge at meso level. How do we measure the progress towards a circular economy at a regional or industry level? Can science-based indicators be developed to clarify desired and possible levels of recyclability within each business model?

On transition processes: What management tools could help companies transition towards circular economy? How can we facilitate the circular business model generation and its translation into a clearly cut strategy? The strong focus on customer-centric logic highlighted in the successful business models suggests that design thinking methodology could prove to be useful when rethinking business models for circularity.

On business model innovation: Business model tools are often company-centred. The analysis of the cases highlighted that often, circular business models are designed within relationships at value network level. What tools and processes could help design sustainable business model at system level (from a multi-company perspective)?

On customer's role in circular business model: one of the biggest barrier to the transition towards a circular economy is related to the final consumer. How can barriers from the consumer perspective be tackled? This question should be addressed at sectoral level, with specific "customer segments" targeted to uncover how personal, cultural, social and psychological factors should be understood to create successful circular marketing strategies.

On marketing the circular economy: can 'circular economy' as a concept be used for marketing purposes? How can the integration of the concept of circular economy improve customer perception of a company?

With this thesis, the author hopes to have triggered new conversations between fellow researchers and sustainability practitioners. As the number of publications around the topic keeps on expanding in various journals, it is expected that strong theory building around circular economy will emerge and extend the current knowledge on this exciting area of business transformation.

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