Business Models for the Circular Economy:

Towards an updated library of building blocks and a CEBM typology

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Preface:

This Master Thesis is the product of a semester of dedicated research, under the supervision of Prof. Dr. Jan Jonker. This thesis was the most challenging piece of work I have ever written up to present. Circular business models got my interest from the selection phase, however throughout the research I was eager to explore and learn more about them. Before tapping into this topic I was not aware of what Circular Economy is about and I have been very sceptic about the purpose of the business models, since I considered it as a profit driven field. However after a series of challenging discussions with Prof. Jonker and an extensive period researching, got me realize that business models can paradoxically be the most critical tool for organizing and operationalizing collective action towards environmental and societal value creation.

This project would have never been completed without the help and support of some people, thus here I would like to express my gratitude to them. First of all, I would like to thank my supervisor, Jan Jonker for being supportive throughout my research. Jan provided me the opportunity to engage in this unique topic and broadened my perspectives. Thank you for your time, feedback and patience.

Finally, I would like to express my gratitude to my family and friends. Thank you for your trust and support throughout my studies.

Abstract:

Current linear economy in Europe is merely concerned with financial flow, without considering to preserve balance of societal or natural ecosystems welfare. The structure of the linear economy can be conceptualized within the so-called 'take-make-dispose' manner in which industrial systems convert raw materials into finished products that consumers buy and dispose at 'end-of-life' (Mathews and Tan, 2011). This linear model has two profound implications on the environment and society. First the creation of accumulated waste, that usually ends up in landfills and oceans and second it creates a societal dichotomy (i.e. producers and consumers) which disconcerts society from taking a collective approach towards effective resource utilization.

This dissociation of economy with society and the environment has stimulated the development of Circular Economy (CE) as a potential concept for enabling economic activity while minimizing environmental impact and increasing societal welfare. The concept in a nutshell enables a systemic transformation by closing technical material flows and designing ecological cycles that allow bio-based products to be returned in the natural world (GEO5, 2012; EMF, 2015). Nevertheless the implementation of CE entails a re-evaluation of societal values since almost by definition, its underlying philosophy is 'collaboration'. Therefore this paper, focuses particularly on value creation. Aligned with the theory of multiple-values of Jonker (2012) this study explores how the concept of CE can enable the creation of environmental, social and economic values simultaneously.

More specifically the study focuses on organizational value creation and incorporates the concept of the 'business model' as the unit of analysis for the process of value creation. Academics and practitioners that concentrate in CE have urged the need of a new breed of circular business models (CEBMs) that would incorporate the new logic of value creation of the CE. Within this context, a variation of sources including grey literature and academic articles have provided CEBM typologies that describe several categories of CEBM archetypes and operational practices – building blocks that emerged in CE. Nevertheless, concerning these archetypes and building blocks, two aspects were uncertain. First information about these building blocks and archetypes were spread between a variety of publications and their content (i.e. archetypes and building blocks) was mixed and often overlapping. Second it was unclear what is their function and value creating logic.

This research was aimed to address these issues. The study attempted to gather data from a limited number of typologies and business documents, in order to gain an inside of how CEBM archetypes and building blocks can enable the creation of multiple values. The results provide an inventory of nine CEBM archetypes and 25 building blocks that are classified and evaluated based on their potential to generate environmental, social and economic development. Moreover the study illustrates how different configurations of building blocks can enable organizations arrange the creation of multiple values in a collective manner.

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Chapter 1. Introduction

1.1 Generic Introduction:

Intensive industrialization and technological development has over the past century resulted into an exponential increase of use in global materials but also into a shift from an organic to a mineral (non-renewable) based economy (Krausmann al., 2009). This has in turn resulted into substantial pressure on natural systems, while the majority of the environmental problems we face today are directly or indirectly correlated to this unsustainable use of natural resources. Research shows that our society stretched the limits of the biosphere by drowning Earth's resources in a much faster rate than they can be restored or absorbed (Meadows et al., 2004). This, coupled with the increasing population which is expected to reach 9 billion by 2040 (WWF, 2016), the depletion of finite resources (e.g. minerals and metals) (Prior et al., 2012; EC, 2014), and the increase of water scarcity in many world regions (Schmitz et al., 2013) manifest the unsustainable and fragile nature of our current global linear economy.

In terms of social impact, research suggests that violent conflicts and humanitarian crises are to associated with, resource scarcity, unsustainable urbanization, extensive mining, the decreasing biodiversity and the unstable economic and social development (Scheffran et al., 2012). Further, the current economic system jeopardizes the societal values as it leads to individualism and a utilitarian culture (Passini, 2013; Beck, 2002 p34). These environmental and social concerns signify that the revision of our economic model is not simply an option to consider, but rather an utmost necessity.

1.2 Transition in the economy

In this context, academics and researchers from a plethora of scientific fields such as economics, environmental management and engineering, have expressed their interest towards the concept of the so-called Circular Economy (CE). The perspective of CE acknowledges the environment as the life support system for humans and other species. As such, CE places the economy as a market-driven solution to balance material flows of resources (Andersen, 2007). The concept of CE entails the integration of economic activity with environmental welfare in a sustainable manner. In other words, CE requires a systemic transformation aiming to integrate the economy with the environmental eco-system by closing technical material flows and designing ecological cycles that allow bio-based products to be returned in the natural world (GEO5, 2012; EMF, 2015).

Although CE as a concept has been present for decades, the application of CE is particularly challenging to implement. This is because the implementation of CE in a large scale entails a re-evaluation of societal values since, almost by definition, its underlying philosophy lies in 'collaboration'. The diversity of governmental, business and organisational models, as well as the plethora of institutional and technical requirements are often seen as a barrier to the flourishing of CE and usually redirect producers to perceive CE as an uneconomical relative to

the conventional manufacturing practices. The ability to move towards CE depends on a shared vision, the involvement of all actors and the implementation of effective resource exchange patterns. Therefore, the transition into a fully-fledged circular system requires, as a first step the fostering of the sense of interconnectivity.

1.3 The role of organizations in CE:

At EU level, various legislative initiatives are in the making, in an attempt to encourage resource effectiveness and achieve closed loops. Several ways were proposed in the Circular Economy Package by the European Commission (2015) including economic incentives to extend producer responsibilities and enhance eco-design, reduction, reuse, recycling, waste-management, and cross-sector collaboration.

The importance of these legislative initiatives cannot be undermined, however the key to the implementation of CE lies in a revision of our mentality and the alignment of societal values with sustainability (Preston, 2012; EMF, 2015; Sauvé et al., 2016). First, value creation in CE takes into account a systemic redesign that enables a continuous positive development cycle of resources. (EMF, 2015). Secondly, this systemic redesign could be perceived as a socio-economic phenomenon that requires the integration of new concepts and values within production and consumption systems that will be in line sustainable development (Andersen, 2007; Preston, 2012). As such, the implementation of CE relies to a large extent on challenging norms and values of societies and existing development pathways.

It is suggested that organizations play a vital role in the creation of values (Meyer, 2010). Organizations usually develop routines (i.e. repetitive patterns of behaviour and interactions) among organization members. The transition towards CE in Europe is still mainly driven through a market-based approach involving a bottom-up attempt by people that want to organize things in a different way (Jonker, 2013; Preston, 2012). In Jonker's (2012) view, the transition towards CE would require organizations to focus on the cultivation of 'multiple-values, a concept referring to the simultaneous development of ecological, social and economic values. Indeed, emerging organizations that adopted the concept of CE have demonstrated that the economic transition requires both the reshaping of existing dominant production and consumption practices on the one hand, and the engagement of multi-actor processes enabling the development of coalitions and networks pursue the systemic restructuring beyond the 'firm-level' on the other. In this sense, Organizations are expected to take the lead in incorporating the values of sustainability and the concept of CE at the core of their value logic.

1.4 Transition in the nature of Business Models

Over the past decade several purposed-driven organizations attempted to grasp the concept of CE by inventing practices that allow them to cooperate with external stakeholders (e.g. users, communities, manufacturers, distribution centers) and manage the maximization of

value creation. As such, the development of 'Business Models' is part of the Circular Economy and can be considered as a unit of analysis for the process of value creation in organizations (Bocken et al., 2014). The changing logic of value creation, has forced academics and practitioners to critically think about the limitations and deficiencies of the current established frameworks, practices and tools used to generate business models. By reviewing existing business model literature, it becomes apparent that most current frameworks and theories are focused around the 'value-proposition'. The 'value-proposition' is a term to describe a product or service offer that represents a significant value to a target customer group for which they are willing to pay (Amit &Zott, 2012; Allen, 2014; Chesbrough & Rosenbloom, 2002). Therefore 'value' for conventional business models is merely concerned with product and service exchanges while the 'value' generated has a separate meaning for producers and consumers. (i.e. for producers is increasing revenues, for consumers is fulfilling individual needs).

It could be argued that this core idea creates a conceptual separation of organizations and consumers leading to the linear 'take-make-dispose' manner. Organizations harvest resources and convert them into products through a linear production chain (value-chain). At the end of this value-chain, consumers buy the products which they subsequently dispose when they no longer serve their purpose. Therefore, two separate entities are formed, namely producers and consumers, both driven by different intentions, objectives and responsibilities. Consumers pursue the satisfaction of a need, while producers pursue the fulfillment of this need to maximize their 'returns on investments'.

Unsurprisingly, the 'take-make-dispose' model has led to corresponding strategies for businesses, such as 'planned obsolescence' and 'optimal durability' of goods, as a method to force customers make more purchases (Bulow, 1986; Waldman, 1996). These models have been traditionally dominant in the market and as a consequence implemented at the core of business models of numerous industries. By incorporating such notions in their 'value propositions', many organizations often implement deceitful practices such as promoting overconsumption. For instance, General Motors promoted 'the desire to own something a little newer and a little better, at little sooner than necessary' (Andrews, 2015). Yet, as explained above, the success of CE requires the development of business models, where sustainability and collective organizing top their value-creating logic, rather than straight-forward profit. This essentially requires a total restructuring of business models beyond their economic value potential.

1.5 Problem Statement – Research Gap

The interest in CE has lead to the quest for a new generation of equivalent business models, the Circular Economy Business Models (CEBMs). CEBMs are unique in the sense that in comparison with traditional business models, organizations have to take into account a circular product/service lifecycle which is at the same time compatible with the economic and social change in order to create new kind of values (Planing, 2015; Preston, 2012). This implies that new instruments and action areas are required to drive a new organizational logic.

A number of scholars explored how the theory of 'triple-bottom-line' (Elkington, 1994; Jonker, 2012; Willard,2012) can be applied in CEBMs. Generally speaking, the theory suggests that CEBMs can only be considered effective if they can deliver simultaneous 'multiple-values' (i.e. economic development, environmental enhancement and societal contribution). However, it is also important to evaluate how 'multiple-values' can be captured and delivered by CEBMs. The theory of the 'triple-bottom-line' has been excluded from traditional business model literature (e.g. Business Model Canvas by Osterwalder and Pigneur, 2010). In this sense, it is still unclear how CEBMs can function, i.e. what is their nature, scope or 'value-creating' logic.

Academics have so far attempted to identify a range of organizational practices that facilitates the incorporation of CE principles in their business models. For instance Stahel and Reday-Mulvey in their 1976 research report, '*The potential for substituting manpower for energy*' mentioned the importance to shift from selling product units to selling services as a mean to minimize resource consumption and emissions (Stahel & R. Mulvey, 1976). This could be seen as the root of the so-called 'servitization' (Tukker 2014; Baines, 2015), which demonstrates how organizations allow users to access product performance rather than buying products. Other examples of business practices referred in the literature involve take-back systems, the exchange of by-products and waste streams (industrial symbiosis) and eco-product design. These organizational practices that are focused in the practical implementation of CE, are referred in this research as 'building blocks'.

Furthermore the literature of CEBMs has been concerned with the introduction of business model archetypes (Bocken et al., 2014). In general archetypes describe groupings or 'configurations' of building blocks and solutions that may contribute to the operationalization of a certain type of Business Model. Each archetype indicates a certain 'value logic' to drive the utilization of resources accordingly. Archetypes can therefore be useful for accelerating the development of CEBMs in research and practice.

Potential projects that classify archetypes (typologies) of CEBMs in the literature include the Eight-Types of Product-Services (Tukker, 2004), closed-loop supply chains (Wells and Seitz, 2005); sustainable business model archetypes (Bocken et al., 2014) and business models for sustainable innovation (Boons and Ludeke-Freund, 2013). Nevertheless often these projects draw from the fuzzy perspective of corporate sustainability while they propose merely

normative requirements for business. Therefore they do not focus on CE but they involve general obsolete sustainability concepts such as 'lean production' and 'eco-efficiency'. These concepts have proved incompatible for the creation of 'multiple-values' since they interlock organizations into the conventional thinking of '*doing less bad*' (Dyllick and Hockerts, 2002; Jonker, 2012).

In a parallel mode with academic research, professional business consultants and analysts have also taped the subject of CEBMs. By harvesting business case studies they have attempted to identify and extract specific trends and business practices. Several research projects have been carried out by organizations such as *Green Alliance (2015); Accenture (2015); McKinsey-ReSolve (2015); Bakker et al., (2014); Kraaijenhagen et al., (2016).* These projects often introduce general archetypes of CEBMs but also a number of building blocks and configurations associated with each archetype.

However, by studying these projects, one can observe three things. First the terminology used varies extensively and second usually terms overlap. Third the content of building blocks in each project vary since their importance is subjective, depending on the interpretation given in each analysis. Therefore, the five projects can be considered as 'grey literature' since it is uncertain what is the 'value logic' behind each practice proposal. Therefore, there is still a need for unification of the various examples in literature and practice research through a 'bridging function' of the two forms of knowledge (Shugan, 2004).

Furthermore the perpetual generation of building blocks might indicate that CEBMs is a dynamic concept and can take several forms by acquiring or inventing new practices. However an assumption about CEBMs is that they allow organizations to configure and recombine already established building blocks and generate new CEBMs. Currently organizational developments in Europe are still lacking in implementation of CE practices. For instance a recent study carried out by SUN (2015), shows that CE and related technologies can improve mobility, food and build environment sectors the potential to achieve costs reduction by EUR 0.9 trillion in 2030. For this reason, it could be argued that CE can be seen as a new institutional phenomenon. Although it is still too early to make any predictions or statements about the future progress of CEBMs, it could be argued that the implementation of CE building blocks in new industries and contexts might lead to new archetypes of CEBMs or even the generation of new building-blocks that are yet not identified.

1.6 Objective and Research Question:

Transition towards a Circular Economy requires a new generation of business models based on a similar logic. Circular Business Models can be seen as the micro translation of the overall

concept of the circular economy. These business models enable the organization to create multiple-values. The creation of multiple values together with organizing closed-loops are seen as the two disguising characteristics of CEBMs. It is assumed that this breed of business models enables a transition towards the Circular Economy. In order to make this happen, the logic of Circular Business Models needs to be in line with the logic of value creation in the CE. Subsequently a dedicated set of building blocks can be chosen leading to archetypes of CE business models. However examples of these building blocks and archetypes from practice are missing. This research sets out to create an overview of building blocks and the underlying logic leading to specific configurations to support a particular value proposition. Within this overview, the thesis aims to address this central research question:

Which comprehensive typology can classify CEBM archetypes which are linked to building block configurations that enable the creation of multiple-values?

To address this central research question, the following sub-questions are formulated:

Sub-question 1:

- *What building-blocks and CEBM archetypes can be found in professional literature and 'practice'?*

Sub-question 2:

- *Which underlying value creating logics can be distinguished in these archetypes ?*

Sub-question 3:

- *How are these specific configurations based upon a Value Logic and related Building Blocks allow the creation of multiple-values?*

First it is important to investigate professional literature and empirical material in practice to identify what building blocks and configurations of business models emerged so far in CE. In theory several building-blocks are proposed, but do practitioners invent new ones? Secondly, this research attempts to explore what underlying values can be distinguished in each business model configuration. Several logics are applicable for the CE but it is unclear what is the purpose of each configuration. Finally the research attempts to explore how these configurations can relate suitable building blocks to allow the creation of multiple-values.

1.7 Scientific Contributions:

The concept of Circular Business Models is in its infancy in academic research. Several typologies have been developed to classify CEBM archetypes and building blocks. Researching CEBMs, it was observed that Building-Blocks are recognized as their underlying mechanism for value-creation since they allow the configuration and recombination of already established

operational solutions to generate new CEBMs. Yet there is a limited number of studies exploring the logic of value-creation behind the application of Building Blocks in CEBMs. Building Blocks may enable CEBMs to create multiple-values for the CE. This is not theoretically proven yet, and therefore this research fills a gap in knowledge. Moreover the research aims to provide a more comprehensive inventory of building-blocks.

1.8 Practical Relevance:

Broader Society:

According to Andersen (2007), there is a variety of benefits that may arise in a society from the implementation of CE practices such as the creation of jobs, reduce the risk of resources scarcity (which are often the cause of conflicts), reduces the quantity of spoil up to 75% in terms of energy, water waste and emissions, create valuable products and services that do not cause environmental impact, and it reduces corruption and unethical practices as it enhances transparency and the practicality of supply chain audits.

An assumption is that business models could play a vital role in the exchange and spread of business practices across organizations (Gassmann et al., 2013). Understanding the nature of these circular business models would therefore enhance the legitimization of those practices and contribute towards a broader adoption.

Future Entrepreneurs:

Bocken et al., (2014) suggested that the development of business model archetypes may facilitate the experimentation and implementation of sustainable business models in practice. Nevertheless, there is also a need to ensure that entrepreneurs can critically evaluate the logic behind any suggested business practices. Therefore by demonstrating examples of evaluations of existing projects, one can practically understand how to make their own judgments about the impact of adopting 'building-blocks' or CEBM archetypes. In addition the project delivers a more up to date inventory of 'building blocks' which can be used in a 'mix-and-match' approach to configure CEBMs in new industries, products, services and environments.

1.9 Thesis Outline and Research Method:

The Master Thesis is divided in Six Chapters:

1. The first chapter involved an introduction which elaborated the background of the research and formulated the research questions.

2. The second chapter aims to discuss the transition towards a Circular Economy. Furthermore, the chapter elaborates what a business model is and how its 'value-logic' might be synchronized with the two corresponding economies. (i.e. The differences of Conventional Business Models with Circular Business Models). Finally, at the end of the second chapter the study explores the relevance of Building-Blocks with CEBMs and proposes the configuration of Building-Blocks in the light of a value-logic.
3. The third chapter elaborates the research methodology which aims to identify CEBM archetypes, building blocks and configurations through a two-fold approach - professional literature review and business document analysis.
4. The fourth chapter aims to present the findings that emerged from the two-fold study and present the CEBM archetypes, building blocks and configurations that were identified in the professional typologies review and document analysis. The chapter will also discuss the decision making process for the selection of building blocks and archetypes and present findings that could explain their value creating logic.
5. The fifth chapter analyze and discuss the potential of the identified CEBM archetypes, building blocks to create multiple values based on the findings presented in the previous chapter. In addition a typology will be established which classifies CEBM archetypes and related configurations.
6. The final chapter draws final conclusion, which summarizes the answers to the research questions, an evaluation of the overall research and directions for further research.

1.10 Chapter conclusion

The first chapter has presented the background of this study. Corresponding literature and relevant studies have been introduced to identify the gap in the research. Furthermore the chapter discussed the objective of the research, the problem and the equivalent research sub-questions. The scientific and practical relevance were also clarified. Finally the last section provided an outline of the project. The following chapter aims to explore the theoretical background of the economic transition and the changing logic of value creation.

Chapter 2. Economic Transition

This chapter aims to formulate the theoretical background that this research is based. The chapter is divided in two main themes – subchapters. The first subchapter discusses the transition from linear to circular economy. The second subchapter explores the changing logic of value creation that could support the economic transition. At the end of each subchapter a

separate conclusion is given. An overall conclusion would be given at the end of the chapter aiming to relate the two concepts and examine how the value creation theories can relate to the CE.

2.1 From Linear to Circular Economy:

In this subchapter, the structure and deficiencies of the current linear economy are discussed. Followed by a section that aims to explore the Circular Economy, its roots, its definition and its fundamental principles.

2.1.1 Linear Economy:

Current linear economy in Europe and human industrial systems are merely concerned with financial flow without considering to preserve balance of societal or natural ecosystems welfare. The industrial system was defined as 'a functional area where technical transformation processes convert raw materials into finished products within a value chain' (Doll and Vonderembse, 1991). Economic orthodoxy assumes that at the end of this 'value chain' the market mechanism is lined up, being the second main entity that is responsible for the economic activity. The market can be conceptualized as the mechanism that provides signals regarding resource utilization (Gregory and Stuart, 2004). The interaction between the market and industrial systems determines how resources are going to be turned into commodities for consumption. Of course economic systems can be complex systems comprised by various agents and can vary based on the government system (Ostrom, 2009). However, for the purpose of simplification and generalization this thesis explains the most basic interaction of the two main entities for resource flows (i.e. industrial systems and market mechanism).

This basic structure leads to the so-called linear economies which is a term used to illustrate the conventional model of *'take-make-use-dispose'*. Organizations are converting inputs (resources) into products that consumers buy and dispose at 'end-of-life'. The whole economic system is based on consumption and a 'throw away culture'. It is estimated that, if everyone on Earth lived with the average lifestyle of a European citizen, humanity would need 2.6 planets to sustain our resource demands for economic activity (WWF, 2014). This material worldview has conditioned society to constantly seeking to capture individual satisfaction by acquiring more and replacing products before they even fail, perceiving that the new is better (Ianole and Cornescu, 2013; Cox et al., 2013).

The increasing consumer demand has stimulated the adoption of neoclassical economic principles of the 'market', perceiving economy as a 'self-containing system' comprising of consumers whose needs are awaiting fulfilment (Simanis & Hart, 2009). Therefore, to keep up with the increased consuming demand, competitive practices were spread among producers. The outcome was the introduction of toxic materials seeking low cost thrills, shortened product life cycles and aggressive strategies to increase volume sales (Iwaarden and Wiele, 2012). This indicates an economic 'rationality' that contributes to the development of high-

throughput systems and extractive industries that manage resources ineffectively, neglecting sustainability.

Accordingly the economic activity has been delinked from society and the environment. The open-ended structure of the linear economy, lines up the three main entities natural environment, producers and consumers which they have different, unstructured and unaligned functions and responsibilities (i.e. producers to convert natural resources into commodities and consumers to consume). Nevertheless this linear structure of the economy overlooks the fact that the three entities are interconnected (Giddings et al,. 2002). First the physical reality suggests that the economy depends on society and the environment for the provision of natural and human resources. Secondly, society and human life depend on the natural world for the fulfilment of basic material needs (e.g. food, medicine, air, water) and energy. Thirdly economy is merely seen as a 'subset' of society to 'enable' social relationships and better information flows for the exchange and production of goods; without society there is no economy (Giddings et al., 2002).

The current linear economy fails to acknowledge this basic interconnection and instead of functioning as a system for better resource utilization and allocation amplifies the occurrence of adverse effects in society and the mistreatment of nature. It could be argued that the current linear economy structure leads to a conceptual separation where producers and consumers are driven by different intentions, objectives and responsibilities. Consumers are pursuing the satisfaction of a need, while producers are striving to fulfil those needs while maximizing their returns on investments. Therefore the linear structure does not inspire a collective approach to utilize and manage resources efficiently and effectively.

As a consequence, at the other end of this overconsumption and production trend, is the amount of waste and pollution that is generated. The average amount of waste generated in EU-28 for 2015 accounts for almost up to 5 tonnes per citizen, of which the majority to be mineral waste (Eurostat, 2015). Only a fraction is recycled while the rest usually ends up in landfills and oceans, causing hazardous risk for human health and the environment. Increasing recycling processes could be one solution, however the fact that recycling is energy and labour intensive and not applicable for all materials (Allwood, 2014), calls for a more conjunctional and systemic approach to be taken.

2.1.2 Emerging transition from a linear to Circular Economy:

A potential concept that could support an economy to continue activity while minimizing environmental impact and increasing societal welfare is Circular economy (CE). The concept of CE pursues a preventive approach towards waste by choosing 'resource-loops' (Greyson, 2007). CE can be traced back to Industrial Ecology's (IE) philosophy, and builds on the notion that the industrial systems and the environment are interrelated systems and must be seen as a whole entity rather than two separate systems (Yuan and Tilley, 2006; Ghisellini et al,

2015).Relating this theme to the general systems theory, all 'industrial systems' can essentially be portrayed as systems that convert natural resources into commodities for human needs (Lowe and Evans, 1995). Therefore IE considers how the industrial systems interact with the environment as it malformed material and energy flows.

Additionally, the performance of the 'industrial system' is dependent on the functionality of the 'ecological system' since it provide resources and services while the 'ecological system' declines when the 'industrial system' infringes the constraints of the biosphere. This 'systems based' perspective encouraged the multi-disciplinary fields of IE to explore ways that would allow the transition from fossil-based and polluting industrial systems into integrated 'eco-systems' where 'production and decomposition are waived with nutrients that are recycled incessantly to support the next cycles of production' (Gibbs and Deutz, 2007; Lowe and Evans, 1995). Nevertheless, it is important to note that the concept of IE is focused on the establishment of efficient industrial processes within 'eco-industrial parks'.

Circular Economy goes beyond the production element and conceptualizes a more holistic perspective on the economy and sustainable development by acknowledging three levels of activities (Murray et al., 2015; Giurco et al., 2014). First the single organization and the firm-level activities for cleaner production. Second the supply chain level and the development of inter-firm clusters and the establishment of industrial symbiosis and third the participation of entire cities, municipalities and people in the organizational processes to activate industrial metabolism (i.e. integrated connection of waste producers (consumers) with the production system). CE not only transforms the production processes but also requires the transformation of consumption patterns and stronger involvement of citizen initiatives to eliminate waste and sustain the value of resources. CE dissents from the conventional premise that the economic system has to be 'open-ended'. Instead CE suggests that organizations need to identify which material and resources flows and which recycling options would have the minimum impact to the eco-system and provide the maximum benefits to the economy and society(Andersen, 2007).

Even though there is an ongoing discussion about the risks and general implementation issues of CE, which can be found elsewhere (e.g. Bilitewski, 2012; Haas et al., 2015; Hobson, 2015), this paper aims to explore the CE through a micro level analysis by understanding how organizations can create societal and environmental value.

2.1.3 Exploring CE:

Studying the concept of CE, one can observe that there is a lack of consistency among concepts. Greyson (2007) suggested that the main objective of CE is to attain 'precycling' (prepare current resources to become future resources rather than waste) initiatives which involve organizations, governments and society's efforts to prevent waste by systematically promoting and formulating closing resource loops. Others have seen CE as an emerging

'market' that has the potential to preserve our 'current way of life' and make it technically viable for longer terms by producing within closed loop systems (Esposito et al., 2015). Therefore before going any further, there is a need to define what is the perspective of CE in this thesis.

While there is no single definition of CE, a generic definition was given by EMF (2015) who championed the idea as 'the continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows'. However, Murray et al., (2015) argued that it is important to describe CE as a restorative and regenerative economy for a more improved total wellbeing (human and non-human) to avoid concentration on the preservation of material resources and the design of industrial systems. CE is a socio-economic phenomenon that requires both a technical system design but also the continuous involvement and cooperation of society (Andersen, 2007;Yuan et al., 2006).

The cooperation of society and each citizen is considered important to achieve closed loops. Nevertheless Posch (2010) suggests that the active involvement of an individual towards tackling sustainability issues depends on how the individual perceive their responsibilities and their possibilities. That could imply that the concept of CE must first recognize the need to enhance humans reflective practice to understand what is their position and 'inter-connectedness' with the eco-system and other constituents of the society. However, in practice the shift towards sustainability might be particularly difficult since different actors have often divergent interests and a lack of cooperating and collective organizing experience (Lambert and Boons, 2002). Therefore the emplacement of an enabling context that would empower trustful relations and embed the concept of community, might be considered important for the implementation of CE. This would promote a collective approach with a mutual objective to improve resource utilization and environmental performance. The above statements suggest that the implementation of CE requires both a technical and a social element, therefore the following definition is proposed for the purpose of this study:

''The restorative and regenerative cycle of finite and renewable resources flows that aims to enhance natural capital, optimize resource yields and improve total well-being''.

In general EMF (2015) has given three main principles aiming to establish a generic conceptualization of CE. The first principle suggests the preservation and enhancement of the natural ecosystem by controlling and balancing finite stocks. Moreover the principle suggests that the industrial system could strive to support the restoration of the eco-system's health by embedding bio-mimicry[1] approach and regenerative design[2] (Lyle, 1996; Benyus,

[1]The concept of bio-mimicry suggests that human systems can be restructured by studying, learning, emulating and applying the processes of nature (e.g. texture and properties of organisms, self-healing abilities, eco-system synergies and collaboration of organisms) (Benyus, 1997).

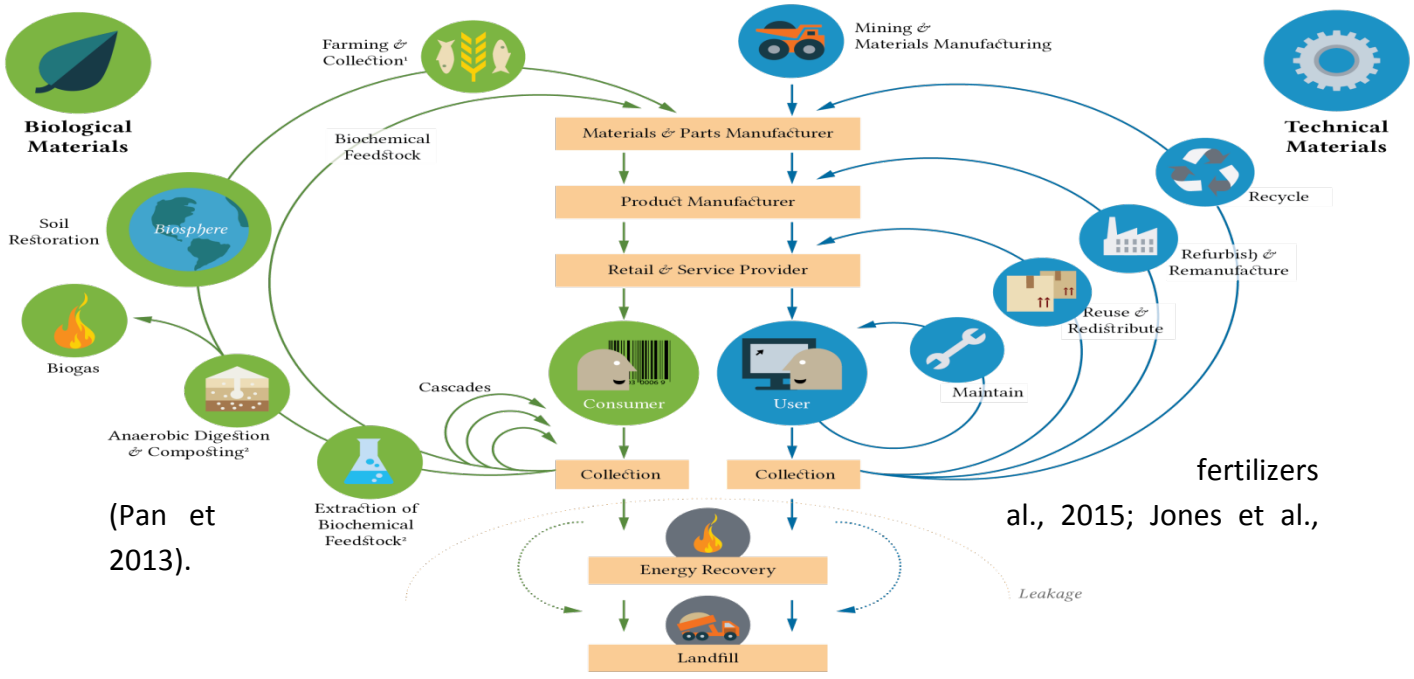
[2] The concept of regenerative design was introduced by Lyle (1996) and points that the development all human systems can acquire a regenerative function role towards the environment, by focusing on the interaction between social, technical and ecological context.

1997;EMF, 2015). For instance Pedersen and Jenkin (2009), in their case study in Wellington (New Zealand) have listed a number of supporting services that society could approach regenerative development. To name a few, the report includes: renewal of fertility and soil quality, plant growth, nutrient cycling, species maintenance and biodiversity. However it is yet unclear how the industrial systems could integrate regenerative development.

The principle also induces the transition towards renewable energy sources such as biogas, solar energy, wind power as an integral part of evolution towards a restorative CE (EMF, 2015). Currently our society is relied heavily to fossil fuels as a primary source of energy. Scientists have repeatedly mentioned that fossil reservoirs are limited and future generations will no longer have the opportunity to rely on fossil fuels as energy resource. This transition provides the potential to achieve 'zero-carbon' emissions, improving air quality and preserve biodiversity (Twidell& Weir, 2015).

The second principle relies on the cradle-to-cradle design approach (McDonough and Braungart, 2002) which suggests the optimization of resource yields by circulating products and materials (both biological and technical) in a structured way so they can yield the highest utility value at all times.

The diagram of EMF (2015) in the figure 1 below, illustrates the concept in a more visual way. At the right side the diagram introduces the hierarchy of value management for technical materials (e.g. metals and minerals) to be treated and reused in closed resource- loops. By establishing a closed-loop system, the economy has the potential to maximize the value of resources and simultaneously minimize waste (Bilitewski, 2012). At the same time, the left side of the diagram suggests the redesign of biological cycles to allow cascaded extraction processes. This would allow the recovery of valuable resources from biological materials before utilizing them as biomass for energy purposes, or return them in their organic origin as



fertilizers (Pan et al., 2015; Jones et al., 2013).

Figure 1: *Biological and technical material cycles (EMF, 2015)*

It is important to note that the diagram has some limitations. For instance Bakker et al., (2014) have argued that the diagram sets a distinguishing format which might be misleading. For example biological materials can also be processed through maintenance, reuse, recycling processes.

The third principle suggests to foster system effectiveness to design out negative externalities such as water, air, soil and noise pollution but also remove toxins, congestion and negative health effects related to inappropriate resource use. So far the decontamination of land and water resources has been seen as an economic burden for municipalities. In contrast in CE, there could be an interesting economic opportunity. For example integrated decontamination could recover valuable raw materials from sludge such as phosphorus (Kočí et al., 2016). This indicates that a new way of thinking could lead to the development of new effective systems, technology and infrastructure.

Nevertheless the principle also points the attention to the use of toxins in products and materials. Research shows that the health costs in Europe of the use of certain toxic chemicals in consumer products, electronics and agriculture are calculated at EUR157 billion per year (Trasande et al., 2015). It is still unclear how to treat those hazardous materials that are currently in the market in circular loops. Therefore the last principle suggests the importance of inventing systems to neutralize hazardous materials and contaminated resources so as to reduce the risk from diseases.

In addition to minimizing environmental impact, the concept of CE offers great potential for economic growth. Economic analysis from the British organization Green Alliance (2015) suggests that CE can offer greater economic stability via resource security, new emerging business sectors and new employment opportunities. More specifically, their report demonstrated that in the United Kingdom, between 2000 - 2010 a more efficient resource use and waste management led to a huge growth of the waste and recycling sector with a tripled sales turnover worth over 19 billion GBP.

Nevertheless, when referring to economic growth one can easily get the perception that CE is just another social construct for growth. Such instrumental stance is criticized by academics as it implies a ‘mean-to-end’ relationship with the environment (Painter-Morland and Ten Bos,

2015). Moreover the concept of CE does not elaborate on the social dimension, but merely focuses on the redesign on the production and consumption systems. For instance it is unclear how the concept will contribute towards equity (intra and inter-generational) and social justice which are at the core of social sustainability (Murray et al., 2015).

2.1.4 Subchapter Conclusion:

In summary the concept of CE suggests three fundamental guidelines to approach a more sustainable economy. First CE goes beyond the conventional approaches of 'neutral' sustainability and pursues a regenerative manner to create the conditions to support the restoration of the eco-system's health. Second the redesign of the technical procedures to manage closed-loops and enhance resource effectiveness. And third if the economy is to be designed in closed loops, the involved materials in the loops must not be based on fossil fuels and polluting substances to avoid spreading externalities and worsen the current situation of the eco-system. Nevertheless CE was described as a socio-economic phenomenon that requires both the technical redesign of closed resource loops but also the involvement of society. Therefore, it was suggested by this thesis that there is a need to address sustainability in a more radical manner to develop mechanisms for both environmental effectiveness and social enlightenment to generate collective thinking. However it is still unclear how these values can be organized and scaled. Therefore the next section aims to explore how these new 'values' can be amalgamated with the concept of CE.

2.2 Addressing the changing logic of Value Creation:

This subchapter aims to discuss the changing logic of values. First the subchapter begins with addressing the relevance of values in an economy followed by a brief examination of institutional theories to assess the relevance of organizations. Second an exploration of several value creation theories related to the CE. Third the subchapter explores the potential of Business Models as a tool for synchronizing organizational entities with the logic of value creation of the CE. Finally the subchapter will elaborate on the assumptions regarding the use of Building Blocks for value creation.

2.2.1 Changing Values and the role of organizations:

Preston (2012) by comparing the shift towards the CE with the industrialization era and the shift in mass production of the 20th Century, suggested that an economic transition involves the change in technological pathways but most importantly the reshape of norms and values. Inglehart and Baker (2000) have described this process with the theory of 'convergence of societal values'. For instance the shift towards industrialization led to significant changes to people's daily experiences and underlying worldviews. In the pre-industrial era, societies were more dependent on nature (e.g. the fertility of soil) while the industrialization was driven along an increasing emphasis on economic growth, modernization and rationalization.

Nevertheless their findings suggested that economic development is associated with a 'cycle' of cultural values that is to some extend predictable. For instance post-industrial development could be associated with a shift of societies towards trust and post-materialistic worldviews. That implies that economic systems can be driven from what a society values more important. Therefore a transition of an economic system could be linked with a transition in societal values.

Before going any further, it is important to identify what 'value' means. Rokeach (1973, p .5), stated that "*a value is an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence*.'' This suggests that value can be an extremely vague term and each individual or organization can determine value in different ways through moments in time and across different societies.

By studying 'value-creation' organizational theories of the past, one can observe that 'value' has been traditionally conceived as the exchange of material resources between organizations and consumers (Bowman and Ambrosini, 2000). Value was translated for consumers in utility terms based on the satisfaction people can get by possessing a unit of good, and in exchange terms for producers based on the profit margins captured by selling these units. Nevertheless as mentioned earlier the notion of value does not hold static attributes but can also be interpreted as a dynamic concept that varies through time and space. For instance the emergence of new forms of organizational value-creation and the spread of CE principles across industries in Europe can indicate a changing thinking of values.
So far the transition towards CE is mainly driven from organizations that explore and experiment with closed-loop practices and collaborative organizing (EMF, 2015; Preston, 2012). This changing logic can be explained by looking into institutional theory perspectives.

The institutional theories suggest that society and as an extend the economy, is a dynamic complex system comprised by different autonomous and inter-depended institutions (e.g. industries, educational institutions, legal institutions etc) which are comprised by organizations. Meyer (2010) suggested that organizations can have a certain internal structure, culture and community that construct individuals' identity and activity. This function of organizations for the broader economy implies the establishment of a stable structure that facilitate interactions and reduce uncertainty (Hoskisson et al., 2000). HoweverPowell and Di Maggio (1983),explicated that organizations are influenced and constrained by a broader institutional environment, the 'organizational field' (e.g. an industry) where organizations involved in a field comply and share rules, norms and cultural content. However the most important property of an organizational field is that it's structure and logic is subject to change. This is due to the notion of '*structuration*' which suggests that organizations within a field interact, develop connections and influence each other. Therefore the introduction of new actors or proactive practices by members in an industry can convey

changes in other organizations. For instance the successful example of Kalundborg's eco-industrial park has directly or indirectly contributed to the introduction of industrial symbiosis practices in other regional projects (Chertow and Ehrenfeld, 2012). Presently, organizations are pressured from environmental criticism of society, increased legislations, raw materials scarcity. To adjust to this dynamic environment they usually incorporate the values of society or even form proactive practices and invest in closed-loop infrastructure. Due to the extended interconnectivity of supply chains and interactions within the organizational field, closed-loop practices can be forced or transmitted. Therefore the theory of institutionalization could explain why organizations adopt CE practices, values or form organizational clusters (e.g. suppliers, partners, local groups) and holds a promising potential for decoupling rapid social change.

2.2.2 Value creating theories for the CE:

In the context of CE the preferable value premises for the CE can be expanded to three inter-related concepts namely: *'shared', 'collective' and 'multiple-value'* creation addressing simultaneously economic, social and ecological value' (Porter and Kramer, 2011; Jonker, 2012, 2014). To elaborate further, as Jonker (2014) suggests, 'value' in general should be based on three basic ideas:

Multiple-Value Creation: the concept of multiple-values suggests that the restoration of the eco-system and restorative contribution to social-systems is not of secondary importance to economic development. In a similar manner, Emerson (2003) introduced the concept of 'blended value creation' which suggests that all investments can be understood in an equation that functions within economic, environmental and social realms. The three components are interrelated therefore cannot be separated as distinct value propositions. For instance if Europe invests to replace toxic chemicals used in consumer products, electronics and agriculture, it can result in improvements of the quality of life for human and non-human while saving EUR 157 billion per year, a cost that is estimated for the treatment of illnesses related to the exposure in toxic substances (Trasande et al., 2015). This indicates that it is irrational to treat investments or economic development separately from the ecosystem and societal welfare. Therefore in contrast with the traditional economic view that there are 'trade-offs' between the three elements, an equal consideration among the multitudes of actions must be given (Emerson, 2003).

For CE, the theory of 'multiple-value' implies that economic development would function in a synergetic manner towards societal and environmental effectiveness. According to EMF (2015) CE has the potential to establish 'effective cycles that allow biological resources to be regenerated and technical resources to be restored'. Therefore economic development might not be associated with growth, as it was the case in linear economy, but rather implies the creation of the appropriate infrastructure to allow 'safe transactions' and regenerating flows

of resources (Boulding, 1966). In the meantime ethics, equity, transparency, accessibility and participation are considered as core values for organizations in the CE to allow the participation of the broader society in the interplay of multiple-value creation (Willard, 2012).

Multiple Values and its roots in Stakeholder Theory:

The theory of 'multiple-values' might intersect with the stakeholder theory which explains the interactions of an organization with its environment and challenges the conventional notion that 'the only responsibility of business is to generate profits' (Friedman, 1970). Stakeholder theory proposes that an organization is comprised of several stakeholders (e.g. suppliers, NGOs, government, users) which are all bounded and interact together due to the shared sense of 'value' they create (Freeman et al., 2004). Therefore the process of value creation can be expressed in two core questions. First the organizations should ask what kinds of values connect the different constituents together. Second the stakeholder theory questions the structure of the organization, and invites stakeholders to define what kind of relationships they want to create in an organization. In essence the theory aims to inspire organizations go beyond personal or 'firm centric-interests' and increase awareness of the stakeholder interdependencies (Mitchell et al., 1997). Therefore the challenge of organizations is to establish symbiotic relationships where all constituents have the same interests.

As mentioned earlier the challenge of the CE towards sustainability is to enable the creation of three kinds of values simultaneously societal, environmental and economic. Therefore taking the perspective of the stakeholder theory, the economy first requires organizations that are comprised of several stakeholders that share the concept of multiple-values. Second it implies that the organizations can balance the creation of all three values while comprehending the underlying stakeholder interdependencies. The several constituents can then be inspired and create a cooperative relationships where everyone strives to accelerate the process of value creation and deliver organization's promise (i.e. create multiple-values) jointly.

Nevertheless some academic developments of the stakeholder theory, go beyond the anthropocentric definition of stakeholders and suggest that organizations need to take into account the impact of their actions towards all stakeholders, including the biophysical environment (Starik, 1995). To elaborate further the theory is based on the general observation that the ecosystem is comprised of human and non-human forms that are inter-depended and any activity on earth would directly or indirectly have an impact upon each other. Therefore by acknowledging this natural reality could lead to '*panoramization*' where an organization obtain a wider view of its external environment, perceiving the environment as a stakeholder in their decision making. Overall stakeholder theory guides organizations to generate mutual interests and create value for all the stakeholders (including environment benefits) involved rather focusing on instrumental relationships and trade-offs.

However the criticism of this perspective is that the balance of natural and societal benefits 'lack conceptual clarity and prescriptive power' (Gibson, 2012). The environment has no direct voice to express its interests and therefore decision making when trying to choose between different actions might not be practical. For example when human actions intervene to preserve an animal species, this might result in an increase of its population and diminish land resources. Therefore the degree to which an organization can contribute towards the creation of environmental value, depends highly on a normative judgement based on human terms (Thomson and Barton, 1994). This could suggest that the challenge for organizations and humans in general, is rather complex and raises philosophical questions when it comes to aligning the dynamic eco-system's interests. In an ideal pragmatic situation, the right communicating and translating technology could allow humans to understand ecosystem's interactions (e.g. the IOT, monitoring technology). Since it is not yet clear how this technology can contribute to the process of value creation, a collective approach to allow society to promote collective and critical learning to search for ways to overcome 'trade-offs', could be more preferable than individual decision making (Hörisch et al., 2014). This leads us to the second criterion of value-creation.

Collective Value-Creation: According to Jonker (2012) the implementation of CE relies heavily on collective organizing. The concept of collective value-creation can also be associated to the theory of social economy (Murray et al., 2010). The theory suggests that our economy is a complex entity comprising of multifarious entities (environment, organizations, state, regulatory institutions, active citizens etc) therefore to move towards sustainable development all those entities must synchronize actions and collaborate together. To coordinate interests between these various entities, three criteria emerge, namely *'success measuring, organizational forms and coalitions and networks'*. The criteria can also concern the implementation of Circular Economy:

- ***Measuring success:*** In the social field the measuring of success is rather problematic since there is no straightforward answer (Murray et al., 2010). Compared to the linear economy where success is measured by scale, market share, profits and material throughput in CE the measures of success could refer to throughput minimization (Boulding, 1966). Therefore success of the economy is translated into resource effectiveness and utilization. However the measurement of success is subjective and therefore is always contestable. For instance is it effective to cascade this resource ? Is it good to replace all recycling infrastructure with new? What is the impact on the environment? The answers may be questionable, so good communication, evaluation tools and value-based dialogue can have an impact towards the implementation of CE.

-***Organizational Forms:*** Value-creation takes shape within organizations (profit, non-profit, government, NGOs etc). CE requires organizations that have the capacity to open their structure and invite society, users, experts and other stakeholders assemble interdisciplinary project teams.

-***Coalitions and networks:*** Transition pathways towards sustainability do not emerge merely through autonomous organizations and proactive involvement but there is a need to facilitate the development of coalitions and networks that can explore the transition experimentally and collectively (Loorbach and Wijsman, 2013). Lessons from the implementation of CE in Japan suggest a close collaboration among industry, government institutions and civil society (IES, 2015). In contrast to the linear 'value-chains' which characterizes the linear economy, the implementation of CE not only requires inter-sector collaboration for the reconfiguration of interlinked components in production systems (e.g. suppliers and manufacturers) but also the participation of people and society to contribute towards closing resource loops. There is a need for entire systemic changes that enable multi-actor processes to escape dominant lock-in infrastructure, change social cultural values, develop new skills, new regulatory frameworks, new 'green' technology, and redesign manufacturing and collection processes.

Shared-Value creation: The concept of 'shared-value' as originally introduced by Porter and Kramer (2010), was mentioned as an opportunity for organizations to reposition their strategies to find new markets and 'capitalize' upon 'societal concerns'. However it could be argued that this conceptualization can have limitations as it implies a profit-focus means-to-end relationship. (i.e. introduce societal solutions to cash out). For Jonker (2012) the concept of shared-value creation assumes that, if the organizations create 'multiple-values', value-creation can be organized to allow society and organizations to share the rewards or costs for the value creation. For instance organizations and society could synchronize investments and efforts for new infrastructure, machinery, logistics etc. (Preston, 2012). Collective financing might be considered as an alternative solution for leap development. Social and technological advancements such as crowd-funding platforms that allow people to co-invest in different projects (e.g. Kickstarter), indicate that people started reconsidering the way the things are done and demonstrate a more social way to manage capital. Accordingly new forms of consumption would allow society access and mutually share the value created.

2.2.3 The quest for a new generation of CEBMs aligned with CE

Conventional Business Models:

According to Baden-Fuller and Morgan (2010) the economic model can be investigated through a smaller model, the so-called business model. By studying a business model, one can explore how an organization functions and eventually generate insights about the qualities and behaviour of similar organizations in an industry. A set of industries comprise the broader economy. Our current linear economy is circumscribed by conventional business models[3] (Bertens and Statema, 2011). First a definition of a conventional business model should be provided: ''A business model articulates how organizations capture, create and deliver value to customers'' (Osterwalder and Pigneur, 2010; Teece, 2010; George and Bock, 2011). To

[3]Conventional business models : are business models focused on traditional economic thinking- profit making.

better understand this definition, it must be clarified what is meant by the term 'value'. Value in a conventional business model represents a product or service that can fulfil an un-served need in the market (Allen, 2014, p.67). This value is then translated to monetary terms, expressing the willingness of customers to pay for that particular product or service (Chesbrough and Rosenbloom, 2002). As a consequence, value in conventional business models is conceptualized as a source of profit making and monetizing.

A widely used approach for the generation of business models is the ''Business Model Canvas" (Osterwalder and Pigneur, 2010). The framework assumes that a business model can be the result of a configuration of nine 'elements' (Appendix 1). In general, a configurational approach is the ‘‘arrangement of parts or elements in a particular form, figure or combination’’ (Oxford Dictionaries, 2016).
the multidimensional constellation of conceptually distinct characteristics that commonly occur together (Meyer et al., 1993).

Different configurations of these elements, can generate several formats of BMs that can be applied to a broad spectrum of industries. As a result organizations have a similar behavior in the way they function and make money. What can be noticed in the Business Model Canvas is the distinction of two sections; on the left side the diagram illustrates the organizations concerns and on the right hand side the customers' experiences with the organization. This conceptual separation enable a linear value-chain where customers and organizations are placed at two opposite ends. The overall objective is to configure and align the elements to capture the 'value-proposition' (i.e. satisfy the 'customer need' and generate more profits). Consequently, all the complementary elements are configured to enable the business model to capture this ‘value-proposition’ and increase their profits potential.

Nevertheless, this conventional logic leads to the establishment 'best-practices', which are then imitated in different business models and spread across of industries. For example, Gassmann et al., (2013), have analyzed 250 business models, and identified 55 repetitive patterns that defined the value proposition and revenue logic of the business model. Examples of such patterns include ´subscriptions, add-on, digitalization, lock-in, e-commerce, freenium, no frills´ etc. What is particularly interesting though is that their research suggested that those patterns could be creatively recombined to fit a certain business context and even generate new (conventional) business model. For example they provide an example of a machine manufacturer that consider the incorporation of subscriptions in their business model and resulted to the idea of 'training-sought after plant operators and leasing them to customers’.

The traditional approach to business modelling interlocks organizations in a short-term perspective of increasing margins and neglects societal and environmental issues. In that sense, conventional business models cannot accommodate sustainability since value creation process is dominated by the logic to achieve economic growth. Sustainability within the

conventional approach can be seen as a market gap which in turn, drive organizations into tactics such as 'eco-efficiency' (i.e. less energy, less resource use, less harm). Those tactics were criticized by many academics as 'insufficient', 'greenifying' practices that guide industries to be simply less destructive (Jonker, 2012;Dyllick and Hockerts, 2002; Young & Tilley, 2006). Consequently, conventional business models serve as money making 'mechanisms' through cost-efficient practices without considering the aftermath. Therefore new forms of value creation must be established in order to allow the economy to move beyond pollution control and instead increase prosperity in multiple directions.

Business Models for the Circular Economy (CEBMs):

Academics and consultants in the field of CE have repeatedly mentioned the importance of a new generation of business models, the so-called 'Circular Economy Business Models' (CEBM), as a mechanism to deliver this value (Murray et al., 2015; EMF, 2015). To elaborate further, in the linear economy, the 'Conventional Business Model', have been practically used as a tool for capturing a single value -profits. However the CE requires the establishment of alternative business models that repurpose the organizational value-creating logic. As mentioned in the previous section, CE is dependent on a large scale and intense networking implementation that allows inter-sector collaboration but also the involvement of society's members. This new logic has profound implications to the way organizations are doing things, therefore CEBMs should adjust business activities and processes in a systemic way to create 'multiple-values', collectively, and allow this created value to be 'shared' mutually.

Before going further to analyze how organizations can integrate those values in a systemic-level, a definition of a CEBM should be given. Mentink (2014) provides the following definition of a CEBM: 'A circular business model is the rationale of how an organization creates, delivers and captures value with and within closed material loops'. However a CEBM, ideally should allow organizations to deliver multiple-values (i.e. preserve ecological effectiveness and contribute to quality of human life). For instance, research of McKinsey (2015) suggests that the CEBMs can implement processes that allow the regeneration of the ecosystem services. Moreover Bocken et al., (2014), suggest that CEBMs are by nature based on collaboration. Therefore a proposed definition of CEBMin this Master thesis is :

' Circular Economy Business Models provide the logic of how organizations (in collaboration with partners and stakeholders) creates, deliver and capture value with and within closed material loops while maintaining and regenerating the health of ecosystems'

2.2.4 The logic of value creation behind CEBMs:

As mentioned earlier, the implementation of CE is assumed to be stimulated by organizations. Therefore the organizations that are involved in the economic transition require to incorporate the changing logic of value-creation of CE at the core of their organizational

culture and structure. According to Jonker (2012), to match the logic of value-creation (multiple, collective, shared value creation) of the CE, there is a need for a new breed of Business Models (CEBMs) that would synchronize their 'value-creation' logic with the three corresponding elements of CE. The emerging elements include: *'Value Logic', 'Value Network', 'Value Capture'* (figure 2).

The elements are elaborated in the following section.

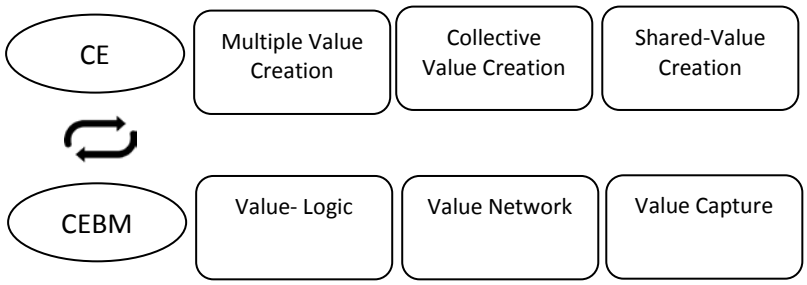


Figure 2: *Organizational synchronization of the value creation logic with CE*

Value Logic: The establishment of a CEBM is mostly originating from a re-evaluated 'logic' of an organizations' go-to-market strategy (Jonker, 2012). The argument relies on the assumption that organizations need to reconsider what is meant by 'value' in the business model equation. In contrast with the conventional BM where in pursuit of the 'value-proposition', business or customers benefited to the detriment of another stakeholder (e.g. society through poor working conditions, or the environment through uncontrollable resource extraction); CEBMs are built on a redefined 'value-logic' which aim to deliver 'multiple-values' simultaneously. To elaborate further, rooted from the theory of 'the triple bottom line' (Elkington, 1998); an organization should strive to avoid trade-offs and contribute positively to three dimensions: society, the environment and the economy simultaneously. Similarly, Dyllick and Hockerts (2002) introduced the idea of 'effectiveness' in the business case as an alternative to the overused 'efficiency' theme.

There are two emerging criteria: Eco-effectiveness: The transition towards CE requires organizations that strive for ecological restoration and the formation of closed resource loops. Socio-effectiveness: CE is only feasible if involved organizations are able to generate positive social values such as knowledge, transparency, equality, involvement, security and trust (Jonker, 2012). This would allow the organizations to focus on the total welfare and add value in the communities they operate and stimulate cooperative circular links.

Organizations can utilize CEBMs as a mechanism to capture a defined 'value-logic' and coordinate all organizational operations around 'multiple-values-creation'. In other words, the CEBMs should be designed in a way that balances the creation of values for the social community while promoting environmental effectiveness. Building on Zott and Amit's (2010) argument who identified the business model as a system of interdependent activities; this paper suggests that if each business operation or activity that compose the overall 'business

model', respond to the 'value-logic' criteria, then it is more likely that the resulted 'business model' is going to match the philosophy of CE and deserve the label CEBM.

Value Network: Value-creation in the CE context should be created collectively rather than the classical linear value-chains (Jonker, 2012). Research proved that the collaboration with various external stakeholders is a prerequisite for sustainable development since organizations by-themselves lack the capacity to innovate and address sustainability challenges (Sarkis et al., 2011). In contrast, when stakeholders are a part of a 'value-network', they have a better understanding of how an organization creates value therefore are able to evaluate processes and contribute more effectively in the process of value-creation (Coombs and Holladay, 2012; Wheeler et al., 2003). The 'value-network' is therefore a basic element to allow stakeholders to co-create and organize value creation in a collaborative manner.

Therefore the CEBMs should establish a 'vibrant community' that allow multi-communication and collaboration of several stakeholders, including citizens and individuals with shared vision to organize in order to co-create and achieve a better resource management. In practice, the relationships are transformed from 'linear' to 'circular', where the linear value-chain, becomes a 'closed' circle (Preston, 2012). To elaborate further, it is impossible to achieve a 'zero-waste' outcome if all stakeholders in the 'value-chain', from suppliers to consumers and back, are not gathered within a collaborative infrastructure (e.g. how can an organization ensure that post-consumer products are returned back in the value-chain). However as Kostakis and Bauwens(2014, p73) argue, co-creation is only viable if business models consider aspects in need of *'protection, enforcement, stimulation, and connection with progressive social movements*'. This implies that the formation of a 'value-network' might require the development of unique processes, activities and even policies in order to stimulate the participation and engagement of relevant stakeholders.

Value Capture: The Value-capture concerns the earning model which has to be aligned with the strategies of the organization towards sustainability (Jonker, 2012). The challenge of the CEBM is therefore to capture economic value while maximizing societal and environmental benefits. Although the earning model in CEBMs is not the end itself, but the mean to incentivize all partners in the 'value-network' to cooperate for resource value maximization. (Kraaijenhagen et al., 2016). Therefore the goal of the 'value-capture' element is not to increase the organization's revenue streams but to increase the benefits for all stakeholders involved simultaneously, while ensuring a positive societal and environmental contribution.

Recent academic developments have demonstrated how the shift from traditional consumption models to the so-called 'collaborative consumption' and more specifically schemes such as 'using rather than owing' can make a positive contribution to resource savings objectives and allow an effective utilization of products and services (Tukker, 2014).However this could imply that society should reconsider the whole notion of ownership (Preston, 2012). Nevertheless it is still uncertain to what degree such schemes contribute to

the distribution of the value-created in a fair manner as implied by the 'shared-value creation' criterion. Therefore the development for new structures and governing policies could be critical. The Table 1 summarizes the two different business models (Conventional and Circular Business Models).

Table 1: Conventional vs. Circular Economy Business Models

Characteristics	**Conventional BM**	**CEBM**
Performance:	Increase economic capital while doing 'less-harm'	Zero-Waste, Environmental effectiveness
Value Principles	Converting a customer need to revenue	Multiple, collective, shared-values
Value Capture	Cost leaders, Optimize economies of scale, increase margins, strive for lean cost structure, Relationship management is cost	Sustainable production/ consumption: Subscriptions, Performance-based, closed- loops, longevity
Stakeholder Relationships	Star-Shaped linear relationships	Value Network – multi-stakeholder collaboration

2.2.5 Building Blocks for Circular Business Models:

CEBMs can be developed if organizations shift their business processes at the value-creating logic of CE. Recent academic research have been aiming to analyze organizational practices in CE and identify action areas that allow organizations create value and achieve 'closed-loops'. In this thesis we refer to these action areas as 'building-blocks' and they can simulate a similar behavior to the notion of 'patterns' as used in the software programming.

Patterns have been recognized from software developers as '*a well proven solution scheme for a recurring design problem*' (Buschmann et al., 2007p.8). Software architects can therefore share, reuse and recombine patterns for the solution of new and similar design problems, without the need to rediscover them. However patterns should not be misunderstood as a finished solution, nor as a 'fixed affair'. They are just templates to illustrate how to solve a problem and can be adjusted in many different situations (Schmidt et al., 1996). Therefore to produce a concrete software program, designers have to wove different related patterns together and 'adjust' the code according to their specific design problem.

In a similar manner, building blocks in this project are seen as recurring solutions to help the formulation of CEBMs. Building blocks can refer to any kind of business activities, processes, technologies, product/service attributes, stakeholder relations that can be implemented in any phase of a product/service lifecycle. However before formulating and implementing a building block, organizations can evaluate its added value in relation to the overall business model, relevant stakeholders, society and environment.

Examples of 'building-blocks' can be traced in several sources in CE academic research. The Table 2, below contains several 'building-blocks' as identified in the relevant literature of Circular Business Models. However it should be noted that is not an extensive listing since there is a vast amount of multidisciplinary research covering organizational practices in CE.

Table 2:*Examples of Building Blocks traced in literature*

Building Block	**Short Explanation**	**Sources**
Re-manufacturing	Manufacturing companies take back their own products to secure material resources and restore products back to same-as-new condition. Remanufacturing processes can be used as a mean to avoid recycling or wasting the components yielding higher savings on material, labor and energy.	Singh & Ordonez (2015)
Reuse/Redistribute	By directly reusing and redistributing products and materials organizations can close resource loops and preempt products turning into waste.	Planing (2015)

'Servitisation'	Systems thinking also directs organizations to think of alternative forms of revenue models (Stahel, 1998). For example, by seeing a product as a technical system, one could argue that it should be optimized to deliver the maximum value potential. It is estimated that cars across the world are parked at least 92% of time (SUN, 2015). Organizations that attempt to turn products into performance based systems can manage to increase further the economic value of the car and allow sustainable consumption patterns (consuming performance rather than product units)	Beuren et al., (2013) Tukker andTischner, (2006)
Take-Back Systems:	Take back systems stands for the operations and activities an organizations applies to enhance collection of post-consumer products and materials back in the supply chain. By providing cash incentives to enhance returns of used products can be a tactic to forbid consumers disposing products.	Roos (2014);Lewan dowski (2016)
Cradle-to-Cradle Design	Cradle-to-cradle concept gives guidance for the design of products to be aligned with CE. *Biological Materials:* can be designed with non-toxic substances so they can be easily returned to the biosphere as a natural nutrient. *Technical Materials:* can be designed to allow them be recovered for reuse purposes without requiring much degradation of its material quality.	McDonough and Braungart, 2002),
Industrial Symbiosis	In general exchanges of by-products and resources can lead to the development of 'eco-industrial parks'. The business models can integrate this activity to achieve 'zero-waste' outcomes and at the same time allow diverse organizations collaborate by forming bilateral deals. (e.g. Kalundborg's industrial symbiosis).	Lowe& Evans(1997); Bocken et al., (2014)
Waste-to-Energy	Non-recyclable waste or otherwise biomass can be treated through bio-heating, incineration and co-digestion technologies to produce energy and heating supplies.	Pan et al., (2015)
Upgrading	This building block suggests that products (e.g. electronic devices) can be designed based on modularity so they can enable old components to be replaced or upgraded. This can ensure that a 'core' product remains valuable reducing the need of physical resources.	Parlikad et. Al. (2003)

2.2.6 Combining building blocks and configurations:

'Building-Blocks' can prove useful for the literature of circular business model innovation. The assumption derives from the theories of *configuration* (Osterwalder and Pigneur, 2010) and *patterns* (Gassmann et al., 2013), which are used in Conventional Business Models. To elaborate further, instead of the conventional patterns (Gassmann et al., 2013); 'building-blocks' can be the assembling units of a CEBM. However there are three indifferences. First, in contrast with the conventional approach where the value pursued in the configuration process, was defined in economic and market terms, the CEBM derives from a 'value-logic' that aims to deliver multiple-values. Secondly rather the typical linear value chain of

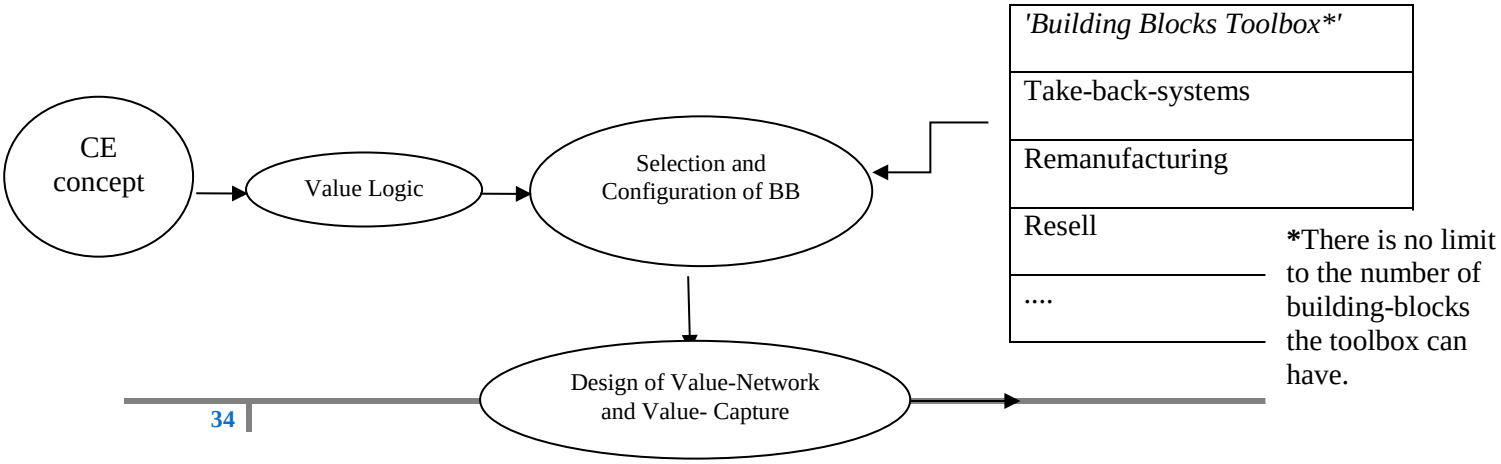
conventional BMs, in circular business models users-individuals, producers and partners are not considered as separate entities with separate interests. Different stakeholders by collaborating together in a 'value-network' are co-creating and capturing the 'value-logic'. Therefore the configuration of building-blocks must take into account the formulation of a CEBM that provides the right infrastructure to allow stakeholders to co-create and deliver value in a collaborative manner.

This co-creation function implies the development of several partnerships that represent de-centralized initiatives (e.g. local communities, lab researchers) which are all embedded in a larger and integrated system, seeking to boost social, technical and environmental transformations for sustainability (Trencher et al., 2014). This statementcalls for the design of a business model that is based on an 'open-model' approach. Such approach would drive organizations away from conventional closed innovation models that are based on secrecy (e.g. patents) and instead are focused on bridging multidisciplinary knowledge, specialists and non-specialists. This would allow multiple stakeholders communicate and access organizational resources and knowledge in a transparent manner to achieve their mutual objective to deliver multiple-values.

2.2.7 Possible configurations leading to archetypes of CEBMs

It could be argued that once a certain 'value-logic' logic is clarified, the 'building-blocks' can be laid out and configured in detail. Nevertheless the configuration can yield a type or scheme of a CEBM archetype that can be transferred in various organizational settings and allow them function in a similar way to deliver the same 'value-logic'.

One of the most well-known archetypes of CEBMs is perhaps the Product-Service System (Tukker, 2004). In a nutshell, the model's 'value-logic' allows organizations to deliver 'functionality rather the ownership of products' while internalizing and restraining environmental and social externalities. Therefore a potential configuration could be the implementation of 'Servitization' to allow them provide a set of services. However 'servitization' is just a piece of the puzzle, as it does not provide a complete circular business model, unless is matched with other, complementary 'building-blocks' e.g. 'take-back-systems' to enable returns of post-consumer products and materials. The figure 3 below illustrates this process.



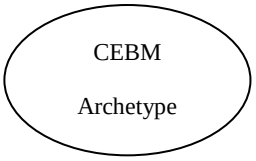


Figure 3 : *Process leading to a CEBM archetype*

2.2.8 The need to collect and analyze these building-blocks and configurations

During the past decade organizations have creatively invented several value-logics within the context of CE. These different logics manifest in different archetypes of CEBMs and represent different settings and solutions for organizing and utilizing resources in an effective manner, considering society and the environment. Therefore different logics might lead to different organizational functions and consequently might require different configurations of building blocks.

Since the literature focused on the operationalization of CEBMs is rather limited and often using vague and obscure (e.g. how do take-back-systems actually occur in practice), there is a need to collect and analyse different configurations from practice-oriented research for two reasons. First new and more precise 'building-blocks' can be formulated by detecting specific illustrating 'key-words' that reflect the latest state-of-practice. Secondly we can understand the relationships of those building blocks and how they can be configured to design different archetypes of CEBMs.

2.2.9 Subchapter Conclusion:

This subchapter has introduced the concept of value and how is related to the CE. Three forms of value creation were suggested for stimulating CE namely: multiple value creation, collective value creation, and shared value creation. Furthermore, the subchapter distinguished conventional and circular business models and suggested the incorporation of CE values in the logic of business models. Finally the subchapter presented the potential role of building blocks and the process of configuration en-route for the creation of multiple values. Building upon this theoretical framework, the following chapters aim to identify more archetypes, building blocks and relevant configuration.

2.3 Chapter Conclusion

The second chapter has introduced the concepts of CE and theories around value creation. The CE was identified as a socio-economic phenomenon that requires both a technical systemic redesign and a change of societal values. Three forms of value creation were identified essential for the CE namely multiple values creation, collective value creation and shared value creation. To allow this happen organizations can be the 'micro' carriers and transmitters of values for driving and scaling the macro-economic transition. Nevertheless it was stressed that there is a need for the development of circular business models to synchronize the process of value creation with the value creating logic of CE.

This new generation of business models can be researched by studying archetypes (which correspond to value logics) and building blocks which can determine the operationalization of those business models. The building blocks can be analyzed further by defining corresponding key-words. So far several building blocks have been identified in the literature, however no study has yet explored their role in the process of value creation. Therefore to assess this claim, there is a need to search for more potential building blocks and archetypes through a practice-based research. The figure 4 attempts to link all the emerged terms and their relations:

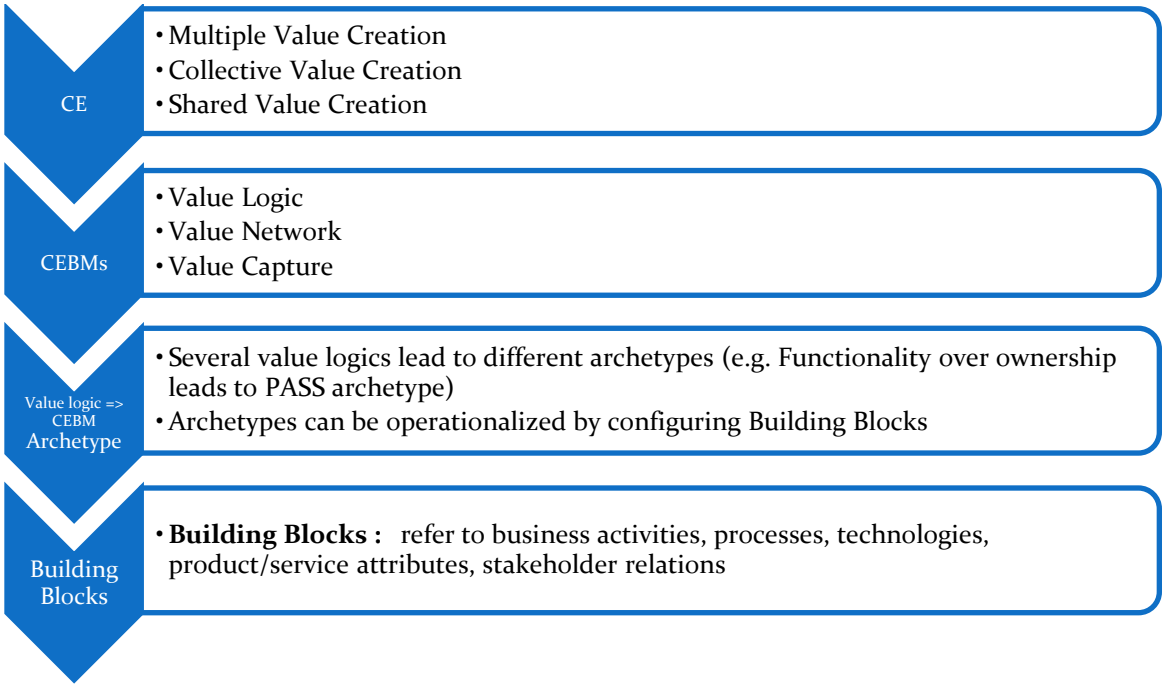


Figure 4 : *Value creation criteria in CE, CEBMs, and building blocks*

Chapter 3. Methodology

This chapter discusses how the research was carried out and to provide arguments of the methods used. The chapter begins with the research objective, followed by the research approach. Afterwards the chapter discusses the procedure for the data collection and the data analysis. The last two sections address validity and reliability and the research ethics of the research.

3.1 Research objective:

This study aims to establish a comprehensive inventory of building blocks and business model archetypes for the Circular Economy. In doing so, the research attempts to establish a typology which would classify archetypes of business models and building block configurations with clear operationalization tips to put into practice. According to Denzin and Lincoln (2005),

qualitative research is suitable when exploring new phenomena. Since there is limited literature that explores the scope or the nature of circular business models, there is a need to collect qualitative data to explore 'why' and 'how' these business models emerge.

3.2 Research Approach:

The study takes a two-fold approach. First a number of professional typology reviews is done by gathering and analyzing data from a number of pre-selected business model typologies carried out by consulting agencies and business analysts. The second part of the study attempts to collect and analyze business documentsfrom the world wide web.

3.2.1 Professional typologies Review:

Several professional agencies and consulting organizations attempted to research organizations that claimed to be active in the circular economy by harvesting case studies and interviewing practitioners. This allowed the development of several (professional) business model typologies. According to Bocken et al., (2014) typologies can be useful for research as they usually describe 'groupings of mechanisms and solutions', which in this thesis correspond to archetypes (business model configurations) and building blocks. Therefore by studying professional typologies, researchers can grasp an overview of circular business model archetypes and understand how organizations operationalize building blocks (i.e. what emerging technologies, processes and activities occur in practice). This thesis aims to conduct a review of a number of pre-selected professional typologies and generate a collective overview of their findings.

Nevertheless these professional typologies are considered as 'grey literature' in this research. Grey literature is research material distributed from sources outside the academic field (e.g. industry, agencies etc) and is often employed in meta-analysis to combine the results of different individual studies and arrive at 'cumulative conclusions' (Conn et al., 2003). However this approach has also some limitations since grey literature sources usually do not involve peer-review process, consequently their validity is questionable. For this research, the advantages of gathering data from professional literature greatly outweigh the disadvantage for two reasons. First their findings are critically evaluated before employed in the research and second the data are cross-validated in a later stage (*business documents analysis).*

3.2.2 Business Documents:

Bowen (2009) suggested that documents contain social facts which worth qualitative examination and interpretation in order to gain an understanding of a single phenomenon, event or organization. In this case, the assumption is that building blocks and configurations are organizational phenomena, therefore business documents might deserve a particular attention in this research. Since the objective of this project is to establish an inventory of building blocks from a practice-based perspective, the study employees data from business documents (PDFs) collected from the world wide web. Organizations active in the circular economy are usually communicating knowledge and information through the distribution of

business documents available online. In such documents the readers can find descriptions of business models and arguments for their underlying logic.

3.3 Data Collection:

3.3.1 Literature Review:

The process for the selection of professional typologies was based on two criteria. First, they incorporated the key terms 'circular economy' and 'business models' in their title. Second the typologies were based on evidence-based research. Under these criteria the selection process has narrowed down to five professional typologies: 1. Green Alliance (2015), 2. Accenture (2014) , 3. McKinsey (2015) [Resolve] , 4. Bakker et al., (2014), 5. Kraaijenhagen et al., (2016). The first three were available in a digital format, publicly available online and the latter two were available in hard copies, privately distributed through the following websites: www.circularcollaboration.com, http://productsthatlast.nl.

3.3.2 Business Documents:

The data collection was not limited to gathering business model typologies but it also involved the collection of online material from several individual organizations. The research targeted a broad spectrum of business documents that were uploaded on European websites. Business documents included organizational brochures, industry reports, consulting reports, case studies, government reports, topical projects and council reports. This diverse selection enabled the collection of documents illustrating different experiences and opinions in the field of CE. The process involved the collection of PDF documents via a scrapping web-tool. The tool was programmed to query the search engine Google, allowing the user to input a combination of terms (e.g. circular economy, business models) in the 'query box' and download the files in an offline desktop computer[4]. The collection procedure was done in an iterative manner as the researcher repeated the process by querying new terms[5] that were discovered during the analysis. It is important to mention that a filter was used to limit the documents in terms of language: English, since the researcher was not multi-lingual and in terms of region, allowing to retrieve documents only from European websites involving 8 countries (Netherlands, Belgium, Finland, United Kingdom, Norway, Sweden, Germany and France). The reason for this decision is because the study was particularly focused in unraveling organizational practices within a European scale.

After the documents were downloaded, the researcher reviewed them manually by quick reading to examine whether they contained content specific information such as descriptions

[4]This allowed a faster data analysis but also the establishment of a more permanent database and enable future recurrence.

[5]Queried terms included the names of business model archetypes (e.g. product service systems) combined with the terms 'circular economy' and 'business models'.

about business activities and business models. The Table 3below summarizes the types of documents employed in this research:

Table 3: *Business documents involved in the study*

	Country:							
Type:	Belgium	Finland	France	Germany	Netherlands	Norway	Sweden	United Kingdom
Case studies	2	1	1	2	4		1	13
Company Brochures	10	1	5	2	23	9	5	23
Conference Reports		1		3	2	2	1	2
Consulting Reports	6	3	4		9	1		17
Regional Projects				1	4			3
Industry Reports	2	3	3	1	11		3	11
Total Per Country	20	9	13	9	53	12	10	69
Total Documents	195							

3.4 Data Analysis:

3.4.1 Pre-analysis - research operationalization:

As it was discussed in the previous chapter, a configuration of building-blocks might demonstrate how a certain value logic can be delivered . Nevertheless an observation is that building blocks can often be further analyzed and described by several 'key-words' that indicate specific business activities. The figure 5 illustrates this assumption which is further explained in the section below.

<table>
<tr><td>Key-word 1 (e.g. user access)</td><td rowspan="2">Building Block 1

(e.g. servitization)</td><td rowspan="2">CEBM archetype

(e.g. PAAS)</td><td rowspan="2">Value-logic

(e.g. deliver functionality rather product ownership)</td></tr>
<tr><td>Key-word 2 (e.g. subscriptions)</td></tr>
<tr><td>Key-word 3 (e.g. incentivized returns)</td><td rowspan="2">Building Block 2

(e.g. take back systems)</td></tr>
<tr><td>Key-word 4 (e.g. collection)</td></tr>
</table>

Figure 5: *Research operationalization: 'keyword approach'*

For instance the archetype 'Product-Service-Systems' aims to deliver functionality rather than product ownerships to attain resource effectiveness. Thus the archetype might configure 'servitization' as a building block by enabling '*subscriptions*' to allow '*user access'* to product use. However the PAAS archetype might require the combination of other supplementary

building blocks together with 'servitization' such as '*take back systems'* to enable '*incentivized returns*' allowing products and materials be '*collected*' for consecutive use.

This example indicates that specific keywords can occur in text (sentences) that describe specific organizational activities or processes. Thus the descriptions that keywords generate, reveal how particular building blocks can be arranged in a certain CEBM archetype. A configuration of building blocks can comprise an overall CEBM archetype that derives from a 'value-logic'. Using the same line of reasoning, a different 'value-logic' would require a different configuration of a different combination of building blocks and might generate new archetypes of CEBMs. For example for a CEBM that is configured on a logic to enhance the environment would require the generation of several building blocks that address different aspects, ranging from restorative practices, funding etc. Nevertheless an assumption would be that these (new) building blocks would be associated with different (new) key-words. Therefore the discovery of new keywords can enable the specification and identification of unrevealed building blocks and different business model archetypes. Based on this methodological assumption, the analysis should take into account this 'hierarchy of terms' and allow the identification and classification of key-words, building blocks and archetypes. The Table 4 summarizes the terms, their differences and their criteria.

Table 4 : *Criteria and boundaries for keywords, building blocks and CEBM archetypes*

Term	**Criteria**
Key-words	-They illustrate specific organizational activities, technologies, stakeholder relationships relevant for the circular economy (e.g. subscription). - Key-words should demonstrate clearly and intuitively how they can be implemented in a circular business model.
Building Block	-Building blocks are aggregate groupings of key-words. -They should categorize key-words based on their function on the business model that correspond to the same underlying value logic. For example 'take-back-systems' include all the relevant keywords that allow organizations collect products and materials back in the supply chain.
CEBM Archetype	-Provide a means for categorizing and explaining a Circular business model (see definition) -Provide examples that illustrate and communicate the CEBM 'value-logic', 'a value-network' and a 'value-capture'

3.4.2 Professional Literature Review - Analysis:

The coding procedure for the professional literature review followed a grounded theory approach (Corbin and Strauss, 1990) which uses a systematic constant comparison of reported data to find similarities and differences in order to give conceptual labels about same phenomena. Each typology provided a framework that classified several keywords that represented 'suggested' organizational practices and summarized each agency's analysis. In this paper a distinction is made between *keywords*, *building blocks* and *archetypes*. To enable this distinction, a systematic constant comparison is made between the keywords found in each typology and the criteria mentioned in 'Table 4'.

For example '*exchange of by-products' is a set of keywords found* in Accenture's (2014) typology that describe the collaborative activity between two organizations to exchange 'by-products'. By evaluating this organizational practice against the criteria mentioned earlier, it cannot be classified as an archetype as it does not accommodate a complete value network (i.e. participation of society). Nevertheless it can be classified as a building block since it has a an underlying value logic (i.e. allow the formation of collaborative industrial networks). Thus the researcher might label it as 'industrial symbiosis'. As the analysis proceeds, the researcher came across other keywords, which when compared to the first, appear to overlap. For example *'residual outputs as feedstock for other processes*' from Kraaijenhagen et al., (2016) typology referred to the same activity as 'exchange of by-products', therefore the researcher labelled them too as 'industrial symbiosis'. The researcher continued this process with each and every keyword found in all five typologies until all data are classified in archetypes, building blocks or keywords. This classification comprised an initial generic framework which was further validated in the second stage which was the business documents analysis.

3.4.3 Business Documents Analysis

The business documents collected were subject to content analysis. According to Patton (2002, p.453), content analysis is used *'to refer to any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings'.* Content analysis can therefore be useful to detect and categorize data based on the context. The objective of the content analysis is to cross-validate the findings of the literature review but also uncover new building-blocks and archetypes and their relationships. To enhance research convenience and allow a systematic and reliable analysis the documents were explored using the qualitative analytics software, Nvivo.

Unit of analysis: One of the most important aspects of a study that undertakes content analysis, is to determine the unit of analysis. The unit of analysis determines what to analyze and in what detail (Graneheim and Lundman, 2004). The units of analysis can be differentiated within sampling units, recording units and context units (Krippendorff and Bock, 2009, p.44). Sampling units refers about the inclusion or exclusion of data from an analysis which in this study concerned the data collection phase. Recording Units are units that can be distinguished

for separate description or categorization and information about them emerge in the narrative in bits and pieces. In this sense, recording units for this study corresponds to the 'key-words' that represent a certain business activity. Context Units are the units from which information about recording units exemplify a particular meaning. Since the study focuses on business models, it should be clarified that the contextual unit of analysis in this project, is defined as the paragraphs in the documents that describe a keyword.

Type of content analysis: There are several types of content analysis. In this study, a flexible content analysis method was used, involving two different techniques: 'directed' and 'summative' content analysis (Hsieh and Shannon, 2005).

The 'directed' content analysis is a method that allows the researcher to code qualitative data based on pre-existing theories in a deductive approach. The generic framework generated through the analysis of professional literature review served as the pre-existing theory to enable the initiation of the directed content analysis of the business documents. The documents have been manually scanned, looking for the sections where the context was related to CEBMs and were coded directly to a corresponding node. Nodes in Nvivo represent 'containers' of gathered related data. In this project, nodes represent containers that gather texts from business documents that correspond to the same archetype (e.g. The 'product service system node' contains all the business model descriptions from the documents that are associated with the product service systems archetype). Nevertheless business model descriptions that could not be coded directly within the archetypes identified in the generic framework, were coded in new nodes to determine later if they represented a new archetype (i.e. by taking into account the criteria for archetypes specified in the pre-analysis).

The 'summative' content analysis method allows the researcher to search for predetermined key-words with the purpose to quantify their frequency of occurrence but most importantly understand their contextual use (Hsieh and Shannon, 2005). In this case the key-words identified in the literature review might have different meanings depending on their use in different business model descriptions. Therefore all the key-words identified in the literature review were systematically queried separately within each node formulated from the directed content analysis. The returned results (i.e. sentences that contain the keyword) from the queries have been coded in sub-nodes. Sub-nodes therefore correspond to the sum of sentences that can demonstrate the particular use of a keyword in a certain archetype of CEBM.

Nevertheless by reading the business model descriptions, the researcher can also identify keywords that refer to new building blocks. Therefore an iterative approach allows the researcher to go back and query the new keywords from the nodes. The example in the Appendix 2 shows how coding and the identification of new keywords emerge.

3.5 Reliability and validity:

According to Graneheim and Lundman (2004), reliability in content analysis refers to aspects such as dependability which is about 'taking into account factors of instability and design induced changes'. In this research the operationalization (design) of the research was agreed upon and was limited to the systematic query of keywords. The use of Nvivo software made the analysis more convenient and stable. Another critical issue is credibility which concerns the selection of context and approach to data gathering. There was an attempt to involve a variation of documents and typologies in the data collection to gain insights from various perspectives in the field of CE.

3.6 Ethical concerns:

It is essential to identify and acknowledge any ethical concerns that might arise due to the implementation of this research. The British Psychological Society (2011) mentioned several considerations related to a research that utilizes online material including rights for copyrights and fair treatment. The first one seems to be especially problematic when dealing with internet mediated research. Therefore it is important that the documents will be used solely for the purpose of this research. Moreover when text or material is directly used in the project to illustrate company examples, the original author is referenced to avoid plagiarism. Fair treatment is another aspect. Data reported should represent an honest and accurate analysis on the information. Coded data and analysis material can be handed upon request from the author of the project.

3.7 Chapter Conclusion:

The chapter has provided arguments for the selection of the research methods: professional typology reviews and business document analysis. The operationalization of the research has been discussed along the procedure for the data collection and the data analysis. The validity, reliability and the research ethics of the study were also discussed. The following chapter presents the results of the study.

Chapter 4. Findings

This chapter *presents* the findings of the professional typologies review and the document analysis downloaded from the web. It is divided in two subchapters; the first subchapter presents the findings of the professional typology review and the second subchapter presents the findings from the business documents analysis. At the end of each subchapter, a separate conclusion is given. An overall summary of the findings is given at the end of the chapter.

4.1 Sub-Chapter one: Findings from Professional Typologies Review

Five CEBM typologies were reviewed in this thesis. In this review, keywords were classified within the building blocks or were distinguished as CEBM archetypes based on the criteria mentioned in Chapter three (see Table 4). The following sections present the results of this process which are the selected CEBM archetypes and building blocks and provide an explanation for this selection.

4.1.1 CEBM Archetypes identified in typologies review

Seven CEBMs archetypes have been identified throughout the professional typologies review. For this task, the three elements of value creation were considered: 1) **a value logic**, which embodies the potential of the CEBM archetypes to create multiple values; 2) **a value network,** which refers to the engagement of collaborative communities and multi-various actors in the

creation of values; and 3) **a value capture**, which captures and shares the multiple values to the collaborative actors (Jonker, 2014). These archetypes are described below:

Circular Supply Chain (CSC): The 'value logic' of the CSC archetype is to replace linear scarce or toxic inputs with fully renewable, recyclable or bio-degradable inputs (Accenture, 2014). Product and service design plays a partial role to establish a CSC. Collaboration with other stakeholders (e.g. procurement partners, end-users to return post-consumer materials) is crucial for the establishment of closed-loops. In that sense the development of a collaborative 'value-network' is plausible. CSC involves a 'value-capture' element through the distribution of circular products that eliminate toxic pollution and simultaneously allow end-users recapture economic value at the end-of-use.

Resource Recovery (RR): The 'value logic' of RR archetype is to reprocess otherwise 'wasted resources' into valuable materials or energy (Lacy, 2015; Kraaijenhagen et al., 2016). The 'value-network' can emerge from 'business-to-business' collaboration to exchange waste streams and by-products, or communities and end-users to recover household waste. The 'value capture' element can be established through the generation of revenues streams to involved actors for waste committed which in turn reduces waste disposal in landfills.

Product Life Extension (PLE): The 'value-logic' of PLE archetype stems from the opportunity to develop long-life products and recover products (e.g. repairing, remanufacturing, upgrading) to enhance their economical useful terms (Lacy, 2015; Bakker et al., 2014). A 'value network' could result with a cooperation with reverse logistics organizations and end-users to return pre-owned products. The 'value capture' entails the resell of restored products and the monetary compensation of end-users for the returned items.

Sharing Platforms (SHA): The 'value-logic' of SHA CEBM archetype is to provide an infrastructure (e.g. online platform) to increase the utilization rate of products by enabling shared access, ownership or use (Accenture, 2014; McKinsey, 2015). The 'value-network' results from the development of peer-to-peer networks (business-to-business, or consumer-to-consumer) that connect providers with users allowing them to share resources and information. The 'value capture' element implies the establishment of collaborative consumption patterns while involved actors (lenders) benefit from monetized exchanges.

Product as a Service (PAAS): All typologies mentioned the 'value-logic' of the PAAS archetype which is to retain product ownership within the organization and offer sustainable consumption patterns (i.e. access to products, or functions e.g. mobility). The 'value-network' emerges from a collaboration with users that return products after leasing period and other organizations to enhance resource efficiency. The 'value capture' element for PAAS implies the minimization of users' costs for using products (e.g. energy costs, initial investment) while reducing the total need for physical goods (Kraaijenhagen et al., 2016).

Reverse Logistics (RL): Accenture (2014) and Kraaijenhangen et al., (2016) perceived RL as the operation for closing the resource loops of any CEBMs by establishing connecting links and infrastructure (e.g. drop-off points). This initiative is recognized in this Master Thesis as a distinguished 'value logic' which can allow organizations focus on the establishment of socially and environmentally effective flow of resources. This can result in a distinguished CEBM archetype with a different 'value network'. For example RL organizations collect post-consumer products from individuals which are then redistributed in secondary markets (e.g. recycling organizations). A 'value capture' is also distinguished as it can involve the compensation of users for returned products.

Regenerate (RGN): The 'value logic' of the RGN CEBM archetype is to enhance the status of the natural ecosystem (McKinsey, 2015). The 'value-network' of RGN results from a collaboration with households to collect bio-waste to be returned in the biosphere and other stakeholders (e.g. municipalities, private investors) to mobilize restoration projects. The 'value capture' element could involve the shared commitment of resources (e.g. funds, bio-waste) to regenerate lands, eliminate fertiliser leakage and optimize crops with higher resilience and yield for involved communities.

4.1.2 Building Blocks identified in typologies review

Within the five typologies review, a number of building blocks were recognized which correspond to particular organizational functions, product/service attributes or technologies that contribute to the formation of collaborative partnerships or the circular flow of resources and information, within the CEBMs.

Keywords found in the typologies were classified within these building blocks based on their interrelated meaning (*see section 3.4.1 for detailed explanation on the methodology*). For example **'advanced engineering'** was recognized by Accenture (2014) as a building block for CEBMs. Within this typology several technologies were referred under this building block, such as *material sciences,* which could yield alternative materials to replace fossil fuels, *advanced recycling* to increase recovery for complex and diverse materials and *automated machines* which could increase product returns and provide instant payments to users. McKinsey (2015) cited *remote sensing/steering technologies* which could reduce time and costs of maintenance. These technologies were also grouped under the building block of advanced engineering due to their technical nature.

Building blocks can be seen as a solution schemes for recurring design problems within CEBMs. That is 'advanced engineering' can be seen as a solution scheme for cost-effective collecting and restoring products and materials. Similarly, a number of other building blocks were identified in typologies review. The Table 5 below summarizes the identified building blocks, their associated keywords and an explanation of their underlying logic.

Table 5 : Building blocks identified in professional typologies review

Building Block	Key-words	Explanation of underlying logic
1.Advanced Engineering	Material sciences, sorting advanced recycling technology, automated collection machines, remote sensing/steering technologies	Life material sciences: can lead to the refining of regenerative materials. Sorting and advanced recycling can drive down operational costs while optimizing material throughput. Automation and remote sensing/steering technologies can allow timeless operation, effective communication and remote management of resources to reduce product failure. Automated collection machines provide instant payment for the return of post-consumer waste for future reuse.
2.Digital Technologies	Mobile, m2m, cloud, social (peer-to-peer, reviews), Online platform	Digital technologies can facilitate the business model effectiveness and allow parties communicate easier. They also allow the analysis and communication of the status assets and resources flow.
3.Eco-Design	Durability, compatibility, ease maintenance, upgradability, ease dis/assembly, advanced materials, self-healing materials, biodegradable, cradle-to-cradle	Those characteristics can prolong product life extension or allow post-consumer products to be cascaded and reprocessed into new products and materials or returned safely into the biosphere.
4.Hybrid Technologies	3d Printers, track and trace	It refers to any technology that combines physical (engineering) and digital technology. *3D printers* can allow democratization of manufacturing (on-demand) and shorten supply chains. *Track and trace systems* generate real-time information about the position and status of products and materials, minimizing leakages.
5.Industrial Symbiosis	By-products exchange, Outputs as feedstock	By-products and waste streams of one production unit can be utilized as feedstock for another process.
6.Insurance	Warranties, insurance	It can be an important mechanism to enhance 'peer-to-peer' sharing activity as it acts as a protection layer for lenders
7.Maintenance	Maintenance	Refers to activities that aim to preserve the quality of product or a resource, preventing waste.
8.Pure Inputs	Non-toxic, fully renewable, recyclable, bio-based inputs	Refers to the procurement operational level of the business model and illustrates the decision for 'clean and pure' raw materials.
9.Recycling	Recycling	Closed-loop recycling (e.g. PET bottles) do not degrade the quality materials in the process while open loop recycling refers to typical recycling (e.g. produce glass aggregate)
10.Refill	Replacements, refill	Replace disposable parts of products while keeping a core product. It can reduce material throughput.
11.Remanufacturing and Repair	Remanufacturing, repair	Remanufacturing is the process where a product is repaired or reconditioned to 'same-as-new' condition while preserving the most value
12.Renewable Energy	Renewable energy, solar, wind, wave power	It involves sourcing or generating renewable energy towards zero-emission objectives.
13.Resell	Resell	Extract economic value from assets while preserving the most value with limited energy requirement.

14.Reuse	Second hand, reuse	Entails the direct reuse of products (e.g. second hand). This can ensure that they preserve the most value and 'embodied energy'.
15.Servitization	Subscriptions, rentals, retain ownership, access based, performance based, multimodal, spare parts services	Any system that increases the effective use of assets by providing services instead of products.
16.Share	Share	Allow users share assets, services. It can be applied virtually in any business model.
17.Take back systems	Collect, take-back schemes, incentivized returns, drop-off points, reclaim	Take-back systems refers to activities that allow the collection of post-consumer products and materials to be reused.
18.Upgrading	Upgrading	It allows the extension of a products functionality to avoid obsolesce.
19.Waste-to-Energy	Anaerobic digestion, bio-refining	It refers to the process that turns bio-waste into combined heat and energy.
20.Waste-to-material	Recover, up-cycling, extract bio-chemicals from organic waste, bio-refining, composting,	It involves activities to transform waste into valuable material resources (e.g. bio-chemicals or proteins from bio-waste)

4.1.3 Configurations suggested in the typologies review

As mentioned in Chapter two, building blocks do not represent a 'fixed solution' for the creation of value since they have to be combined with other building blocks and configured according to the value logic of a CEBM archetype. Professional typologies suggested specific configurations of building blocks that can lead to the establishment of each CEBM archetype. These configurations are summarized in the initial generic framework (*Appendix 3*), which maps the seven CEBM archetypes, building blocks and related configurations found through the typologies review. What can be seen in this framework is that the twenty building blocks mentioned earlier, can be incorporated and recombined in several CEBMs while each CEBM archetype results from a specific configuration.

Furthermore, the proposed configurations take into consideration the behaviour of the individual building blocks in each CEBM archetype. Many of the suggested configurations of the professional literature are focused on a centralized approach and do not substantiate CEBMs as a basis for collaboration and co-creation, a prerequisite which is discussed in Chapter 2. For example Accenture (2014) suggested that digital technologies in a PAAS archetype, can *''provide insights into use patterns and user requirements, helping organizations optimize asset management and customer propositions''.* This citation suggests that digital technology could only be adjusted and implemented in a CEBM in a centralized approach to allow organizations control over the assets and information extracted from consumer use patterns. Therefore the behaviour of building blocks in many proposed configurations within the professional typologies are focused on the technical side of CEBMs and overlook the social aspect. Thus, the role of communities and individuals (users) apart from their involvement in take-back systems and the consumption of services is rather unclear in these configurations.

4.1.4 Conclusion from typologies review:

The typology review enabled the recognition of seven CEBM archetypes and twenty building blocks which were presented in sections 4.1.1 and 4.1.2 respectively. The generic framework (Appendix 3) provides an overview of all the building block configurations per archetype as suggested in the five typologies.

However, by the end of this review, several issues remained unaddressed. First it is uncertain what other building blocks and archetypes exist in practice. Second there is a need to verify the underlying value logic of archetypes and building blocks through empirical approach. Third it is unclear how building blocks can be configured in each archetype to allow actors co-create and deliver the corresponding value logic. To address these issues, the study performed a document analysis. The results of the document analysis are described in the following subchapter.

4.2 Sub-Chapter two : Findings from Document Analysis

In order to understand how CEBM archetypes, building blocks and configurations are developed within organizations, empirical evidence was collected through an investigation of a number of business documents which were downloaded from various websites. It was no surprise that some more archetypes and building blocks were identified. The new CEBM archetypes were '*Remediation*' and *'Knowledge Platforms';* and the building blocks were : '*Hubs, knowledge flow network, waste separation, social currency and quality management'.* Moreover the document analysis enabled the identification of several configurations that often deviate from the configurations identified in the professional typologies review. This sub-chapter presents the findings from document analysis in the following order: first findings that could explain the value creating logic of CEBM archetypes, the building blocks, and finally the CEBM configurations.

4.2.1 CEBM Archetypes : *Empirical Data and new CEBM archetypes found in documents*

Throughout the document analysis it was revealed that the seven CEBM archetypes identified in typologies review, were well considered in several organizations. In addition two more CEBM archetypes were identified within several documents which were not mentioned the professional typologies, namely ‘remediation’ and ‘knowledge platforms’. The Table 6 below illustrates the number of documents related to each CEBM archetype.

Table 6: Number of documents associated with each CEBM archetype

CEMB archetype	Number of related documents found
Circular Supply Chain	44
Product as a service	65
Product life extension	68

Regenerative	9
Resource Recovery	78
Reverse logistics	44
Sharing Platform	42
Remediation	15
Knowledge Platforms	31

In the classification of the 'remediation' and 'knowledge platforms' as CEBM archetypes, the three elements of value creation (i.e. value logic, value network and value capture) were also considered. The section below describes how these three elements can be accommodated within these two archetypes.

Remediation (RMD): Descriptions of 'remediative' business models in the documents stated the predominant 'value logic' of the CEBM archetype which is to remediate water and land resources from contaminants. For example *'Many of the plots in Buiksloterham are polluted and require intensive and costly remediation. Bioremediation combined with temporary use can transform these areas into an societal asset' (Metabolic, 2014).* Seven documents provided statements which demonstrate that the RMD archetype could accommodate the formation of a 'value network' that engages multiple actors and communities to co-create value. For example: For example: '*Healthy Seas aims to provide a solution by bringing together businesses, NGOs, divers, fishermen and other stakeholders to remove ghost fishing nets and marine debris and recycle them into Desso carpets, amongst others' (Desso, 2015).* Four documents provided statements that demonstrate that the RMD archetype could accommodate the formation of a 'value capture' element, allowing involved partners and communities share financial value created and other intangible benefits. For example European Parliament (2014) in a report named 'Characteristics for multispecific fisheries' mentioned an *''EU Trial Project aims to Compensate Fishermen for Catching Plastic Waste''*. This indicates that the 'value capture' within remediative CEBMs could enable the simultaneous decrease of plastic debris issues in oceans or lands while all involved actors (in this case fishermen) receive shares of the economic earnings from recovering reclaimed materials.

Knowledge Platforms (KP): The 'value-logic' of the KP CEBM archetype was described in all nine documents and was associated with the dissemination of practical knowledge related to the CE (e.g. composting, recycling). For example: '*Repair Cafes combine community-led repair with a cafe setting, rather than a workshop. They bring together people – especially those at the margins of society, the elderly, unemployed, retired and those with disabilities – who have tools, skills and time that they wish to put to good use within their community. Repair Cafes thus meet both environmental and social needs* (FEE, 2014). Several citations in these documents were directly indicative for the establishment of a 'value network' that involves a collaborative community of members (users) which contribute in the creation of a knowledge basis. For example: ''*iFixit encourages a collaborative community to contribute to gadget*

repair manuals'' (JWT, 2014). The 'value capture' element was also evidenced in all nine documents, in a sense that any member involved can access the knowledge basis created. For example: *''Having Fab Lab as an open access space and community hub is a big advantage as people can just walk through the door and get involved''* (Fab Lab, 2015).

4.2.2 Generic characteristics of the CEBM 'value network' and 'value capture'

As mentioned in the previous sub-chapter, empirical data were required to explore how the elements 'value-network' and 'value capture' can be established in organizations that adopted the identified CEBM archetypes. These elements were evidenced in several citations in the documents for each of the nine CEBM archetypes. Willing to make sense of the development of the two elements, the citations are grouped to several aspects that represent generic characteristics of the value-network and value capture of CEBMs in general terms. In other words, these generic characteristics aim to provide an insight how the two elements of value creation (value network, value capture) can be established in any CEBM archetype. The following sections discuss the corresponding findings.

Characteristics of the CEBM value-network	**Number of Documents**
Engagement of dedicated communities	35
Peer-to-peer interactions	27
Cross-industry collaboration	24
Self-organization	20
Multi-disciplinary teams	15
Inter-organizational knowledge sharing	14
Transparency	10
Open Dialogue and communication	6

Value Network: Document analysis point out that the nine CEBM archetypes are developed around a 'value-network' which enables multiple actors including users, communities, local authorities, scientific institutions and business partners to collaborate and together co-create value. A number of documents were found that communicate a number of generic characteristics for the establishment of the value network of any CEBM archetype. The table below presents these categories and the number of the associated documents that provided qualitative data to substantiate them.

Table 7: Generic characteristics of the CEBM 'value network' and number of associated documents

The table in the Appendix 4 presents a number of representative citations (i.e. illustrative examples of the qualitative data found in the documents) for each of the above categories. The most prominently category is the *engagement of dedicated communities.* For example:

''*iFixit sees prevention, re-use and repair as preferable to recycling, and produces free online repair guides, encourages a collaborative community to contribute to gadget repair manuals, and sells spare parts. 3.5 million people visit iFixit's website monthly'' - (iFixit, 2014).*

The engagement of collaborative communities that are dedicated on certain circular activities (e.g. repairing), is recognized as an important aspect of the 'value-network' to stimulate broader users involvement and enable collective problem solving and collaboration. When considering the empirical findings that substantiate the characteristics of the value network, the empirical data support the emergence of new forms of organizing to enable CEBMs connect multi-various entities and stimulate broader participation in the CE. These characteristics therefore provide an insight in the synchronization process of organizations to match their value-network with the concept of 'collective value creation' - a value premise discussed in Chapter 2. The characteristics of the value-network and their significance in the creation of value will be analyzed and discussed in more depth in Chapter 5.

Value Capture: The results of the document analysis point out that the nine CEBM archetypes can accommodate the 'value capture' element which implies the sharing of associated costs and resulted benefits with the involved actors. Several citations in the documents referred to benefits and costs that the organizations capture and share between involved partners. In order to better understand the 'value capture' element, these citations were organized within a number of generic characteristics under two levels, a '*collective level'* (i.e. benefits and costs shared among engaged partners and communities), and an *'individual level'* (i.e. individuals commit resources and experience benefits

from participating in CEBM activities). The Table 8 below presents these generic characteristics of the value capture element and the number of associated documents that provided qualitative data to substantiate them.

Table 8: Generic characteristics of the CEBM 'value capture' and number of associated documents

The table in the Appendix 5 presents a number of representative citations for each of these categories. Overall the above characteristics provide an insight to organizations' synchronization process to match their CEBMs with the concept of 'shared value creation' which involves a mutual commitment of resources and sharing of benefits captured. The significance of the characteristics for the design of an effective 'value capture' element is discussed in depth in Chapter 5.

	Costs/ benefits	Category	Number of documents
Individual level	Costs	Return Waste Materials	11
		Assets commitment	10
	Benefits	Monetary Compensation	15
		Education	17
		Belongingness	5
Community Level	Costs	Crowd-funding	10
	Benefits	Monetary compensation	3
		Co-ownership	3
		Green shared areas	10
		Self-Sufficient communities	12
		Social-Cohesion	17
		Functional Economy	14

4.2.3 Building Blocks: *Empirical data and new building blocks found in Business Documents*

Through the document analysis it was recognized that the twenty building blocks which were identified in the professional typologies review were used within CEBMs. To achieve that, an iterative querying of keywords[6] was carried out within the nine nodes corresponding to each archetype. This process enabled the validation of the 20 building blocks identified in the typologies review but also resulted in the identification of five more building blocks namely : *Hub, waste-separation, social currency, knowledge management and quality management.*

[6]Iterative query of keywords implies that the researcher query terms emerged from the analysis

The new identified building blocks, their associated keywords and their underlying value logic are presented in the Table 9 below

Table 9: Building Blocks identified in Document Analysis

Building Block	Keywords	Underlying value logic
1. Hub	Hub	Hubs represented a central physical and/or digital infrastructure that allows users and partners to interact, access and exchange resources and information.
2. Waste-separation	Sorting, separating	Waste separation building block refers to activities aiming to enable waste producers 'pre-sort' disposed waste. This can increase recovery rates as homogeneous products are presorted, reducing costs for latter treatment.
3. Social currency	Credits, swopping	Social currency involves the exchange of credits between users which correspond to the exchange of services. Such practices can be considered as a marketing tactic to enable exchanging and swopping patterns within a platform. However credits can also enable the communication of additional value which is cannot be measured (e.g. reforestation and biodiversity projects).
4. Knowledge Management	Open-Source, Open-access pilot-plant, online courses, blueprints	Knowledge management refers to activities that an organization undertakes, aiming to enhance the exchange of expertise knowledge and information. (e.g. open-source development, peer-to-peer learning, expertise sharing). Organizations also establish open-access pilot plants and online courses, to share engineering knowledge, technologies and sustainable production knowledge.
5.Quality Management	Monitoring, inspection, testing, peer review	Quality management for the CE could refer to monitoring and testing activities to ensure safe circulation of resources, reducing risks associated with reuse, or recycling contaminants. Quality management can also entail a 'peer review' process which involves the access and contribution of individuals with certain knowledge and tools, to quality management activities and evaluate activities effectiveness.

4.2.4 Configurations: *Empirical data from Document analysis*

The configurations as mentioned in Chapter 2 are functions that allow organizations to develop CEBM archetypes by combining building blocks and adjusting the behavior of particular building blocks to enable partners to co-create a certain value-logic. Through the iterative query of the keywords it was possible to validate the incorporation of building blocks in the nine archetypes. The data retrieved from the document analysis that indicate how each archetype can be linked to a certain configuration, are organized in a table in Appendix 6.

The table shows three things. First it demonstrates what keywords were detected and the number of documents returned from the iterative query in each Node (*see section 3.4.3 for detailed explanation of the process).* Second the table illustrates what combinations of building blocks can lead to each CEBM archetype. For example it was found out that the CEBM archetype 'Reverse Logistics' emerges from a combination of the following building blocks: '*Digital technology, eco-design, engineering, hub, hybrid technologies, industrial symbiosis,*

knowledge management, quality management, recycling, refill, resell, reuse, servitization, share, take back systems, social currency, waste separation'. Therefore these combinations can be understood as generic recipes that allow organizations draw the building blocks together and arrange them ways to create the 'value logic'.

Third the table presents exemplary cases of organizations that indicate how building blocks can be implemented and adjusted within each CEBM archetype. These adjustments take into account the establishment of CEBMs that allow stakeholders deliver value in a collaborative manner. For example The Savory Institute (2016) stated the implementation of digital technology in their CEBM:

''*The Savory online platform is used to create partnerships, share best practices and solutions for success, and learn vital information from other Network members and the Savory Institute*''.

Digital technologies in this case indicates an implementation which takes into consideration the delivery of the archetype's value logic (i.e. the value logic of 'Knowledge Platform' is to disseminate practical knowledge for CE activities) and the participation and collaboration of multiple actors, including individual farmers and communities. Therefore the above citation, and other exemplary cases cited in Appendix 6, demonstrate how building blocks can be implemented in each CEBM archetype. These cases consider the simultaneous creation of the corresponding 'value logic' of each archetype and the participation and collaboration of multiple stakeholders, including individuals and communities. In the next chapter these cases are discussed and analyzed in order to clarify what configurations of building blocks can be linked to each CEBM archetype.

4.2.5 Sub-Chapter Conclusion:

The second sub-chapter presented the results of the document analysis which was conducted to identify other kinds of CEBM archetypes, building blocks and configurations which did not follow from the typologies review. Two additional archetypes were presented, namely *Remediation* and *Knowledge Platforms.* Moreover findings involved a number of general characteristics which explain how the 'value network' and the 'value capture' can be established in the nine CEBM archetypes.
The sub-chapter presented five additional building blocks which followed from the document analysis, namely: *'hubs, waste-separation, social currency, knowledge flow network, quality management'.* Data that could explain the building blocks configurations were also presented. A number of cases extracted from the document analysis, described particular adjustments of building blocks that enable multiple actor participation and collaboration for the creation of the corresponding value-logic of each archetype.

4.3 Overall conclusion

The above presented findings regarding the typologies review and document analysis, allow for the following conclusions to be drawn considering the CEBMs.

The nine CEBM archetypes were categorized based upon the three elements: value logic, value network, and value capture. The value logic of the nine archetypes is as following. The *Circular Supply Chain:* aims to introduce bio-based, fully recyclable, renewable products and materials and design circular processes. *Resource Recovery:* focuses on up-cycling waste into valuable materials or energy. *Product Life Extension:* aims to prolong products lifespan. *Sharing Platforms:* match the supply and demand of underutilized assets. *Reverse Logistics:* develop connecting links and infrastructure for the effective flow of resources between distinct entities (users or businesses). *Product Service Systems:* target on the delivery of functionality over product ownership. They enable organizations to optimise the utilization of resources and foster a shift towards sustainable consumption. The *Regenerative* archetype : aims to enhance and regenerate the eco-system. The *Remediative* CEBM archetype which fosters the removal of contamination from natural resources and *knowledge Platforms* which aim to disseminate practical knowledge and collective learning regarding CE. An overview of the nine identified archetypes can be found in Table 10.

Table 10: Overview of the nine CEBM archetypes identified in typologies review and doc. Analysis.

CEBM Archetypes	Value Logic	Value Network	Value Capture
Circular Supply Chain	Replace linear scarce or toxic inputs with fully renewable, recyclable or bio-degradable inputs.	Collaboration of users to return post-consumer products and materials and procurement partners to source 'pure' inputs	Communities reuse sustainable products and materials within closed-loops or share sustainable energy output.
Product Life Extension	Extend the lifecycle and value of products and assets. Products are designed for longevity	Collaboration with users to return or restore products to functioning condition.	Shared income is generated through the redistribution of restored products to secondary markets and the provision of restoring services.
Product Service Systems	Turn a product into a commodity bank, increasing the rate of resource utilization among several users.	Communities of users and organizations collaborate to enhance resource effectiveness and accessibility	Shared access to product-functions
Regenerate	Enhance and regenerate the health of ecosystems	Communities separate and return bio-waste and safely return the recovered resource output (compost) to biosphere.	Elimination of bio-waste leakage and optimization of crops with higher resilience and yield for involved communities.
Resource Recovery	Up-cycle waste into valuable materials or energy	Collaboration with communities for the collection and separation	Shared income is generated through the redistribution of

		of waste. Business partners to identify new material purposes	recovered materials and energy to secondary markets
Reverse Logistics	Establishment of connecting links and infrastructure (e.g. drop-off points) for the effective circulation of resources	Multi-stakeholder collaboration for easy collection, evaluation and redistribution of returned products. Peer-to-peer logistics and collection of products.	Shared income is generated from the redistribution of products in secondary markets.
Sharing Platform	Provides the infrastructure that aims to match demand and supply of underutilized assets.	Collaboration within 'Peer-to-Peer networks' (business-to-business, or consumer-to-consumer) to share access to resources use.	Users receive a return for sharing their assets while the organizations receive a transaction fee for provided services (e.g. insurance, payment processes)
Remediation	Remediate water and land resources from contaminants	Multi-stakeholder approach and communities involvement in remediation activities (e.g. removal of debris, monitoring and measuring of pollution).	Simultaneous elimination of pollutants and generation of shared income, through converting contaminants to marketable products and materials.
Knowledge Platforms	Dissemination of practical knowledge related to the CE (e.g. composting, recycling).	Collaboration of users for the sharing of practical knowledge (e.g. repair tutorials) and peer-to-peer learning processes.	A shared knowledge base is created, which allow members accumulate CE skills.

The findings also suggest that all nine CEBMs archetypes can accommodate the 'value network' to enable a collaborative and collective effort for the delivery of the value logic and the 'value capture' element to enable the sharing of associated costs and resulted benefits within involved partners. A number of generic characteristics were also presented that could illuminate the value creating logic of the value network and value capture of CEBMs in general terms. The next chapter proceeds with an analysis of the presented data and aim to clarify the significance, interrelatedness and implication of these characteristics.

Within the research a total of twenty five building blocks were identified that correspond to a number of business activities, processes, technologies, product/service attributes and stakeholder relations. A brief description for the underlying logic of each building block was given. Perhaps these building blocks have a similar function when incorporated in CEMBs; this would be explored in the next chapter.

A number of configurations were extracted from the two sources (i.e. typologies review and document analysis). These configurations involve building block combinations and particular building block adjustments that lead to the establishment of each CEBM archetype. Most building block adjustments identified in the typologies review seem to be associated with a centralized approach in value creation. In contrast, building block adjustments detected from the document analysis take into consideration the involvement of communities of people and enable collaboration of multiple actors in value creation.

The next chapter will analyze and discuss the data from the two sources, and elaborate on the value creating logic of the archetypes, building blocks and synthesize a CEBM typology with related configurations.

Chapter 5. Analysis and Discussion

In the previous chapter, findings from the typologies review and the document analysis have been described to present the identified CEBM archetypes, building blocks and configurations. In this chapter, the results will be analysed to understand how these CEBM archetypes, building blocks and configurations can relate to the theory of multiple values (i.e. creation of social, environmental and economic values, collective collaboration, and shared value creation). The analysis is divided in three sections. The first section will analyse and discuss the CEBM archetypes, the second section will discuss the value creating logic of the building blocks. The third section will discuss potential configurations of these building blocks per archetype. At the end of the chapter a conclusion will wrap-up the analysis.

5.1 Value creating logic of CEBM Archetypes:

As it is referred in Chapter 4, nine CEBM archetypes were identified in this study. Moreover results from the typologies review and document analysis provided an empirical substantiation for the three CEBM elements namely *'value logic', 'value network', 'value capture'.* From these results some generic characteristics were also generated for the latter two elements.

This section aims to evaluate how the theory of multiple values can apply to these CEBM archetypes. To achieve this, the findings described in the previous chapter that correspond to the three elements (value logic, value network, value capture) will be analysed and discussed. The analysis first evaluates the findings from the results which indicated the *'value logic'* of the identified CEBM archetypes in order to clarify to what extent these CEBM archetypes enable the creation of environmental and social values. Following that the general characteristics of the *'value network'* and the *'value capture'* will be analysed to clarify how they are related and what is their significance in the creation of these CEBM elements. The purpose of this analysis was not to differentiate the development of these elements for each CEBM archetype, rather to understand how the 'value network' and the 'value capture' can be designed in a CEBM in general terms.

5.1.1 Value Logic: *Towards social and eco-effectiveness*

The value logic of CEBM archetypes can be assessed based upon on two criteria. These are the *eco-effectiveness* which aims for ecological restoration and the formation of closed resource loops and *socio-effectiveness* which aims for the generation of positive social values such as knowledge, transparency, equality, involvement, security and trust (Jonker, 2012).

With respect to the CEBMs, six archetypes can lead to the establishment of closed-resource loops and sustainable consumption patterns. These are the *circular supply chain (CSC), resource recovery (RR), product life extension (PLE), reverse logistics (RL), product as a service (PAAS), sharing platforms (SP).* **CSC** is driven from a predominant value-logic to design closed-loops of products and materials from bio-based, fully renewable, recyclable inputs. **PLE** aims to influence a consumption-based society and enable a better handling of priority materials to prevent high levels of extraction which cause environmental damage, **RR** aims recover material resources or produce energy from waste and by-products, **SP** aims to match the

demand and supply of underutilized assets, **RL** aims to scale connecting links and infrastructure for the effective flow of resources between distinct entities and **PASS** aims to provide access to multiple users and functionality over product ownership.

All the above mentioned CEBM archetypes are essential for the CE since they could lead to sustainable consumption patterns (transition to renewable energy resources, closed-resource loops, extension and recovery of products and materials consumed, shared ownership and function-based consumption). However they do not intend to directly improve the condition of the bio-sphere, rather to optimize resource flows by restructuring 'zero-waste' and 'neutral' production and consumption patterns. For example Dutch Awareness (2015), an organization with a CSC CEBM mentioned:

''The company's disruptive manufacturing process for garments includes incorporating reuse at the design stage, an improved recall process for worn garments, and the development of recycling technologies and infrastructure''.

Most of the statements identified in the documents and the professional typologies, indicating the 'value logic' of the above mentioned CEBM archetypes; were claims that demonstrate the consideration of organizations for the provision of products and services to satisfy society's needs while minimizing their environmental impact. It could be argued that such logic fulfills solely the first aspect of 'eco-effectiveness' which is the optimization of resource utilization for societal (consumption) purposes.

This research also identified two CEBM archetypes which can be associated with a 'net-positive' logic towards eco-effectiveness, namely *Regenerative (RGN) and Remediative (RMD).* McKinsey's (2015) typology pointed that **RGN** CEBMs pursue the regeneration of landscapes through reclaiming and returning recovered biological material back to the bio-sphere. Aligned to this observation, the document analysis has identified fifteen documents that portrayed organizations which are focused on ecosystem regeneration. For instance Common-land (2016) stated: *''landscape restoration offers large untapped opportunities for sustainable economic development and to demonstrate this potential, the company develops landscape restoration projects that are based on business cases''.* The RGN archetype allows a supportive relationship with the eco-system and economic development. This is achieved through the establishment of regenerative activities such as the returning of bio-materials in the biosphere, landscape regeneration and reforestation (*a more detailed analysis on how RGN CEBM emerge would be discussed in the third section*).

The third principle of EMF (2015) was stressed as a required condition for the CE to design out existing, negative externalities such as pollution in water, air, soil and toxins from material resources to restore contaminated resources and reduce the risk for diseases. The document analysis was able to identify organizations that are purposed to tackle this environmental issue. Thirty-one documents presented CEBMs which corresponded to the **RMD** archetype. The value logic of these CEBMs is to improve the quality of water and land by removing

contaminates. The related documents, often described an integrated approach in which decontaminated and recovered material resources are re-introduced in circulated closed-loops. The Ocean Clean Up (2015), a large scale project which aims to remove plastic debris from the ocean, explained this: *''Converting the extracted plastic into either energy, or new materials could partly cover execution costs.''* This indicates a change of thinking, whereas the conventional imperative was to passively remove pollutants and often perceived as an economic burden for municipalities, organizations have now shifted towards integrated decontamination initiatives where treated contaminants can simultaneously serve economic purposes.

Knowledge Platforms (**KP**), was identified as a distinguished CEBM archetype which derives from a value logic to disseminate practical knowledge related to the CE. For instance a case study cited: *''people throw away broken items without even trying to repair them; this is one of the rationales behind 'repair cafes- to make repairing more accessible, easy and fun….they bring together people- especially those at the margins of society''* (Friends of the Earth EU, 2014). The 'value logic' of KP can be associated with 'social-effectiveness', since it stimulates peer-to-peer learning and training which in turn facilitates the integration of previously unconnected individuals in a community. This community creates a sense of collectivity that bounds members together to create solutions, partnerships and innovate collectively.

Figure 6 below provides a conceptual overview of the value-logic of the identified archetypes. CSC, PASS, SHA, RR, RL and PLE allow the formation of sustainable consumption patterns within closed resource loops. The figure also suggests that the value-logic of Knowledge Platforms could lead to social effectiveness while the logic of Remediation and Regeneration archetypes lead to net-positive eco-effectiveness.

Figure 6: Conceptual overview of the CEBM archetypes value-logic

5.1.2 Value Network: *Engaging collaborative communities*

The results described in chapter 4, provided an insight on how CEBMs enable the formation of a 'value network'. Professional literature described the potential of CEBMs to engage cross-

industry collaboration to exchange waste streams and customer collaboration in order to manage closed material loops (Kraaijenhagen et al., 2016). However, the document analysis demonstrated that the most predominant category that could emerge in a 'value network' is the *'engagement of collaborative communities'*. Such collaborative communities are themselves the most valuable characteristic of a 'value network', since through them organizations are able to stimulate *'self-organization' and 'peer-to-peer interactions'.* Certain characteristics like *'multi-disciplinary teams'*, *'knowledge sharing'* and *'transparency'* are also significant characteristics for the value network. The characteristics and their relevance are discussed below.

Self-organization: The engaged communities in the 'value network' have the capacity to stimulate citizen's involvement and participation in the organization's activities. For example: *''Visitors bring their broken items from home. Together with the specialists they start making their repairs in the Repair Café ''.* This indicates that the engaged communities in the value-network can act as agents that stimulate citizens' participation in a decentralized manner. In contrast to conventional business models where customers are passively engaged in hierarchical transactions and relationships (e.g. traditional retail), the 'value network' of CEBMs allow users to participate in organizational activities such as repairing or composting, autonomously and voluntarily while being supported from the community for the provision of guidance.

Peer-to-peer interactions: In contrast with the conventional business models where customers are isolated and unaware of each other, document analysis suggests that the 'value network' in any CEBM archetype, can enable the members of the community to interact and be involved in transactions, exchanging products, services. However, the most significant aspect of these peer-to-peer interactions is that they enable the exchange of valuable information between members regarding CE practices such as recycling, the collection system, regeneration, repairing etc. Therefore, through these 'peer-to-peer interactions', self-organized members are connected with each other and together they represent an interconnected collaborative community.

Multi-Disciplinary teams: Another significant characteristic of the 'value network' is the formation of multi-disciplinary teams. For instance the Community Composting Network (2015) stated: *''groups involve individuals working within schools or small groups working on allotment sites or promoting home composting, to community supported agriculture schemes, to social enterprises with Local Authority contracts providing kerbside collection services, with lots more variety in-between''.* This case clearly indicates that organizations aim to dissolve boundaries between diverse stakeholder groups and create multi-disciplinary collaborative teams. Environmental and social issues are multifaceted phenomena and require a close collaboration between local communities, the investors, local authorities, and scientific institutions to achieve a mutual objective to invent creative solutions for the recovery of materials and the restoration of the environment that are economically viable. Therefore the

ability of organizations to inspire inter-disciplinary collaboration is an important aspect of any CEBM 'value-network'.

Sharing Knowledge: Knowledge sharing within 'coalitions and networks' is required to leapfrog the economic transition and expand CE practices in wide-ranging sectors. 'Knowledge sharing' was identified as an appropriate characteristic of the 'value network' for unlocking and transmitting internal organizational knowledge in various organizational networks. For example Ecoshape (2015) stated *''Ecoshape foundation, is to encourage the use of Building with Nature in hydraulic engineering solutions. That is why Ecoshape develops knowledge in pilot projects, distributing it to everyone involved in hydraulic engineering projects''.* By developing an open knowledge base, organizations contribute to collective problem solving and progress eco-innovation.

'Transparency'- 'open dialogue communication': The last two characteristics that were found relevant and significant for the formation of a 'value network' in a CEBM are 'transparency and equity' and 'open dialogue communication'. Together these two characteristics imply the realization of a transparent 'value network' and procedures for a democratic and open dialogue (e.g. sociocracy[7]) in order to evaluate progress in value creation and manage a democratic decision making between various groups of stakeholders.

5.1.3 Value Capture

'Value Capture' constitutes a prerequisite element for the creation of value in a CEBM archetype. The 'value capture' element of CEBMs enables organizations to synchronize their value creation process with the concept of shared value, which takes into consideration the sharing of benefits and costs, equitably within communities and partners involved (Jonker, 2014). Chapter 4 presented the results from the document analysis, which described how the 'value capture' element can entail a number of general characteristics that regard what costs and benefits are distributed between involved actors. These characteristics were classified within an 'individual' and a 'collective' level. The following part will therefore explain the significance of these characteristics, their inter-relation, as well as their contribution towards the creation of multiple values.

‘Social cohesion’ reinforces ‘long-term collaboration’ and ‘sustainability’:

[7] **Sociocracy:** For instance the illustrative case of Moray Carshare club (2014), a car-sharing organization in the UK, stated: *''The car club is run in a democratic way, as a social enterprise, using a methodology called Sociocracy''*. Sociocracy is a form of governance that was used in this CEBM to ensure that each group of stakeholders (e.g. administration, end-users, municipality) had equal control in organizational decision making.

The most frequently cited benefit of CEBMs is 'social cohesion'. Organizational documents citing 'social cohesion' often describe it as an outcome of the engagement of collaborative communities. For instance:

Onion River Exchange (ORE) utilizes local resources through the network, to create a thriving social economy and tool exchange that results in community wellbeing, strengthens social cohesion, encourages reciprocity and enhances our local economy and is built on a foundation of respect and equality. They implement initiatives including building partnerships with various community organizations, developing "Circles" as a strategy for enrolling groups of people at one time such as neighbors, friends, and those linked by a common interest, and revitalizing / expanding the Tool Library to include food processing and garden equipment.

The above-mentioned reference, illustrates that CEBMs that are able to capture 'social-cohesion', are able to promote the development of trustful relationships, solidarity and an overall connection (i.e. social interaction and social networks) within the engaged community. More specifically 'social cohesion' in CEBMs emerges from an on-going cooperation of members of a community which is formed around groups of interests towards common objectives such as 'self-sufficiency'. It follows then, that 'social cohesion' reinforces long-term collaboration and of a vibrant community. For instance:

''*ORE has committed 2015 to growing a vibrant membership through nurturing the circle of care program and tool library, outreach to families with young children and offering member-lead workshops to the community.*''

CEBMs that manage to capture 'social cohesion' are therefore more likely to engage, sustain and expand a collaborative community. In these communities members acquire and develop daily activities and social practices that are aligned with environmental sustainability such as composting, development of green shared areas, maintenance, transition to renewable energy and the exchange of resources. In that sense 'social cohesion' can improve an organization's ability to sustainably manage resources (natural or technical) through generating norms focusing on sustainability and enhancing trust and long-term collaboration between members. The assumption is thus that higher the 'social cohesion' captured through the CEBM, affords better environmental effectiveness.

<u>The significance of individual benefits:</u>

'Social cohesion' is an outcome captured only when the organization is able to incentivize, engage and retain individuals within the community. As discussed in chapter 4, CEBMs the participation and involvement of individuals to submit their resources (e.g. waste or assets) or share their knowledge. In return they receive a *'monetary compensation'* for this contribution and '*access to functions'* as the tangible, economic benefits. When individuals are involved directly in the CEBM activities they also experience intangible benefits such as *'education'* and '*belongingnes*s'. For example Fab Lab (2015), an organization with a PLE CEBM specializing in community repairing, mentioned *''people can just walk through the door and get involved, helping to spread the values and practices of repair and re-use further''.* Such tangible and intangible benefits could be considered as an essential aspect for triggering responsibility and inspiring participation of individuals in CEBM communities.

Distributive equity - *the missing link:*

Yet the extent to which economic benefits are fairly and equitably distributed is uncertain. The category *'monetary compensation'* referred to cases in which organizations claimed that their CEMBs enable the generation of multiple types of income for several groups of people and individuals for their participation in CEBMs. For instance a company brochure stated: ''*Lafarge Holcim* (2014) *wants to reduce its dependency on natural resources and fossil fuels by transforming waste into resources for all our production processes...this provides employment and other income opportunities through community-based waste collection*''. The concept of shared value creation, as described by Jonker (2014) is clearly visible in this model and other CEBMs in practice as the rewards created by the organizations activities are shared between involved partners.

However, the potential of the 'value capture' element in CEBMs must be examined by the degree of 'distributive equity' which implies the distribution or allocation of costs and benefits in an equitable and fair manner among collaborative partners. Organizations barely mentioned procedures or context that covers an equitable distribution of income. In fact, in a report on community-based renewable energy models, expressed concerns regarding this aspect about the compensation model:

''Even if a community receives compensation not all residents close to a RE plant might agree or benefit, therefore acceptance cannot be guaranteed. For the project to be successful, the Wider Community members need to accept the compensation result as fair and adequate'' (FMEA, 2016).

CEBMs that are cooperating with communities or individuals for resource circulation or other related activities (e.g. commitment of resources, participation in projects) could consider a fair redistribution of funds that is equitable to the value of resources and effort contributed by each individual. Therefore the challenge of CEBMs is to create a 'value capture' element that embodies transparency and fairness as central values, to allow profits to be channelled in an equitable manner between involved actors and secure continuous cooperation.

5.2 Building blocks and their underlying value logic

This section discusses the underlying value logic of the identified building blocks which were presented in Chapter 4 (*Tables 5 and 9*). The analysis aimed at exploring similarities between building blocks in their function of value creation when incorporated in CEMBs. The outcome of this analysis is the development of five outstanding categories which are aggregation levels of the 25 building blocks. Even though, these categories are not intended to put the building blocks in a box, or create boundaries between them, rather to discover common features and understand what is their function in CEBMs. Each category is discussed below.

Enablers for systems-effectiveness: The first category of building blocks refers to several practices which are carried out from organizations to establish effective circular micro-systems. The four building blocks include '*eco-design, pure inputs, waste separation, quality*

management'. These four building blocks, overall have the same underlying function which is to engage solutions that foster system effectiveness and ensure that a CEBM do not causes disruptions or negative consequences to other systems (e.g. other organizations, the environment, or individuals) in the circular flow of physical resources. *Eco-design-Durability, compatibility, ease maintenance, upgradability, ease disassembly:* all these product design characteristics acknowledge that several actors will be involved in the product handling and subsequent actions would follow. Nevertheless *cradle-to-cradle* is a process-design characteristic which focuses in the interaction of humans with the natural environment – thus it enables effective systems for the preservation of the environment. *Pure-inputs:* ensure that procurement partners (supplying systems) emplace *'renewable, recyclable, bio-based'* inputs to reduce dependency on fossil-fuels and ensure that inputs used enable flexibility for recovering systems (e.g. recycling operations).*Waste separation:* This building block refers to any activities that involve pre-sorting of waste in order to increase recovery rates and reduce costs for treatment. In that sense, organizations by implementing this building block they enhance systems-effectiveness as they reinforce the expediency for later recycling and recovery systems. *Quality management:* involves systematic monitoring and testing activities to ensure that the reprocessing of resources would not cause any disruptions (e.g. wipe out private data from devices, testing the quality of compost created).

Technological Advancements: The second category refers to all technological advancements that were found applicable in CE and involves four building blocks namely: '*renewable energy, advanced engineering, hybrid technology* and *digital technology'*. However the analysis spawned three features regarding the underlying logic for the implementation of these technologies in CEBMs.

From Digital to Physical collaboration: In contrast to professional literature which introduced digital technologies simply as enablers for managing physical resources flow and performance optimization in a centralized manner (i.e. organizations monitor and control the data), document analysis suggest that digital technologies can be implemented by organizations to create a collaborative infrastructure based on a peer-to-peer approach. Documents often described the formation of digital, collaborative platforms that enable users autonomously access data and interact with each other to co-create and contribute to the creation of multiple values. For instance the Savory Institute (2016) claimed ''*our data management platform allows land managers to create and manage their farm, collect ecological data, and communicate with network members to create partnerships, share practices and solutions for success''.* This indicates that organizations in the CE could implement digital technologies to allow users exchange information, access resources and together coordinate activities to be taken in the physical world.

Eco-Innovation: In contrast to professional typologies which suggested that technology as a mean to optimize product performance and coordinate circular flow of materials, evidence from the document analysis suggests that technological advancements could be utilized for

restoring and regenerating the eco-system. For instance Hybrid technologies (3D printing) can enable bio-mimicking practices (e.g. 3D print artificial reefs for decontaminating water pollution), advanced engineering is used to remediate natural resources (e.g. bio-scrubbers), and digital technology is used to monitor and track the status of the eco-system.

Open-source technologies: Another emerging feature that was identified in 16 documents, regarding technological advancements in CEBMs was the promotion of open-source in both digital technologies and engineering. Unlike professional literature which introduced a configuration of digital technologies, as proprietary solutions (i.e. organizations log and control data flow) for organizations to enhance competitive advantage and optimize firms' resource use, document analysis suggest that digital technologies can be incorporated in CEBMs through an open-source manner where a community of users can access data, co-create and optimize processes. Such approach builds on the value of transparency and enables collective value creation. Characteristically Open Trip Planner (2014) stated:

''OpenTripPlanner (OTP) is an open-source platform for multi-modal and multi-agency journey planning. It provides a range of passenger information and transportation network analysis feature using our infrastructure for finding itineraries combining transit, pedestrian, bike and car segments. OTP relies on open data standards. Launched in 2009, the project has attracted a thriving community of users and developers, receiving support from public agencies, startups and transportation consultancies alike. ... OTP goes beyond passenger information, applying OpenTripPlanner's routing engine to problems in transportation planning, public policy and the social sciences.''

This could imply 'digital technology' can be implemented in a way where users are at the same time co-creators of the digital infrastructure. Each user has the freedom to access the data and digital infrastructure and contribute with their own expertise to organization's purpose. This implementation challenges the hierarchical structure of organizations where data are merely seen as a disclosed advantage of organizations' purpose to increase profits. Consequently, potential for sustainability arises from individual responsibility and 'self-organization', at the edges of the value-network instead from centralized operations within the organization.

Organizations even 'un-lock' their advanced engineering. For instance Carbion (2014) claimed: *''Our open-access facility provides test time to companies, universities, and knowledge institutes from all over the world, who are looking for bio-based alternatives''*. Such practices indicate a transition towards open innovation where diverse entities can participate in learning, improving and transferring technological innovations required for the CE across industries, saving time and resources. A practice which stems away from the notion of secrecy and competitive advantage.

Circular Activities

Circular activities refer to the building blocks which correspond to operational activities that CEBMs can implement to generate a source of income and contribute to the circulation of resources. Nine building blocks corresponded to organizational activities that are purposed for the optimization of the use of physical resources. These are *reuse, resell, maintenance, upgrade, refill, repair and remanufacturing, recycling, waste-to-material, waste-to-energy.*

Supporting Activities

The fourth category involves two building blocks which refer to supporting initiatives. The two building blocks include : ‘’*Servitization and Insurance.* Overall, these two building blocks could enable organizations to provide support to individuals, communities and other organizations to engage with CE. Moreover they could indicate a shift of organizations towards the creation of non-materialistic values.

Servitization: was a relevant building block to all nine archetypes and demonstrates a shift of CE organizations towards the provision of services rather physical resources. However, in comparison to professional literature where servitization, was simply concerned with ‘’*increasing profits through decreased material consumption* and *customer convenience*’’ document analysis has identified a trend among organizations towards the provision of services that are community-focused and support member participation in the provision of these services (e.g. peer-to-peer services).

Insurance: Professional typologies suggested that Insurance can reduce the risk associated with lending assets. Furthermore document analysis suggested that insurance can also represent a supporting initiative for reducing the risk associated with decontamination activities or mobilizing and funding regeneration projects. In any case insurance can be seen as a supporting activity which facilitates the circular flow of resources and restoration activities.

Collaborating Links and Infrastructure

Included in this category are six building blocks: *Industrial Symbiosis, take-back-systems, social currency, knowledge flow network, hubs, share.* A common characteristic of these is their ability to enable the collaboration of multiple actors for the creation of closed-loops, and the exchange of physical resources and knowledge. A flow of resources and information across organizations is facilitated between and across organizations and the CEBM is converted into an open-platform of interaction and co-creation.

The figure 7 below summarizes the five categories mentioned above:

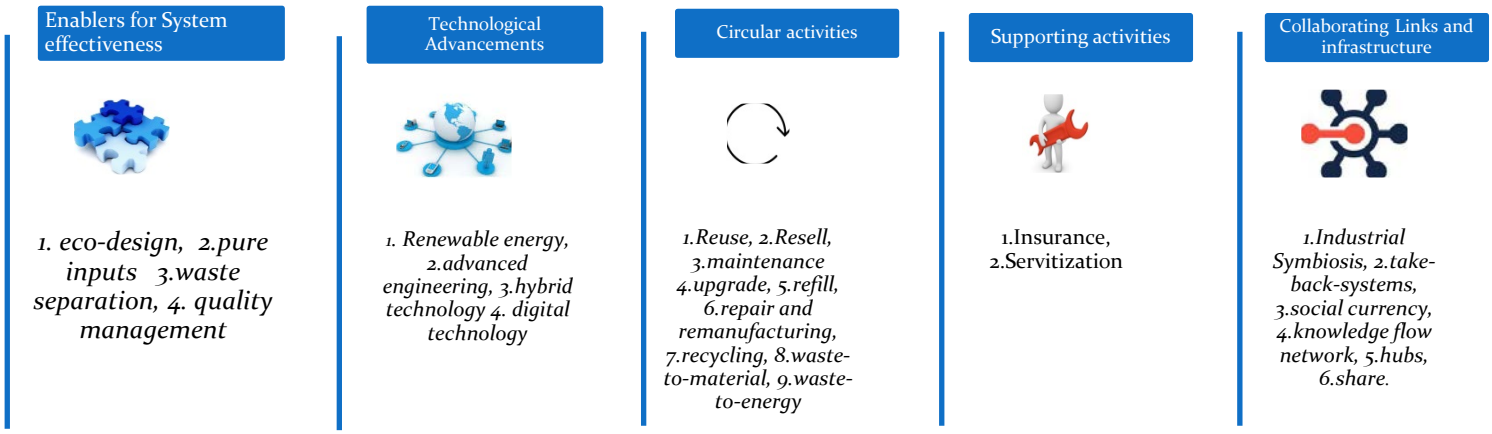


Figure 7: Summary of the five aggregated categories of building blocks

5.3 Configurations of Building Blocks per CEBM Archetype

Presented here are the building block configurations. The analysis involved a constant comparison between the generic framework of the typologies review (Appendix 3) and configurations found in the document analysis (Appendix 6). In this comparison, the analysis aimed to explore, interpret and understand which configurations of building blocks enable CEBM archetypes deliver their corresponding value creating logic, while allowing several partners collaborate and share the value created. The configurations are analyzed below per CEBM archetype.

Circular Supply Chain

Enablers for systems-effectiveness: ***Eco-design****:* Organizations design circular processes (e.g. cradle-to-cradle) to enable a continuous circulation of product and materials. ***Pure inputs****:* Bio-based materials, fully renewable and recyclable materials and fair-trade are several requirements for the procurement levels that could allow the transition from fossil fuels and bring justice throughout supply chains. ***Quality management****:* Organizations perform testing and quality control to ensure that produced materials are free of toxins.

Collaborating Links and Infrastructure: ***Take-back-systems****:* Take-back-systems are essential for a holistic circular supply chain. For example Decade Products (2013) stated: *''we have a unique "buy-back" program which allows for recycling to go toward the purchase of new pallets''*. This could imply that take-back-systems for CSC are configured to enable a two-way collaboration, by informing and compensating end-users for the correct disposal approach, and the emplacement of product-specific collecting points to enable a cost-effective collection process. ***Industrial Symbiosis:*** waste streams and by-products of other industries are seen as source of materials to refine (e.g. to produce bio-based products). ***Knowledge flow network****:* collaboration with scientific institutions and cross-sector industries to investigate and improve bio-processes and create advanced materials. ***Hubs****:* are designed as strategic locations for the

production and supply of bio-based or recyclable materials, the collection and processing of residues.

Advanced Technology: ***Advanced Engineering***: The restructuring of manufacturing practices are synchronized to increase recovery rates of specific advanced materials. Digital technology: ***Hybrid Technology:*** CSC models were concerned with the production of bio-degradable, fully recyclable filaments. For example 3D filaprint stated: *''made from plant starches, Biome3D is a biodegradable thermoplastic that is environmentally friendly, safe to work and odour free''.* This indicates that the predominant value logic of CSC to replace fossil fuels, guides the organizations' configuration of 3D printing technology and enable them to focus on replacing conventional filaments providing users an eco-friendly material.

CE activities: **Reusing and recycling** collected materials are the major CE activities of the CSC model. However as suggested by professional literature, in almost all the identified documents, organizations stated increasing efforts for preserving material quality in the reprocessing phase.

Resource Recovery

Enablers for systems-effectiveness: ***Waste-separation***: is one of the core building blocks in RR business model since half of the documents described systems to enable waste-producers sort disposed materials at the source. ***Quality management:*** The documents often stated efforts of designing user-friendly, cost-effective collecting services, the production of quality secondary materials, and quality sanitation services through hygiene control.

Collaborating Links and Infrastructure: The archetype requires efforts to reinforce quality collection and optimize waste-streams and ***take-back-systems***. For example: *''we analyze the waste flow and advice enterprises and municipalities on the correct approach to take´´ (Van Scherenzeel, 2014).* This implies that a configuration of the ***knowledge flow network,*** *building block* by advising the public and organizations for proper disposal, can mediate increased pre-sorting efforts. Furthermore, aligned with professional literature, the document analysis confirms the configuration of ***industrial symbiosis*** for the RR archetype as means for sourcing by-products from other industries as inputs for up-cycling purposes. ***Hubs:*** for the RR archetype enable multiple industries optimize logistics, and handle large quantities of refined materials (e.g. Aperam steel refinery).

CE activities: In a similar manner to professional literature review, the document analysis confirms the configurations of ***waste-to-material*** (e.g. recovering, up-cycling, biochemical extraction, composting) and ***waste-to-energy*** (anaerobic digestion, geothermal systems, bio-refining). These two building blocks refer to the technical activities for the conversion of the waste into energy or materials. However ***resell*** activities could be configured to allow organizations find applications for the recovered materials and remarket them in secondary markets.

Advanced Technologies: ***Digital technology:*** is configured to optimize logistics of trucks, analyze waste flows and match the supply and demand for waste streams. For example Deafvalmarkt.nl enables organizations and individuals to find secondary markets for their by-products or waste. ***Advanced engineering***: auto-sorting robotics and advanced recycling are configured to improve recovery yields.

Supporting Activities: ***Servitization:*** is configured for the provision of waste management services which involves the outsourcing of expertise regarding the optimization of waste recovery, to business partners, municipalities or households.

Knowledge Platforms

Technological Advancements: ***Digital technology****:* The use of digital platforms (online forums) are used for the distribution of device blueprints, open-source designs, repair guides, instruction videos and online courses to increase member's knowledge and participation in the CE. Nevertheless documents suggest that digital technology could be utilized in an un-centralized manner for KP, which means that the organization is not the only responsible entity for the production of information material, rather users are contributing for the establishment of a 'common database', on a peer-to-peer basis, to be accessed by any individual. ***Advanced Engineering:*** The use of open-source prototyping hardware platforms (e.g. arduino) enables users to create communities to investigate and together improve related technologies to the CE (e.g. processors for wind turbines).

Supporting Activities: ***Servitization***: for KP could refer to membership subscriptions in websites or the provision of spare parts services. Therefore this configuration represents the earning model of KP and is compatible with its value-logic, since it aims to provide users the necessary means to proceed with their CE activities (e.g. repairing).

Collaborating links and infrastructure: ***Hubs:*** For the KP archetype represent meeting points for exchanging knowledge, training and the provision of equipment for users which are unable to have at home (e.g. 3D printer etc). Users from different backgrounds and expertise have the opportunity to share their knowledge and form partnerships. ***Share:*** Users share expertise knowledge and development information (e.g. performance stats) to innovate collectively and optimize processes.

Product life extension

Enablers for systems effectiveness: ***Eco-design***: Several design characteristics are applicable for this configuration including: *upgradability, easy disassembly, easy maintenance, durability, compatibility, modularity.* Products are designed to last and evade obsolescence. ***Quality management:*** it involves inspections and quality assurance processes (e.g. wiping out private data to allay private concerns).

Supporting Activities: ***Servitization:*** It involves repairing and upgrading services or the provision of spare parts services are less resource demanding activities and can allow users extend a product life cycle.

CE activities: The CEBM is focused on ***reusing, maintaining, upgrading, repairing, remanufacturing*** products to avoid product obsolescence or ***recycling*** parts when the former activities not suitable.

Collaborating links and infrastructure: ***Take-back-systems:*** are configured through trade-in and buy-back schemes to incentivize users return pre-owned products. Such schemes enable a fair ´value capture´ as users receive economic benefits from organizations as an exchange for the returned items. ***Hubs:*** Repairing hubs could lead to the formation of collaborative communities to exchange repairing skills, create job opportunities and inspire sustainable consumption. For example Repair Cafe (2015) claimed: *''At the Repair Café they learn that you don't have to throw things away; there are alternatives.*

Technological Advancement: ***Digital technology:*** could be configured as online marketplaces to enable users find secondary markets for their used items or as collaborating platforms for the exchange of repairing knowledge. ***Hybrid technology:*** Document analysis suggests that 3D printing could configured as a tool for additive manufacturing, enabling instant reworking of replacing parts as a way to extend durability of products - a configuration which is in line with McKinsey's (2015) analysis.

Reverse Logistics

Enablers for system-effectiveness: ***Eco-design:*** it involves the use of modular, standardized packaging to improve handling and storage. Furthermore organizations minimize transportation emissions through the use of electric vehicle fleet or multimodal transportation. ***Quality management:*** Organizations could implement user-friendly, quality-preserving collection points and processes. For example the use of pre-paid envelopes could eliminate the risk of quality loss or leakage of hazardous material throughout the transportation of collected items.

Collaborating links and infrastructure: ***Take-back-systems:*** Document analysis supports professional literature's configurations regarding the use of automated machines to allow users return items and receive compensation on point. Thus such configuration could be a critical condition for shared-value creation. ***HUBs:*** are configured as Hub-and-spoke systems (Appendix 7) which allow logistic organizations to organize their fleet, collaborate and optimize procurement routes reducing emissions and costs.

Technological Advancements: ***Digital*** and ***hybrid*** technologies for RL could have a synergetic function in the creation of value. The use of 'track and trace' technology can enhance transparency between the value network, by enabling users or associations ensure end-to-end processes are conducted in a responsible manner (e.g. products were properly recovered).

Supporting activities: ***Servitization:*** The provision of personalized collection and advisory services (e.g. data accumulation) can allow organizations or households establish material balance (e.g. weight of waste recovered) and improve participation in CE.

Product Service Systems

Supporting Services: ***Servitization:*** Professional literature suggested that servitization for PASS could be configured to satisfy individual user needs, focusing into the fulfillment of functions. However document analysis suggested that multiple-user access could reinforce the establishment of collaborative communities. For instance Renault (2015) described their Twizy vehicle as an ''*open-ended object – allowing different communities of users to adopt it and invent a lifestyle with it''.* That could indicate that PAAS models can combine sharing-schemes enabling users access and operate products in a collaborative manner.

Collaborating links and infrastructure: ***Take-back systems***: Products and materials are returned by the users at the end of leasing. ***Hubs:*** for PASS could represent meeting points for users to access products, and exchange information regarding the effective use of products (e.g. right dosages of materials, energy saving etc.)

CE activities: In a similar manner to the professional literature, most documents referred to the execution of routine activities such as ***upgrading, maintenance*** *and* ***repairing*** as a total package of services together with the product leasing, to ensure multiple users receive access to services from the same inventory. However in contrast to Accenture's (2014) analysis which suggested that PAAS might be difficult for lower-value products, the documents analysis reviled that ***reuse*** and ***refill*** building blocks can be configured to enable users receive commodity products as a service to optimize the use of physical resources (e.g. refillable cleaning equipment).

Enablers for systems effectiveness: ***Eco-design*****:** is configured to optimize product environmental performance, enabling organizations achieve resource efficiency through upgradability, easy maintenance, modularity, recyclability. ***Quality management:*** Testing and cleaning of returned products after leasing, to ensure that they are safe for a consecutive use.

Technological Advancements: In line with professional literature, ***hybrid technologies*** and ***digital technologies*** are configured to allow users locate and access resources.

Sharing Platforms

Advanced Technology: ***Digital technology*** for SP are configured to enable the matching of demand and supply for underutilized assets, but also the creation of a collaborative community.

Connecting links and infrastructure: Users could ***share*** virtually anything through sharing platforms. However the configuration of ***social currency*** might enable non-monetary transactions. For example users can exchange credits that could be swapped for products (e.g. second hand items) or services (e.g. accommodation). This configuration could be regarded as a marketing practice to increase transactions on the same platform, however it adds a social texture and could enhance sustainable consumption patterns.

Supporting Activities: Document analysis suggests that **servitization** could be configured through the provision of intermediary services such as **insurance** and payment services to enable trust between peer to peer transactions for the sharing of assets - which is in line with Accenture's (2014) typology.

CE activities: ***Reuse*** and ***maintenance*** can be relevant building blocks for SP, however the activities are carried out directly from the users. For example ´´*the app provides residents with notifications, alerts and maintenance requests*´´. This can indicate that SP could configure maintenance activities to support the trend of 'prosuming' (i.e. users that provide quality sharing services).

Enablers for systems-effectiveness: ***Quality management:*** The establishment of review systems can enable trust between members' as they could influence members interact in a respectful manner to each other.

Regenerative

CE activities: ***Waste-to-material:*** food-waste is converted into compost which is a valuable soil fertilizer.

Enablers for systems-effectiveness: ***Eco-design:*** Cradle-to-cradle design as a way of designing systems and procedures for returning biological material into the biosphere. ***Waste-separation:*** it can be configured through a variety of methods, including kerbside pick-up, self-delivered or community bins to organize collection of organic waste from households.

Collaborating links and infrastructure: ***Hubs:*** are configured as meeting points to connect individuals, organizations and government agencies interested in regenerative projects, allowing them to interact and exchange resources such as information, tools, compost. ***Social currency:*** Social currency can be configured through the exchange of biodiversity credits which represent nutrient cycling, reforestation projects and habitat provision. Therefore this configuration can enable transparent transactions between investors, local authorities and communities and the evaluation of human-induced regeneration practices.

Supporting Activities: ***Servitization:*** Is configured around the provision of eco-system services. Through Payments for eco-system services private investors can fund regeneration efforts.

Technological Advancements: ***Digital technologies*** are configured to enable users collect process and share data related to eco-systems status (e.g. indicators of biodiversity). This indicates that digital technologies could be a critical building block for collective value creation, as it enables a close collaboration and communication between authorities, investors and communities to fine-scale regeneration processes.

Remediation

Enablers for systems-effectiveness: ***Quality management:*** The RMD archetype could involve the configuration of quality management activities for the monitoring and ranking of

contaminated sites to allow organizations select the appropriate remediation methods and quantify the results.

Technological Advancement: ***Digital technologies:*** are configured for the analysis and labeling of hazardous materials as a way to allow multiple actors (e.g. authorities, communities, organizations) communicate the risk and coordinate remediation activities. ***Advanced engineering:*** can be configured through the implementation of water treating technologies (e.g. Greywater systems, ozone technology) and site remediation technologies (e.g. bio-scrubbers and thermal treating).

CE activities: Collected and treated pollutants are then ***recycled*** to be ***reused*** in sustainable development projects, which creates further economic incentives for remediative projects.

Supporting activities: ***Servitization:*** it could involve the configuration of modular remediative systems for in-situ projects. Such approach enables the treatment of multiple contaminated sites with a single infrastructure, saving resources and building time. ***Insurance:*** is configured to mitigate risks for handling hazardous material and ultimately support clean-up projects.

Collaborating links and infrastructure: ***Hubs:*** multifunctional premises can allow a simultaneous remediation and recovery of contaminants, providing bespoke solutions for supplying recovered materials in surrounding industries. ***Knowledge flow network:*** Community's access to tools and evaluation techniques is required for participation in decision making of remediation projects. For example a case study stated: '' *The residents personally handed a memorandum. In this memorandum, they stated all their concerns and demands about their neighborhood: a new play area, more safe cycle paths, more green areas, etc.'' (Ovam,2014).* Therefore an open knowledge network could enable collective value creation by reducing uncertainties of facing environmental hazards and enforce the active involvement of communities.

5.4 Chapter Conclusion:

This chapter discussed the results of the professional literature review and the document analysis as presented in the previous chapters. This discussion leads to three main conclusions. First, the chapter elaborated on how the theory of multiple-value creation could be implemented in CEBMs. This responded partly to the first and second sub-questions, namely: 1. '' *What building-blocks and archetypes can be found in professional literature and 'practice'?''; and* 2.*''Which underlying value creating logics can be distinguished in those archetypes and building blocks ?''.*

The chapter revealed the value-creating logic of in total nine CEBM archetypes. It was argued that the first six archetypes could lead to the establishment of closed-resource loops and sustainable consumption patterns. These are: the *Circular Supply Chain:* aims to introduce bio-based, fully recyclable, renewable products and materials and design circular processes. *Resource Recovery:* focuses on up-cycling waste into valuable materials or energy. *Product Life*

Extension: aims to prolong products lifespan. *Sharing Platforms:* match the supply and demand of underutilized assets. *Reverse Logistics:* develop connecting links and infrastructure for the effective flow of resources between distinct entities (users or businesses). *Product Service Systems:* target on the delivery of functionality over product ownership. They enable companies to optimise the utilization of resources and foster a shift towards sustainable consumption. The *Regenerative* and *Remediative* archetypes foster environmental-*effectiveness* since they enable the restoration and regeneration of the eco-system. In addition to these eight archetypes, *Knowledge platforms* could be perceived as an additional archetype for disseminating knowledge and collective learning - a logic directly related to socio-effectiveness.

The 'value network' of all CEBM archetypes could be designed by *'engaging collaborative communities'* which in turn stimulate self-organized members and peer-to-peer interactions. However *'multi-disciplinarity'*, *'knowledge sharing'*, *'transparency' and 'open dialogue'* are also significant characteristics for the creation of a social-effective 'value network'- a requirement which corresponds to the creation of social values as suggested by Jonker (2014).

The 'value capture' element of CEBMs entails the sharing of costs and benefits between individuals and groups participating in organizational activities. A major collective outcome of CEBMs is 'social cohesion' as it contributes to the development of long-term collaboration of members towards common objectives which are either green development, or optimization of technical resource use. However 'individual benefits' are important to incentivize and retain individuals within the community. Fairness and transparency in the distribution of benefits is a fundamental principle and a missing link.

The second outcome of the analysis relates to the function of the building blocks in CEBMs. Coupled with the abovementioned conclusion, this outcome provides a complete response to the sub-questions 1 and 2. The analysis resulted in five aggregated categories[8] that represent groups of in total twenty five building blocks which seem to have a 'grouped' or shared impact in CEBMs. The categories include the *'enablers for systems effectiveness'*, that represent building blocks for risk mitigation (i.e. disruptions in other systems-individuals, organizations or the environment); *'technological advancements'*, which refers to building blocks that enable members to collaborate, deliver environmental performance and collectively innovate; *'circular activities',* which represent dedicated activities of organizations to create the conditions for the restoration and regeneration of natural environment and the circulation or cascading of materials; *'supporting activities',* which correspond to building blocks that organizations could implement to develop supportive relations with individuals and other organizations and ultimately enhance a broader involvement in the CE and ultimately *'collaborating links and infrastructure',* which is about building blocks that enable organizations and individuals to collaborate for exchanging resources and information.

[8] As explained earlier these five categories do not intend to draw boundaries between the BBs but rather understand common features and patterns among the 28 identified items.

Finally, the chapter articulated how the nine CEBM archetypes are linked to specific configurations of building-blocks, based on their value-logic. It was evidenced that each of the nine CEBM archetypes can incorporate several building blocks in a configuration approach. In this approach, CEBM archetypes can be conceptualized as the sum of interrelated configurations of building blocks which involve a simultaneous consideration of the delivery of a certain value-logic (i.e. archetypes' value-logic were clarified above) and the optimization of a value network which allows multiple stakeholders to interact and co-create value. The following figure provides an overview of this outcome. In sum it reflects the answer to the third sub-question of the study, namely: ''*How are these specific configurations based upon a VL and related BB allow the creation of multiple-values?''.*

Aggregate Dimensions	*CSC*	*RR*	*PLE*	*SHA*	*RL*	*PAAS*	*RMD*	*RGN*	*KP*
Technological Advancements	**Advanced eng:** Advanced recycling and material sciences **Hybrid Tech:** biodegradable filaments	**Advanced eng:** Auto-sorting robotics, **Digital tech:** match supply and demand for waste streams	**Digital tech:** share repairing knowledge	**Digital Tech:** online p2p platforms, **Hybrid:** access systems, track & trace	**Digital Tech: Hybrid:** track & trace for supply chain transparency **Advanced Eng:** automated collecting points	**Advanced eng:** Remote monitoring for cost-effective and timeless maintenance **Hybrid**: access systems, track & trace	**Advanced eng:** Water treating technologies, site remediation technologies **Hybrid:** enable bio-mimicking (e.g. 3Dprint artificial reefs)	**Advanced Eng:** Geo technologies **Digital tech:** Collect process and share data of environmental impact	**Advanced Eng:** open-source prototyping hardware **Digital tech:** Interactive online forums for p2p learning
Collaborating Links and infrastructure	**Take-back-systems**: product-specific collecting points **Industrial symbiosis** bio-refine	**Take-back-systems**: waste collection, Industrial symbiosis **knowledge management:** share analytics and advices for waste streams	**Take-back-systems:** trade-in pre-owned products, **Hubs:** meeting points with 3D printing & laser cutting	**Share:** underutilized assets **Social currency:** swopping points for exchanging products	**Social currency:** trade-in pre-owned products for credits **Take-back:** drop-off, pick-up points; **HUBs:** consolidate & recover products	**Take-back-systems**: Collect products after leasing users return products to docks **Hubs:** strategic locations for	**Share:** tools techniques, and concerns regarding remediation activities. **Hubs:** acceptance and treatment of contaminants	**Hubs:** Connect individuals, orgs and agencies interested in regeneration **Take-back:** Collect bio-waste to provide compost	**Share:** blueprints of eco-innovative machines and CE practical knowledge (e.g. repairing) **Hubs:** Meeting places for parts, tools and knowledge,
Supporting activities	**Servitization:** subscriptions for refills, **Encourage sufficiency:** increase awareness for bio-based products	**Servitization:** Outsource waste management services	**Servitization:** After sales support, spare parts services **Insurance:** warranties for restored products	**Servitization:** Intermediary services, **Insurance:** to reduce lenders risk	**Servitization:** Collection services **Insurance:** packages	**Servitization:** Subscriptions for access to services	**Servitization:** Remediation services **Insurance:** reduce the risk for handling hazardous material	**Servitization:** Payments for eco-system services, Consultancy for sustainable development **Insurance:** eco-system services	**Servitization:** spare parts services, subscriptions to knowledge forums
CE activities	**Reuse, recycling, waste-to-material:** to recover and up-cycle collected materials	**Waste-to-energy:** anaerobic digestion to produce energy & heat **Waste-to-material:** recover, up-cycle materials from waste	**Upgrade, remanufacture**, **reuse, resell** Obsolete products **Replace & recycle** parts	**Maintenance:** User notifications for reminding maintenance activities; **Reuse:**	**Reuse:** packaging **Resell:** remarket collect products to secondary markets	**Reuse, recycle** materials to cut wastage **Maintenance**: ensure durability	**Recycle, reuse:** pollutant materials (e.g. plastic debris)	**Waste-to-material** Convert bio-waste into compost output to be returned in the bio-sphere	**Reuse, recycle** products and parts
Enablers for system effectiveness	**Eco-design:** cradle-to-cradle products and processes **Pure inputs:** Bio-based, renewable, recyclable , fair-trade materials	**Waste separation:** pre-separating points for waste **Quality management:** Hygiene control and monitoring	**Eco-design:** upgradable, durability, easy maintenance, modularity	**Quality Management:**	**Eco Design:** Modular, standardized packaging, eco-fleet (e.g. electric vehicles, cycles) **Waste-separation**: pre-separating collecting points	**Eco-design:** easy maintenance, upgradability, durability of products **Quality management:**	**Quality management:** Community monitoring of air, water and soil quality	**Eco-design:** nature-based solutions to bring natural features and processes into cities **Waste separation:** Bio-waste separation	**Quality management:** Monitoring learning and building performance of individual projects to enable community identify areas for improvement

Figure 8 : *Configurations of Building Block per archetype, that allow the creation of Multiple Values.*

Chapter 6. Conclusion

This final chapter aims to summarize the theoretical and practical implications towards organizations within the CE. The research set out to conduct an explorative study with the intention to unravel business model archetypes and their building blocks for the circular economy. To accomplish this objective several steps have been taken. The primary contribution of the study is a business model typology, which maps and analyses existing circular business model archetypes on the one hand and on the other hand proposes a number of additional potential configurations of building blocks based upon an Internet search of professional documents. These two outcomes reflect a state of organizational practice in the CE.

This chapter first provides a synopsis of the background of the research, followed by the methodological approach and a summary of the results based on the research questions. The final sections address the limitations of the research, the implications for practice and a number of suggestions for further research.

6.1 Background Research and Research Gap:

The thesis started with exploring how the current linear economy does not consider the two main pillars of sustainability namely societal and environmental protection. The deficiencies of the open-ended structure of the linear economy have been discussed, illustrating how it leads to production and consumption systems that correspond to a 'take-make-dispose' economy. Against this backdrop this thesis has investigated how the concept of CE could be seen as an opportunity for harnessing economic activity in which sustainability is incorporated.

Theoretically this study focused on value creation. The organizational challenge of the CE is seen as one that requires so-called multiple-vale creation. Several studies (Preston, 2012; Sauve et al., 2016) show that the implementation of the CE requires both a technical system redesign (i.e. closed resource loops) and the realignment of current societal values and actions with sustainable pathways.

Through the investigation of various value creating theories, it was suggested that organizations could be the main driver for creating rapid social change. As such, the design of business models for the circular economy is considered as ultimate 'bridge between the multiple-value requirements of the CE. Thus the unit of analysis of the process of value creation is an emerging group of dedicated business models. By reviewing existing literature it was found that 'conventional' business models(e.g. Osterwalder and Pigneur, 2010) cannot accommodate the creation of multiple values, since they are centered around capturing a 'value proposition' that represents merely economic concerns. This analysis of the conventional literature made clear that the nature and value creating logic of business models for the CE was unclear. It was particularly this gap that was addressed in this thesis, by

suggesting three corresponding elements that can enable circular business models to synchronize with organization's value creating process and accommodate a changing logic of value creation of the CE. The three elements include the 'value logic', 'value network' and 'value capture'. Together they represent the 'micro translation' of anchoring multiple values into a business model.

To gain understanding of how this translation on business model takes place, circular business models were explored. Literature concerning BM for the CE suggested several building blocks leading to a limited number of business model archetypes. Collective characteristic of these models is that all aim at the development of closed resource loops. However previous research did not explore how these building blocks can prove useful for multiple-value creation. Moreover archetypes often derived from unsuitable sustainability concepts such as 'eco-efficiency' which implies solely a reduction of environmental impacts and resource intensity (e.g. Bocken et al., 2014; Boons and Ludeke-Freund, 2013). At the same time by transferring these emerging circular practices into organisations and broader industries could lead to the creation of business model archetypes and building blocks that were not yet identified in the literature.

This lead to the identification of a several research gap - what new CEBM archetypes or building blocks can be found and how organizations establish CEBMs in business practice.

The second research objective of the thesis was to explore, collect and compare organization practices. Overall the research underpinning this MT has led to a typology of CEBMs, illustrating their building blocks and value creation logic(s).

6.2 Methodology

To establish the typology, a two-fold qualitative research was initiated. The research was grounded of keywords that represent organizational practices and activities relevant for the development of business models for the circular economy. The keywords then were classified as building blocks or archetypes based on predetermined criteria and boundaries[9]. To achieve this, the research followed a two-step approach. First it gathered and analyzed five already existing typologies to produce a generic framework. This generic framework served as the initial base of classified keywords (found in the typologies), that would be extended and verified in the second step. The next step involved the collection of 195 business documents from European websites through an iterative manner (i.e. iterative querying combinations of terms emerged from the analysis to an online search tool). Documents were then downloaded and imported in analytic software Nvivo and were subject to content analysis. This analysis was aimed at verifying and extending the generic framework generated from the typology review by unraveling and classifying prominent keywords found in the documents. This approach was particularly challenging since it was facing 'confusion of tongues' and resulted in a plethora of terms that usually overlapped. Despite this challenge, the pre-defined criteria

and boundaries allowed a more suitable classification.[10] The applied methods overall were useful for realizing the objective of the research as they enabled a scaled identification of organizational practices.

6.3 Research Questions:

The professional literature review was conducted together with the business documents analysis, to address the main research objective which was the development of a typology which classifies CEBM archetypes which are linked to specific building block configurations, enabling the creation of multiple-values. To achieve this objective, three sub-questions were formulated. The following section demonstrates the sub-questions and summarizes the responding findings.

This first sub-question pursued the identification of CEBM archetypes and building blocks.
Research sub-question 1: "*What BM building blocks and CEBM archetypes can be found in professional literature and practice ?''*

Building blocks: Building blocks represented categories of key-words that refer to a business activity, process, type of technology, product/service attribute or stakeholder relation that could contribute to a circular business model. After the literature review, twenty building blocks were identified, while the business document analysis had been able to identify patterns of organizational activities that correspond to five additional building blocks. The Tables 5 and 9 in the chapter 4 presented the building blocks identified in professional literature review and business document analysis, respectively.

CEBMArchetypes:

The classification of CEBM archetypes was based on the three elements of value creation (value logic, value network, value capture). The professional typologies review allowed the identification of seven business model archetypes that could accommodate these three elements, namely *Circular supply-chain (CSC), sharing platform (SP), resource recovery (RR), product life extension (PLE), product as a service (PASS)*, reverse logistics (RL) and regenerative (RGN). Through the business document analysis, the before mentioned CEBM archetypes were verified through empirical data. Within these documents, organizations described their value logic and business practices that explain how the value network and value capture can be established in these CEBMs. 44 documents provided business model descriptions that correspond to the CSC archetype, 78 documents with information related to RR archetype, 68 documents with information related to PLE archetype, 65 documents with descriptions related to PAAS archetype, 14 documents with descriptions related to the RGN archetype and 44 documents with information related to the RL archetype. In addition document analysis identified two further CEBM archetypes, namely: '*remediative' (RMD)* and '*knowledge platforms (KP)* within 14 and 8 documents respectively.

[10] Detailed criteria and boundaries between the terms can be found in methodology chapter.

Following this identification, the second sub-question applies, which aimed at clarifying the potential of the nine CEBM archetypes for the creation of multiple-values.

Research sub-question 2: ''*Which underlying value creating logics can be distinguished in those archetypes and building blocks ?''*

Value creating logic of CBEM Archetypes

Chapter 4 and 5 provided and discussed data from the documents and professional typologies which corresponded to the three elements of value creation of a CEBM (i.e. value logic, value network, value capture). The following conclusions can be drawn regarding these elements and hence illuminate the archetypes value creating logic.

Value Logic: The value logic of CEBM archetypes is based upon two criteria, the ability to pursue eco-effectiveness (i.e. establish closed resource loops and enhancement of the environment) and socio-effectiveness (i.e. total positive social impact). Six CEBM archetypes were associated with the development of closed-resource loops. The value logic of these six archetypes is as following the '*Circular supply chain' which* is driven from a predominant value-logic to design closed-loops of products and materials from fair-trade, bio-based, fully renewable, recyclable inputs. *'Product life extension'* aims to influence a consumption-based society, design durable products and extend life of existing products*. 'Resource Recovery'* aims to recover material resources or produce energy from waste and by-products, The *'sharing platforms'* aim to match the demand and supply of underutilized assets, '*Reverse logistics'* aim to scale connecting links and infrastructure for the effective flow of resources between distinct entities and *'Product as a service'* aims to provide access to multiple users and functionality over product ownership. These archetypes allow the establishment of closed resource loops and therefore they can lead to an 'optimized' and 'neutral' utilization of resources and adoption of sustainable consumption patterns (transition to renewable energy resources, closed-resource loops, extension and recovery of products and materials consumed, shared ownership and function-based consumption).

Two identified CEBM archetypes enable organizations to develop systems to restore and enhance the natural environment. These are the '*Remediative'* archetype which aims to improve the quality of water and land by removing contaminates and '*Regenerative'* archetype which pursues the regeneration of landscapes through reclaiming and returning recovered biological material back to the bio-sphere.

The *'Knowledge Platforms'* archetype stems from the logic to disseminate practical knowledge related to the CE. It was suggested that such logic could be related to socio-effectiveness since it empowers individuals education and through peer-to-peer learning facilitates the integration of previously unconnected individuals in a community focused in sustainability values.

Value Network: Through the document analysis it was revealed that the 'value network' of CEBMs entails a number of general features (characteristics) which could be applied in any

CEBM archetype. These are the *'engagement of collaborative communities'* which implies the support and promotion of community groups involved in CE activities (e.g. repairing, composting). Such communities can then stimulate *'peer-to-peer interactions'* which were found significant features for stimulating the participation and guidance of individuals. This in turn results in *'self-organization'* which implies the autonomous, decentralized involvement of individuals in CE activities. The formation of *'multi-disciplinary teams'* and *'coalitions and organizational networks'* were also significant features of the 'value network' as it allowed inter-disciplinary groups to collaborate and together contribute to collective problem solving and progress eco-innovation (e.g. Eco-shape). However *'transparency*', *'equity'*, and *'open dialogue procedures'* were recognized as fundamental features for enabling multi-actor collaboration.

Value Capture: The thesis suggests that the 'value capture' of CEBMs could entail a number of general costs and benefits that are shared between the actors involved. These are distinguished in an individual and a collective level. It was suggested that *'social cohesion'* can represent an important collective benefit that is captured through CEBMs since it reinforces the continuity of a collaborative community. Since the community is engaged in activities that are aligned with environmental sustainability (e.g. regenerating, repairing, remediating etc), 'social cohesion' could improve sustainability potential. The 'value capture' element could also involve individual benefits, intangible *(education, belongingness*) and economic (*monetary compensation, access to functions*) in order to retain individuals within the community of the CEBM. It was also suggested that fairness and transparency could enable the concept of 'distributive equity' which was found to be the missing link of CEBMs for the equitable distribution of benefits among involved partners.

Building blocks

Five aggregated categories demonstrated the value creating logic of the twenty five building blocks. The categories grouped building blocks, that cause a similar impact when incorporated in CEBMs. These aggregated categories are: the *'enablers for systems effectiveness'*, that represent building blocks for risk mitigation (i.e. disruptions in other systems-individuals, organizations or the environment); *'technological advancements'*, which refers to building blocks that relate technologies that enable members to collaborate, deliver environmental performance and collectively innovate; *'circular activities',* which represent dedicated activities of organizations to create the conditions for the restoration and regeneration of natural environment and the circulation or cascading of materials; *'supporting activities',* which correspond to building blocks that organizations could implement to develop supportive relations with individuals and other organizations and ultimately enhance a broader involvement in the CE and *'collaborating links and infrastructure',* which is about building blocks that enable organizations and individuals to collaborate for exchanging resources and information.

Document analysis and professional typologies review suggests that these building blocks can be implemented by organizations through a configuration approach. Specific configurations lead to the development of the nine CEBM archetypes. Therefore the third sub-question applies.

Research Sub-Question 3: *"How are these archetypes are configured based upon a VL and related BB to enable the creation of multiple-values ?''*

This sub-question was aiming at exploring different configurations of building blocks to understand how the combination and adjustment of building blocks in a CEBM can enable multiple value creation. The figure 8 in Chapter 5, summarizes different building block configurations of the nine archetypes as identified in the study. Overall the thesis suggests that organizations by defining a certain 'value-logic' can then select and configure several building blocks to capture this value within their value-network and accordingly share the value created with the partners involved. The section below draws two conclusions, regarding technical aspects of the configuration process.

Configurations enable the capturing of the Value-Logic: The first overall conclusion that can be extracted from the analysis that each building block for each archetype is seen as an opportunity for capturing the distinguished multiple values identified in the previous research question. Moreover the results suggest that the architecture of CEBMs is based on the implementation of several building blocks that are all configured to their corresponding value-logic. Therefore by taking a system perspective, each CEBM can be seen as a total functioning system that is comprised by a set of sub-systems – the building blocks. All sub-systems - building blocks interact with each other to enable the total system –CEBM capture the corresponding value-logic.

Building blocks are configured around Value-Networks: The second conclusion that can be drawn from the results of this study, is that these configurations are centred around the formulation of value-networks. Building blocks configurations usually take into account the activation of collaborative linkages within multiple-actors in the CEBMs. For example the configuration of hybrid technologies (e.g. track and trace) that was found relevant in most archetypes does not serve mere internal organizational purposes but is configured to allow users gain transparency and increase participation. This could suggest that building block configurations does not concern mere organizational integrity or 'internalizing benefits' but rather the formulation of CEBMs that operate as an open collaborative platform.

In summary, the three research questions have been addressed. Together the three corresponding answers have provided first an inventory of building blocks and CEBM archetypes, second the clarification of the value-logic for each archetype and third they gained a first inside on how building blocks configurations can enable organizations create multiple values.

6.4 Contributions to theory:

The results of this study may contribute to the theoretical considerations of value creation within organizations. As mentioned in the section 6.1, the research was aiming to explore how building blocks can enable CEBMs create multiple values in CE. The results have several theoretical implications. First the research brought forward nine CEBM archetypes that support the theory of multiple value creation (Jonker, 2012). All nine archetypes were associated with organizations that claimed the development of environmental, societal and environmental values, as the core of their business models and operations. Hence the research has also contributed to Murray et al (2015) who observed that the concept of CE overlooked the social dimension.

Second the search revealed 25 building blocks that represent organizational practices for the CE. Most importantly the study has provided evidence and elucidation on the use of building blocks. It has been clarified that organizations in the CE, share and exchange building blocks across different industries. The results suggest that the architecture of circular business models is mostly based on different re-combinations and configurations of building blocks. However, in contrast with conventional theories on business models (Osterwalder, 2004);these configurations were not centered on a value proposition (i.e. increasing revenues and customer satisfaction), but they enabled the creation of multiple values, the formation of 'value-networks' and the capturing of 'shared value'.

6.5Practical Implications:

The study has been able to identify nine different archetypes of circular business models that can allow organizations to pursue economic, societal and environmental values simultaneously. A wide-range of building-blocks were detected that can contribute in the formation of CEBMs. For each archetype, the study discussed a set of building blocks and configurations that were linked to a value logic. This analysis helps organizations in understanding the nature of circular business models and the logic of applying building blocks.

Several practical implications occur. First it was found that each of these building blocks can be configured and operationalized differently, depending on the value logic pursued by the business model. This could suggest that building blocks in practice, have the same properties with 'patterns'. *'A pattern is an idea that has been useful in one practical context and will probably be useful in others'(* Fowler, 1997). Similarly this notion of 'pattern transferability' can concern organizational domains and more specifically it can represent as an applicable value creating logic for the Circular Economy.

Organizations by assigning a value logic, which is often based on multiple values, they attempt to capture and deliver this logic by reusing and configuring solutions – building blocks, used in other industries and organizational contexts. For instance, organizations were found to recombine and configure Digital technologies, 3D printing, HUBs, together with other building blocks. Nevertheless the nine configurations were always designed and focused on attaining the promised value logic. It could suggest that organizations in the CE could first define an

organizational strategy-logic that is based on multiple values. Following that, organizations can systematically explore innovation efforts and applied solutions (building blocks) within a cross-industry perspective. By identifying emerging building blocks occurred in other contexts, can then assess their applicability and if possible, configure them by focusing on their value logic.

An observation from the findings could also suggest that innovative business models can result from the configuration of 'unusual combinations' of building blocks. This can indicate that innovation within Circular Economy could result by cross-industry collaboration that exchange best practices. Nevertheless the study cannot clarify how organizations can assess distant building blocks. (i.e. how a building block in a distant industry can be applicable). Therefore configurations of building blocks could be established as a method that takes into account a 'value-network' perspective.

Many organizations involved in the CE claimed that the development of infrastructure enables multi-actor collaboration as essential for delivering multiple values. Therefore several building blocks such as HUBs, knowledge management, digital technologies and social currency can be incorporated in circular business models and configured to enable multi-actor participation, exchanging patterns and access to resources and information. Most industries are currently circumscribed in linear business models where customers and partners are perceived as simply external stakeholders. Configuration of building blocks while pursuing collaborative value creation can offer the opportunity to start-ups and established organizations drive and scale the circular economy.

6.6Limitations

6.6.1 Limitations of the study:

This section aims to discuss the limitations of this study. Overall, the explorative character of the study, attempted to disclose as many business model archetypes and building blocks as possible, thus it lacks in-depth analysis. For instance each business model archetype might have more aspects and building blocks that need to be considered. The dynamic nature of circular business models, implies that new organizational practices are invented perpetually therefore it is not certain if it includes all relevant archetypes and building blocks.

6.6.2 Methodological limitations:

The research involved data from professional literature (typologies). The degree of reliability in those projects is questionable, therefore it was attempted to evaluate a limited number of publications. Moreover documents analysis is usually a complementary process in support of triangulation in a research project (Bowen, 2009). The fact that the documents collected were business 'self-reported' online material can result in incomplete and fragmented data. For instance it is still unclear whether the reported activities and business model descriptions in documents involved represent or match actual business practices. Thus the empirical evidence brought forward can be rather weak to validate the usefulness and practicality of

the proposed building-blocks. Moreover coding in the nodes has been done manually by a single coder. The linguistics used in documents to describe business models activities and building-blocks usually overlapped which can be puzzling. This could lead to bias as the coding in nodes was due to coder's own interpretation.

In addition value-creating potential was evaluated based on the views demonstrated in the business documents. However, it is yet unclear what other implications could result from the implementation of the building blocks suggested. For example 'big data', 'remote monitoring' or 'automation' can be used to optimize environmental performance. However these building blocks can also result in ethical issues such as privacy risks, safety issues etc.

6.7Suggestions for further Research:

'Distributive equity' was identified in this study as the missing link of the 'value capture' element to allow CEBMs synchronize their value creating logic with the concept of shared value creation of Jonker (2012). The concept of shared value creation entailed the sharing of benefits between multiple collaborative partners. Many of the organizational cases explored in this thesis claimed to engage individuals and communities in their efforts to capture value. The participation of communities in different CE activities (e.g. repairing, composting), resulted in the creation of economic wealth and other economic benefits; the question of how these benefits ought to be distributed then arises. None of the organizations in the documents studied have described procedures and context that demonstrate the design of a transparent and fair 'benefits-sharing scheme'.

However, scholars suggest that benefit-sharing schemes in organizations should consider the design of mechanisms that allow funds to be allocated in an 'equitable' manner among eligible beneficiaries (Brockhaus et al, 2014). There are several reasons for this consideration. First it could be argued that a fair distribution of benefits can influence the cultural and economic values of local communities and individuals since they can encourage them to continue participation in CE activities. Second, it could contribute to the society as a whole, since it makes criminal and political violence less likely (Maiese, 2003).

It is important to explore how 'distributive equity' can be achieved in CEBMs so as to establish a framework that would enable an equitable and fair redistribution of the benefits captured. It is still unclear what defines a fair system for the distribution of benefits. Equitable distribution could consider the effort of individuals and the fair value of resources contributed (e.g. waste, pooling of assets). Although rewarding people based on their productivity or performance could also lead to ethical questions (i.e. those who cannot compete with performance will receive less benefits).

A comprehensive framework is therefore required to explore different aspects of distributive equity and understand how they can be pursued. Without this framework it is difficult to evaluate the effectiveness of the 'value capture' element and the impact of CEBMs in the

wellbeing of society and individuals. Therefore, further research is needed to understand how 'distributive equity' could be related to CEBMs.

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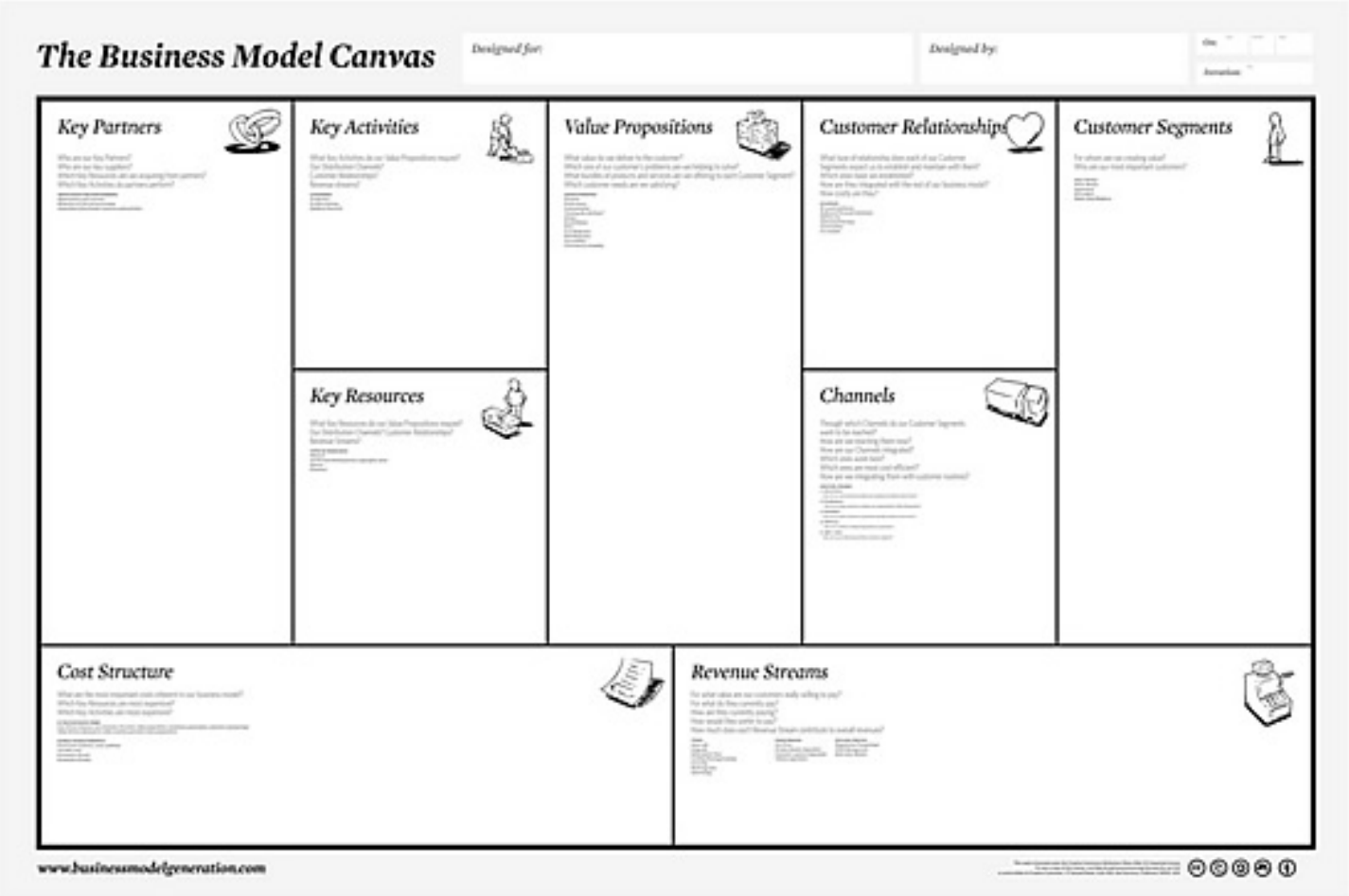
Appendices



Appendix 1: Business Model Canvas (Osterwalder and Pigneur, 2010).

Nodes	Context Units	Recording Unit	Sub-Nodes
Circular Supply Chain_node *It is comprised by several business model descriptions that correspond to the archetype: 'circular supply chain'*	Carbios is active in value creation in recycling: the aim is infinite recycling of waste, thus obtaining a circular economy. Carbios targets PLA and PET recycling. It sees enzymatic depolymerisation as its key competitive advantage. (*Example of a sentence popped up after querying 'recycling' in the Circular Supply Chain Node*)	Recycling	Biorecycling: the aim is infinite recycling of waste, thus obtaining a circular economy. *Narrative coded in 'CSC_ Recycling' sub-node*
Resource Recovery *It is comprised by several business model descriptions that correspond to the archetype: 'resource recovery'*	We have a role to play, by offering our knowledge along with customized and innovative solutions to customers, every day, whether local communities or manufacturers, to provide them waste separation services to keep public areas clean and pollution-free, and solutions to recover waste by recycling or re-using it to produce energy. (*Example of a sentence popped up after querying 'recycling' in Resource Recovery Node*)	Recycling Waste separation* **New identified Key-words represent a new building block*	Solutions to recover waste by recycling *Narrative coded in 'RR_Recycling' sub-node* Waste separation services to keep public areas clean and pollution-free Narrative coded in *'RR_waste separation'*

Appendix 2: Coding example for Document Analysis in Nvivo

Building Block	***CSC***	***PAAS***	***SHA***	***RR***	***PLE***	***RGN***	***RL***
1.Eco-Design	Introduce Cradle-to-cradle process to eliminate waste from the design of products and services [3]	Durability, maintenance, upgradability to avoid degradation [3] [1] Multi-modal services [3]			Durability, compatibility, ease-maintenance, upgradability, dis/assembly[11] self-healing materials [4]		
2.Pure Inputs	Non-toxic, fully renewable, recyclable, bio-based inputs to replace linear, toxic, non-renewable materials [3]						
3.Reuse			Reuse and share assets through the entire lifecycle [4]		Reuse second hand products to save embody energy [5]		
4.Renewable Energy	Source and supply renewable energy [3]						
5.Advanced Engineering	Invest in material sciences to introduce circular inputs and enhance recovering [3]	Remote sensing and steering to optimize maintenance [4]		Sorting, reprocessing, refining technology [3]			Auto-collecting machines to remotely evaluate returns [3]
6.Waste-to-Energy				Anaerobic digest to produce biogas from waste [4]			
7.Waste-to-material				Recover valuable materials from waste, bio-refining [5]		Recover biological resources [4]	
8.Industrial Symbiosis				Collaborate by exchanging feedstock [2]			
9.Recycling		Recycle reclaimed materials [3]		Open-loop or closed loop recycling [5]			
10.Remanufacturing and Repair		Repair products for consecutive use [3]			Repair products to save embodied energy and economic value [5]		
11.Take back systems		Centralized take-back systems to lower coordination costs [3]			Trade-in schemes [3]	Collect bio-waste and bio-nutrients from households and business [4]	Take -back schemes
12.Resell		Resell returned products [3]		Resell recovered materials	Resell restored products [3]		Resell previously unwanted products
13.Upgrading		Upgrade of product functions [1]			Device expansion and modification to avoid obsolescence [1]		
14.Refill					Repeat sales of the fast-cycling consumables or replacements [1] [3]		
15.Servitization		Retain ownership, subscriptions, [3] pr	Intermediary services (e.g. payment processing) [3]				

[11] Bakker et al., (2014) 2. kraaijenhagen et al., (2015) 3. Accenture (2014) 4. McKinsey (2015) 5. Green Alliance (2015)

		access or pay for performance [1]					
16.Share		share, use and return [4]	Share assets [3]				
17.Hybrid Technologies			Track & trace to enable users track assets [3]	Track & trace to screen material flows [3]	3D printer to enable the reworking of spare parts [3]		Track and trace to screen end-to-end flows of materials [3]
18.Digital Technologies		Use of big data to optimize product efficiency [4], predictive maintenance [3]	Mobile tech to locate assets and communicate with users [4]				
19.Insurance		Partner with insurance companies to create value for both [3]	Insurance to reduce the risk of the lender [3]		product warranties [1]		
20.Maintenance		Maintenance as a part of the service [3]	Prolong lifetime through maintenance [4]		Predictive maintenance [4]		

Appendix 3: Configurations of Building Blocks found in Professional Typologies Review

Characteristics of the CEBM value-network	Documents	Representative Citations
Engagement of dedicated communities	35	*"The common theme is that members of the local community are involved in the management of the waste they produce"* (Community Composting Network, 2016). *"Net-Works is driving a net-positive impact commercially, socially and ecologically by creating community-based supply chain for discarded fishing nets that provides access to finance for the artisanal fishing communities" (Interface, 2016)*
Peer-to-peer interactions	27	*"We are transforming the energy sector with our peer-to-peer marketplace for buying and selling renewable energy. Instead of trusting energy companies to act in their best interest, consumers will be able to buy their energy directly from independent renewable generator " (Climate KIC, 2013).* *Vixster is a trash and recycling service company that provides a peer-to-peer waste removal service for commercial and residential customers on-demand or by subscription (Vixster, 2016).*
Cross-industry collaboration	24	*"We intend to collaborate with various project partners in the field of e-waste collection, dismantling and recycling" (EWIT, 2015).* *"With our knowledge of logistics systems, raw materials and recycling, we are a logical partner for companies who want to close their cycle by reusing their waste streams"* (Van Gansewinkel, 2013).
Self-organization	20	*It's a year since M&S launched 'shwopping' – an initiative that encourages customers to bring old items of clothing into the store "* *"The Restart Project is a London-based social enterprise that encourages and empowers people to use their electronics longer in order to reduce waste* (London Waste and Recycling board, 2015).
Multi-disciplinary teams	15	*"We are an open network of community organizers, educators, technologists and researchers working to create low cost solutions for monitoring air, water and land"* (Public Lab, 2015) *"To create new life on degraded land, local users of the land – governments, local experts and other stakeholders – must be involved and co-own the project"* (The land life company, 2016)
Inter-organizational knowledge sharing	14	*" The pilot plant provides test time to companies, universities, and knowledge institutes from all over the world, who are looking for bio-based alternatives" (Tebodin, 2014)* *That is why Eco-shape develops knowledge in pilot projects, distributing it to everyone involved in hydraulic engineering projects. (Eco-shape, 2015)*
Transparency	10	*Urban sensing and open data infrastructure are critical for monitoring progress towards the goals, enforcing key directives, and for purposes of research and communication (Metabolic, 2014)*
Open Dialogue and communication	6	*The car club is run in a democratic way, as a social enterprise, using a methodology called Sociocracy (Mooray Car Share Club, 2016).* *"This was preceded by extensive consultations with the residents of the area and the Flemish Land Agency (VLM), who will be redeveloping the site. OVAM and VLM started by setting up meetings with residents to explain the plans. Residents were able to share their objections and remarks" (Ovam, 2014)* *Polyflor's goal is to be as transparent and informative as possible, operating an open communication policy with all stakeholders. (Polyflor, 2015).*

Appendix 4: Representative citations for the characteristics of the CEBM 'value network' (found through Document Analysis)

	Costs/ benefits	Category	N	Illustrative Citation
Individual level	Costs	Return Waste Materials	11	*"Customers must register with the scheme and then request smaller or larger bulk bags to gather their waste vinyl" (Polyflor, 2015)* *Banking of high-quality materials with customers creates a new customer touch point without creating added costs (*Kienbaum, 2011*).*
		Assets commitment	10	*"Together, all Dutch, German and Danish SnappCar participants share nearly 15.000 cars."* (Ernst & Young Accountants LLP., 2015)
	Benefits	Monetary Compensation	15	*"A1 Electronic Recycling may be able to provide per pound monetary compensation for certain recycled products (A1 Electronic Recycling, 2016)"*
		Education	17	*"The centre also offers training in upcycling skills like sewing, upholstery and wood work, helping to spread the values and practices of re-use further"* (FEE, 2014). *"Using inexpensive DIY techniques, we seek to change how people see the world in environmental, social, and political terms" (Public Lab, 2015).*
		Belongingness	5	*"Having Fab Lab as an open access space and community hub is a big advantage as people can just walk through the door and get involved" (Fab Lab, 2014).*
Community Level	Costs	Crowd-funding	10	*"The Ocean Cleanup has successfully completed its crowd-funding campaign. with the support of over 38000 funders from 160 countries" (The Ocean Cleanup, 2015).*
	Benefits	Monetary compensation	3	*"Community-based supply chain for discarded fishing nets that provides access to finance for the artisanal fishing communities that the partnership works with." (Interface, 2016).*
		Co-ownership	3	*In Denmark, 90 % of wind turbines are community-owned, with the benefits retained entirely by localities (FMEA, 2016).*
		Green shared areas	10	*Our customers work hard to develop their local communities to develop shared areas. They may be looking to develop a community garden, an allotment, herb garden or community orchard" (New Ground, 2015).*
		Self-Sufficient communities	12	*"This would be North London's first compost hub, self-contained within this unique King's Cross Space. The hub could be a catalyst to extend and support self-reliance within this community's food growing projects"* (EcoPark Compost Hub, 2014) *Future developments in wave and tidal technologies will further increase its self-sufficiency in renewable energy (EMF,2012).*
		Social-Cohesion	17	*Onion River Exchange (ORE) utilizes local resources through the network, to create a thriving social economy and tool exchange that results in community wellbeing, strengthens social cohesion, encourages reciprocity and enhances our local economy and is built on a foundation of respect and equality (ORE, 2016).* *In an integral approach that we call Desycling (from recycling to redesign) we address social issues as social cohesion, participation, integration and waste material awareness. All activities are focused on participation, with design as the main tool to stimulate this (LSDP, 2015).*
		Functional Economy	14	*´´A multi-modal on-demand system would provide universal access and enhance user benefits by at least a factor three versus today." (SUN, 2015).*

Appendix 5: Representative citations for the characteristics of the CEBM 'value capture' (found through Document Analysis)

Business Model	Building Blocks	Keywords	Frq (doc)	Exemplary cases indicating configuration of building blocks for each CEBM archetype
Circular Supply Chain	Reuse	Reuse	7	*'' ...all product parts can be recycled and reused''/ ''incorporating reuse at the design stage''* *" The company's disruptive manufacturing process for garments includes incorporating reuse at the design stage, an improved recall process for worn garments, and the development of recycling technologies and infrastructure"*
	Eco-Design	Cradle-to-Cradle	4	*Conceiving eco-innovative products that conform to the Cradle to Cradle®* *principles remains part of our vision to transform spaces for better living.* *The water bottle has been Cradle to Cradle certified because it doesn't contain toxic or prohibited substances, it is produced in a climate-neutral fashion, with responsible* *water and energy use, and the bottle is 100 percent recyclable – collection points are provided.*
		Easy separation	2	*'' DSM has developed a technology that enables the manufacturing of high-quality carpets from one single material or two at most. In the event that two materials are used, they can easily be separated as a result of an innovative interlayer. This makes the materials fully recyclable so that they can be used to manufacture new carpets, for example, or for different purposes"*
		Modular	1	*"More recently, Interface has pioneered the world's first recycled poly-vinyl butyral (PVB) precoat for use in the manufacture of its modular flooring, by obtaining PVB from car windscreens and turning it into an environmentally-sound replacement for the synthetic SBR latex precoat. The PVB has a carbon footprint 80% less than the industry standard and takes the company's progress in this area to 66% – one step closer to Mission Zero"*
		Biodegradable	12	*Further they are developing circular innovations, such as the Green Fiber Bottle – a fully biobased and biodegradable bottle made from wood fibers, to be developed over the coming three years with Technical University of Denmark, EcoXpac and Innovation Fund Denmark.* *"But what about the plastics that are labelled by manufacturers as being biodegradable? Here is where most of the confusion arises, as claims of biodegradability must be followed by explicit instructions to consumers on how to properly make these plastics biodegrade, or how readily biodegradable the plastics really are."* *"And finally, a look at the waste phase: whether materials can be reused or are easily biodegradable. Not all 'compostable' products are biodegradable in all environments, such as soil and sea."*
	Pure Inputs	Non-toxic	6	*''...by removing toxic chemicals facilitates treatment and return to the biosphere''*
		Bio-based	10	*''...our bio-based chemicals derived from renewable resources such as sugar, starch'', 'We created and tested a clear model for the bio-based procurement process. This starts with dialogue with regular and new suppliers''.* *"For biobased products, Tebodin has selected five criteria, specific to procurement. First, the percentage of organic material in the product. Second, how product fits its function, such as durability, hygiene and fire safety. Third, looking at the entire footprint, because some bio-based products produce other waste"*
		Recyclable	8	*''...our primary resources are rapidly renewable and recyclable '' / "As a material, vinyl is ideally suited to being recycled. It is 100% recyclable and can be recycled many times over without losing any of its performance properties"*
		Renewable	8	
		Fair trade	13	*''... made from organic, fair trade cotton sold under Max Havelaar label which guarantees a decent income to the producers''/ ''fairtrade foundation is a non-profit organization aims to foster fair behaviour at all stages of the supply chain by setting standards for fair trade, minimum wages and fair working conditions''*

	Adv. Engineering	Advanced Recycling	6	*" In a true British innovation success story B&Q, in partnership with its UK growers, has launched easyGrow™, which uses pioneering Teabag Technology™. This sees polystyrene plant trays replaced with a 100% recyclable alternative and promises to significantly reduce volumes of nonrecyclable polystyrene gardening trays going to landfill."* *" Avantium is a leading technology firm that, among other things, develops PEF. PolyEthylene Furanoate (PEF) is a new ground breaking polymer, made with Avantium's YXY technology. It can be used in multiple applications, like bottles, fibers and film. PEF is 100% plant based and 100% renewable. It provides a lighter, thinner, smaller, stronger and more sustainable alternative for oil-based PET."*
		Material Sciences	2	*Designers and technicians consider material sciences and integrated system features. Innovation clusters, supported by public-private funding, enhance the performance of large-volume equipment and critical applications. All value chain partners work to guidelines for optimal functional* *design and resource use and recycling, encouraging innovation in product development and manufacturing.*
	Industrial Symbiosis	By-products, feedstock	6	*'' ...develops its products and materials from potato starch, a by-product of the wallpaper industry'', ''companies in the region collaborate to use each other's by-products and otherwise share resources. The residual product of one enterprise is thus used as a resource by another enterprise, in a closed cycle"*
	Renewable Energy	Solar	10	*It starts at home People are increasingly aware of their own influence on the environment, adopting green technologies such as solar panels at homes, driving e-cars.We want our people to take that attitude, that motivation to the market, raising awareness of energy consumption, waste, and eco-footprint - with clear choices in CAPEX and OPEX. Our work is an important part of the client's investment, whether it is a small or large project, we can achieve significant effects over long-term operability.*
		Wind	10	*We are in dialogue with stakeholders, including authorities, on the best approach, and we put a lot of work into fully understanding the footprint of wind energy, compared to gas, oil, nuclear and coal.'* *DEDICATED EXCLUSIVELY TO WIND ENERGY: 'WE ARE TAKING OUR OWN MEDICINE IN USING 100 PERCENT RENEWABLE ELECTRICITY, PROVING THAT IT CAN BE DONE.'*
		Wave power	1	*The concept is partially inspired by the Pelamis® wave power project where a steel floatation boom is placed in the ocean to generate electricity from waves.*
	Take-back-systems	collect	5	*"We've increased the number of collections at Cardiff and Recofloor is very good at responding to our requirements. We encourage our customers to take part and give them free Recofloor sacks to keep their vans and site tidy. They can then drop off waste vinyl at any of our depots – it's a free service. It's important to emphasise the benefits because it really is a 'win-win' situation for everybody."* *"We started collecting textiles in selected Swedish stores in 2014. During 2015 and 2016 we will offer customers in other countries the opportunity to recycle their textiles as well. When opening the first Lindex store in London, the opportunity to recycle textiles is a given from the start."*
	Waste-to-material	Composting	5	*''Ecovative produces mycelium packaging, an innovative material made of mushroom 'roots' grown in and around agriculture byproducts, acting thereby as a glue.* *• An alternative to petroleum-based expanded plastics* *Design novelty and advantages* *• Raw materials are locally available agricultural feedstock with low economic value*

				• *Fully **compostable** at home"*
		Recover	1	*′′All Dutch aWEARness work wear is 100 percent recyclable. By recovering the elementary fibers and weaving them again, the company has reduced carbon dioxide emissions by 73 percent, waste by 100 percent, water usage by 95 percent and energy usage by 64 percent"*
	Recycling	recycling	43	*"eco-friendly beauty care giant Aveda will kick off its new Full Circle recycling program. Coinciding with their Cradle-to-Cradle design philosophy, the program will invite customers to return any Aveda packaging not accepted by their curbside recycling programs to an Aveda retailer. The company will then sort and recycle the packaging into new Aveda containers or accessories."* *‘’...Houdini delivers products that can be recycled through a closed- loop recycling system’’*
	Digital technology	Peer-to-peer	1	*"The Piclo platform enables Good Energy to launch a new local renewable energy procurement solution for business customers, underpinned by Open Utility’s proprietary peer-to-peer energy matching algorithms. The online service will provide customers with a refined user experience and access to data and analytics. Open Utility has developed a digital platform which offers end users more choice and control. We look forward to developing a proposition which is attractive to business users and renewable generators.”*
	Waste Separation	Sorting, separating	3	*"Also, with its Take Back™ and Refinity™ material separation technology, Desso has been able to begin taking back postconsumer carpet wastes"* *"Biorecycling: the aim is infinite recycling of waste, thus obtaining a circular economy. Carbios targets PLA and PET recycling. It sees enzymatic depolymerisation as its key competitive advantage. Recycling processes that are currently used are expensive, due to sorting and process requirements, ie with regard to purity. There are also issues with toxicity of additives."*
	Knowledge flow network	Open-access pilot-plant	1	*The Bioprocess Pilot Facility (BPF) in Delft, offers a modern state-of-the-art, versatile, open access pilot plant facility which is capable of meeting the demands of innovators in the biobased economy, enabling them to achieve success.* *BPF’s capabilities allow the pilot facility to offer a unique set of services, from feedstock treatment and process optimization, through to the development and testing of robust processes at scale. The pilot plant provides test time to companies, universities, and knowledge institutes from all over the world, who are looking for biobased alternatives for products currently based on oil and gas. In this unique multipurpose facility, they can investigate how production processes developed at laboratory scale respond to largescale conditions and how they can best be scaled up for production purposes, using BPF’s special set of equipment and expertise*
	Hybrid Technology	3D printing		*‘’The 3d printer filament made from old car dashboards makes everything you print fully recycled’’*
PAAS	Reuse		7	*"Packaging Reinvented: Packserve - Packserve is a global packaging service provider committed to making packaging cheaper, smarter and more effective. Smart, reusable containers from Packserve are helping manufacturers to better manage their supply chains and increase transparency, tracking the location and contents of their products at all times."*
	HUB		2	*" To tackle this bizarre mixture of over-supply and under-availability, tool-sharing libraries are cropping up around the world. These ventures give their members access to a huge range of tools for far less money than they'd cost to buy individually, and can become real creative community hubs' '*

				‘’...Galileo satellite system connecting vehicles and hub’’
	Quality Management	Inspected, tested, monitoring	6	*‘Copiers and printers returning from Ricoh's leasing programme are inspected, dismantled, and go through an extensive renewal process — including key components replacement and software update* *"in Germany at end of lease to undergo a strict cleaning, testing and quality assurance process. This ensures the device is as good as new, effectively doubling its lifetime and guaranteeing the same quality and performance as the original machine"*
	Recycling		15	*"With this rental or leasing option baby clothes can be used by other babies or recycled if no longer suitable"*
	Refill		2	*"Splosh and Replenish are two businesses that have developed customer models based on different reusable packaging formats that enable a user to refill in the home. This model has the potential to reduce the volume and simplify the pallet of plastics used in packaging.* *Replenish estimates that one of its reusable containers can replace up to 30 single-use equivalents.180* *By first providing reusable containers and afterwards just packaging the active ingredients in liquid ‘refill pods’ that fit into the initial consumer-sized bottles, the company believes that its format could replace any product that is largely water based.*
	Servitization	Retain Ownership	28	*‘’..shift from battery ownership to battery rental’’ / ’’...Philips retains ownership of the products’’*
		Leasing, rental, Subscription	22	*‘’...with this rental or leasing option baby clothes’’ / ‘’rental fee’’ / ‘’leasing contract’’ / ‘’subscription service’’*
		Access based	27	*‘’ members get access to around 100 tools’’ / ’design for access over ownership’’ / ´´ The goal of Marcel Peters, founder of Bundles, is to prevent the sales of cheap washing machines that break and are scrapped within a few years by making a more durable device more accessible to people"*
		Performance based	15	*‘’ ...Bundles helps its customers to achieve a better laundry performance while cutting energy and water use’’*
		Multi-modal	7	*‘’...this system would provide multiple mobility options’’/ ‘’we are moving from a private owned to a more integrated transportation system due to changing demographics, preferences and technology’’*
	Take-back-systems	Return, collect, take back	20	*"Bixi system allows subscribers to make use of unisex bikes by taking and returning them to solar-powered docks located at strategic points throughout the city"* *‘’ ..Devices are returned to their factory at the end of leasing’’* *´´ The take-back service works by charging customers a monthly fee to lease the jeans"*
	Repair and remanufacturing		22	*‘’...broken machines will be repaired’’ / ‘’ ..apply remanufacturing principles to cut wastage’’ / " Ricoh first tries to repair it, so the customer can keep on using the same appliance. If repairing is no possibility, the next step is recycling."*
	Digital Technologies	Telematics	1	*‘’..development of digital tools such as telematics eases the production of detailed analysis of overall fleet’’*
		mobile	2	*" Members use a mobile app to reserve cars, locate them using their mobile phones and unlock the car (keys are inside)"*

		Data	1	*"OpenTripPlanner (OTP) is an open-source platform for multi-modal and multi-agency journey planning. It provides a range of passenger information and transportation network analysis feature using our infrastructure for finding itineraries combining transit, pedestrian, bike and car segments. OTP relies on open data standards.* *Launched in 2009, the project has attracted a thriving community of users and developers, receiving support from public agencies, startups and transportation consultancies alike. ... OTP goes beyond passenger information, applying OpenTripPlanner's routing engine to problems in transportation planning, public policy and the social sciences."*
	Hybrid	Track and trace	1	*"The company also has an "accessibility-based" business model, wherein clients don't own but use the clothing when required. Additionally, clients are offered services that include track and trace management, as well as washing and repair. Users pay a fee for the service as opposed to buying the garment."*
	Adv. Engineering	Remote monitoring	7	*'' These services cover the use of solar electricity produced on the customer's roof, including the installation, monitoring, maintenance, repair and replacement, similar to a comprehensive leasing arrangement. The benefits of this business model are manifold. The two main benefits are first the possibility of many house-owners to use self-produced solar electricity (even those to whom the purchase of solar panels would constitute too much of a financial burden)."* *"Value added services like system monitoring, reporting and energy saving measures''*
	Insurance		8	*''... rentals normally include all maintenance and additional services such as insurance''* *"Members use a mobile application to reserve cars, locate them using their mobile phones and unlock the car (keys are inside) with a card. Reservation and hire charges cover fuel, parking, insurance, and maintenance."*
		Share	13	*''...thousands of companies use the company's pallets.. but they don't buy them they share them''* *"Car2Go and Zipcar enable short-term car rentals to paid subscribers, while Alta Bicycle Share is a company that provides a similar bike-sharing concept. A new service called Blade even offers booking of short-term helicopter rentals through a mobile app. Each of these services bears similarities to the peer production economy. Nonetheless, they are corporations that retain ownership of the vehicles and equipment, even if, from a consumer perspective, they offer a substantially different experience than traditional rental companies"*
	Eco- Design	Durable	5	*''organizations have an economic interest in making their products more durable, easily repairable and upgradable, because their costs will be less when a product lasts for its entire leasing period ''*
		Easy Maintenance	1	
		Disassembly	1	
		Upgradability	3	
	Pure Inputs	Recyclable, renewable	3	*''manufacturers are incentivized to use more recyclable materials'' / ''part of their product is made of recycled and renewable fibres''*
	Maintenance		14	*'' Ricoh is responsible for the maintenance of the products'' / ''the customer does not have to worry about installation, maintenance''*
	Knowledge Management	Expertise sharing	2	*"R-Urban Wick Tool Library in East London is one of the first being set up in the UK, a not-for-profit, semi-mobile project that will use temporarily vacant urban sites, with a planned monthly donation of £7 for members. It will stock, lend and maintain tools, as well enable makers to exchange tools and expertise between themselves, recirculate used tools surplus from the construction industry, and provide a venue for workshops and skill-shares"*

		Open Source	2	*"Travel Spirit is a new enterprise that is fusing together disparate open source community projects lined to New Mobility Services. By deploying the code, TravelSpirit's goal is to create a new cooperative platform that will provide the public a 'lifestyle enabler" called mobility as a service. In stak contrast to platforms that seek to dominate the world, they contemplated the need to empower communities and put 'true' user-centric design at the heart of the matter. The platform enables community-wide participation through equitable transport access. Such solutions due to their open architecture and ethical underpinnings would have a good chance of out-gunning solutions based around more of a commercial model, a proprietary code-base, or isolated transport concept with some wrap-around IP. Travel Spirit has focused on engaging cities, transportation companies and the digital sector to educate them about the MaaS open collaboration"*
Product Life Extension	Repair and Remanufacturing		118	*‘’...enable remanufacturing and repair through cooperation along value chain’’* *".. IFIXIT is a global repair community of people helping people repair things. The organization represents hundreds of thousands of technicians and volunteers working together to make the world better by teaching people how to fix products"*
	Servitization	spare parts services	20	*‘’...develop sustainable service and spare parts offering” / "* *manufacturers make repair information and spare parts available for all service providers"*
	Reuse	Reuse, second hand	25	*‘’ The Kleider Kreisel online second-hand shop is a marketplace where people can find clothing articles of their interest and negotiate to acquire this article. This online marketplace relies on the reviews of buyers which builds trust among customers’’’*
	Digital Technology	Online shops	5	*‘’....swapstyle is an online swap market where users can exchange personal items’’/ ‘’ikea created a website for customers who wanted to sell their used furniture’’* *"iFixit is a free, publicly editable online repair manual with a mission to empower people to fix their stuff. Ifixit reaches hundreds of thousands of Europeans with repair information every month."*
	Eco-Design	Modularity	11	*‘’...is build around modular architecture making it easier for owners to open and repair their phones’’*
		Upgradable	8	*‘’...If the product is designed in a way that is easy to repair and upgrade is less likely to be thrown’’*
		Dis/reassembly	21	*‘’...the product is able to be disassembled and restored to its original condition’’*
		compatibility,	2	*‘’many parts are compatible across generations and model types’’*
		easy maintenance	4	*‘’ ... the bike has been specifically designed for NS to allow durability and decreased cost of maintenance’’*
		Self-healing	4	*‘’ ...self healing materials lead to more efficient solar panels as well to extend the technical lifecycle..’’*
	HUB	Hub	4	*‘’ 3D Hubs combine community creativity with on demand production’’ ‘’electronics can be brought into the HUB for inspection. Depending on each item’s status can be delivered to the next owner or for refurbishing’’*
	Hybrid	3D printing	12	*“Fab Lab have the additive (3d printer) and reductive (laser cutter)kit to enable and open-source the reuse and fixing activities”*
	Insurance	Warranties, insurance	13	*‘’ same warranty as the original products’’ ...’’ to decrease customer concerns’’*
	Knowledge flow network	Open Source	4	*’Open source manuals create product transparency’’/ ‘’we use open source methods and develop environment available for anyone to use, review, modify, improve and repair"*
	Maintenance		9	*‘’ prolong life time through maintenance’’*
	Recycling		41	*" With respect to resource conservation, the Plenic presentation system closes resources flows by combining closed-loop recycling with lifetime extension and the reuse of parts over multiple lifecycles .The company has developed a take-back*

				system to ensure reuse of parts and recycling of parts into new components via selected partners"/''If repairing is no possibility, the next step is recycling''/ '' parts that cannot be used at all are recycled''
	Refill	Replacements	16	*''components can be replaced'', ''replacing broken or out-dated parts'', "It also makes environmental sense: replacing a screen and battery on a longer lived device only slightly reduces the overall carbon savings from life extension for smartphones (from 53 per cent to 46 per cent), although the carbon cost of replacement is higher for tablets"*
	Quality Management	Inspection, testing	5	*''returned products are inspected, cleaned and tested though a quality assurance process''/ "Collection systems must be user-friendly (addressing users' key reasons for making or not making returns, such as guaranteeing complete deletion of a user's phone data to allay privacy concerns), they must be located in areas accessible to customers and end-of-life specialists, and they must be capable of maintaining the quality of the materials reclaimed.*
	Take-back-systems	Trade in, collect, buy-back	18	*''customers can trade in old gear'' , ''H&M collect garments in all stores'' , ''the company reclaims used furniture through its buy-back guarantee''*
	Upgrade		25	*''Phoneblocks is an idea for an open platform modular smartphone that is made to last. Phonebloks is an idea for a smartphone where all the parts are easily removable for upgrade or repair yourself"*
	Adv. Engineering	Remote monitoring	4	*''Samsung research found that 30% of all repairs in support centres could have been fixed by remote management support*
	Share		1	*"The meta category forum allow users discuss and share concerns about its functions, improvements, repairing and upgrades"*
Regenerative	Eco-design	Nature-based solutions	4	*''Nature-based solutions address specific demands or challenges, and at the same time they seek to maximise other environmental, social and economic co- benefits" "In the project City Deal Climate Adaptation the municipalities of Dordrecht, Zwolle and Eindhoven collaborate with Ecoshape and TAUW on climate robust development though 'nature based solutions'.*
		Bio-degradable	3	*''The Land-life company provides a low-cost biodegradable product to improve the ecological aesthetic value of land''*
		Permaculture	3	*"Permaculture is a design system for sustainable and self-sufficient lifestyles. The word 'permaculture' comes from 'permanent agriculture' and 'permanent culture' it is about living tightly on the planet and making sure that we can sustain human activities for many generations to come, in harmony with nature' "Landmatters is a rural permaculture project working within Devon to promote landbased communal living"*
	Digital Technology	Online platform	3	*"The online platform is used to create partnerships, share best practices and solutions for success, and learn vital information from other Network members and the Savory Institute. A robust platform that provides mapping and data management tools for land managers who desire to enhance their existing land, production, or organizational management." "The Regeneration Hub is an interactive online platform that connects project holders, individuals, funders and communities focused on regenerative agriculture and land-use projects"*

	Hybrid Technology	3D Printer	1	*"3Dponics is an open-source initiative for the development of 3D models that are used to build efficient and affordable aquaponic gardens" 3Dponics is all about innovation through collaboration"*
	HUB	Hub	3	*"He approached LondonWaste Ltd for further support and to create a secure safe space to deliver and store buld loads of eco-park compost. This would enable local residents and community groups easy access to collect smaller quanties for their own particular growing needs. This would be North London's first compost hub, self-contained within this unique King's Cross Space. The hub could be a catalyst to extend and support self-reliance within the community's food growing projects."* *"L.A Compost is working to create an entirely local solution to food waste through composting. Our community supported compost hubs will keep organics within the same community in which they were consumed, and provide finished compost for local growers. By expanding our current countrywide compost hub network, we will continue to divert thousands of pounds of organics from reaching landfills monthly, while providing residents with the tools and education needed to compost on their own".* *"The Regeneration Hub is an interactive online platform that connects project holders, individuals, funders and communities focused on regenerative agriculture and land-use projects and other related concepts that address multiple global challenges, including climate change and food security. We aim to accelerate the adoption and development of scalable and replicable regenerative projects across the globe by inspiring and facilitating collaboration between project holders, individuals, funders and communities from the regenerative movement"*
	Knowledge Management	Knowledge sharing	5	*"we will continue to divert thousands of pounds of organics from reaching landfills monthly, while providing residents with the tools and education needed to compost on their own".* *"The aim of the Building with Nature programme, which is implemented by the Eco-shape foundation, is to encourage the use of Building with Nature in hydraulic engineering solutions. That is why Eco-shape develops and share knowledge in pilot projects, distributing it to everyone involved in hydraulic engineering projects. Building with Nature still looked like a distant dream some years ago"*
	Adv. Engineering	Monitoring Tech	2	*‘’A Group research project also carried out additional analytic monitoring to provide indicators of biodiversity and evaluate the zone’s bacteriological"*
		Hydraulic Engineering	2	*"Nature programme, which is implemented by the Ecoshape foundation, is to encourage the use of Building with Nature in hydraulic engineering solutions"*
		Aquaponics	4	*"3Dponics is an open-source initiative for the development of 3D models that are used to build efficient and affordable aquaponic gardens"* *"GrowUp Urban Farms grow sustainable and healthy salads, herbs and fish in cities using aquaponics and vertical growing technology. In September 2015 they opened the UK’s first commercial aquaponic urban farm, showing the viability of high density aquaponic production in urban areas. Aquaponics is a recirculating system that takes the waste from a fish farm and uses it as a natural fertilizer for plants. Each farm that GrowUp builds helps the local urban area improve its food security and creates jobs for young people in parts of the city that need them the most. "*
	Industrial Symbiosis	By-products exchange	5	*"There are many fish farms, hatcheries and fish processing plants in the Puget Sound region. O2 Compost has partnered with Northwest Fish by-products to demonstrate the technical and economic viability of composting salmon waste from Northwest fisheries. It is nutrient-rich and full of beneficial micro-organisms. The net results are beautiful and bountiful landscapes and vegetable gardens."*

				"That transformation includes activities such as using London's influence to support more resource efficient and regenerative agricultural practices (e.g. precision and organic farming), the use of all by-products and waste streams along the whole food supply chain at their highest value"
	Maintenance		4	*''In the Netherlands the Northen Fresian Woodlands is an association of farmers of 1000 members on an area of 50000 hectares. Beyond landscape maintenance and the strengthening of biodiversity a range of other activities is organized: from energy production to the development of new forms of self-regulation.*
	Servitization	Payments for ecosystem services (PES)	5	*''under Payments for ecosystem services, a user or beneficiary of an ecosystem service provides payments to individuals or communities whose management decisions and practices influence the provision of ecosystem services'', ''PES are important mechanisms to encourage biodiversity conservation with the use of a price signal'*
		Performance Based	1	*''Delivering performance-based payments and ensure adequate enforcement'' .. ''services to regenerate and rehabilitate biodiversity*
	Quality Management	Monitoring, modelling	7	*10. Monitor the plan. No plan ever goes exactly to plan. What you expect to happen rarely does, and thus planning is always a process of planning, monitoring, controlling or adjusting, and re-planning if necessary. • Monitoring Daily Growth Rates of Plants. This is a critical with lower numbers of grazing divisions to ensure adequate plant recovery and to reduce overgrazing. It is less critical when a plan involves 50 to 100 or more grazing divisions because one recovery rate can cater for any daily growth rate of plants.* *• Landscape Level Monitoring. In Holistic Planned Grazing managers are using their livestock to produce, among other things, the landscape of the future described in their Holistic Context.* *"Monitoring Biodiversity* *When implementing plans to reduce biodiversity loss, it is important to have a method of measuring the progress and overall success of plans. One way this can be done is by using the environmental indices that have already been developed and are those that are currently in development. These indices, created by various organizations, provide concrete data to back-up projects. The Convention on Biodiversity created the Biodiversity Indicator Partnership to promote the development of multiple indicators. The convention was established in 1993 in an international effort to conserve biodiversity, provide sustainable methods for the use of biodiversity, and to assure fair sharing of the benefits of biodiversity. This convention is comprised of 193 parties, including countries such as such as Belgium, Egypt, and Zimbabwe. Over forty organizations have collaborated in creating and sharing an extensive list of 17 indicator indices."*
	Share		2	*"We 're giving you all the resources you need to build your own system, interact with others and make 3Dponics better. All we ask is that you share, share, share with the community. After all, that's what open source is all about"* *"Over forty organizations have collaborated in creating and sharing an extensive list of 17 indicator indices."*
	Social Currency	Credits, swap	*2*	*''conservation banks sell credits that represent an expected ecological outcome to offset impact'' , '' habitat exchanges are designed to provide a platform for both compensatory and voluntary credits'' , ''credits are the currency for market-based biodiversity mechanisms''*
	Reuse		4	*''the output water is then reused'' , '' phosphorus and organic matter for reuse in urban agriculture''*
	Insurance		1	*"In addition to ensuring adequate institutional frameworks and greater connectivity between legal frameworks, banks and (health and risk) insurance companies should be approached as key potential investors given the (insurance) value of ecosystems in relation to other investments and their function, for example, in mitigating risks to human*

				health and real estate"
	Take-back systems	collect	2	*'' The waste management sector has an important role to play in collecting, transporting and treating organic wastes, and currently possesses a range of technical competencies to carry this out effectively" ( )*
	Waste separation	Sorting , separating	2	*"Denver Composts makes composting household organic material as easy as recycling, by providing a green cart that is collected weekly. Households separate out organic material like yard debris, food scraps and non-recyclable paper and place them in the green cart instead of the trash. The organic material collected is sent to a commercial facility where it gets turned into a high quality soil amendment known as compost"* *'' will also need to increase and improve the scope of separate organic waste collections in order to maximize quality as improve pre-treatment methods''*
	Waste-to-material	Composting	7	*'' Cerratto studied the role of civil society organisations in participatory organic nutrient waste recycling; a community composting initiative in Rotterdam, where urban gardeners started to compost their own green waste, thus avoiding the costs of having to get rid of green waste through public waste collection and also avoiding the costs to buy compost and or fertilisers"*
		Bio-refining	2	*''using anaerobic digestion of manure turning manure intro biological fertilizers'' ... ''both the treated used water sludge and other products can be used as a fertilizer and a soil conditioner''*
Resource Recovery	Quality Management	Monitoring, quality	18	*"the core of the transition to a more resource-friendly green economy. We have a role to play, by offering our knowledge along with customized and innovative solutions to customers, every day, whether local communities or manufacturers, to provide them with high-quality sanitation services (which are the source of good hygiene), waste collection services to keep public areas clean and pollution-free, and solutions to recover waste by recycling or re-using it to produce energy."* *"Sanitary Landfills are designed to greatly reduce or eliminate the risks that waste disposal may pose to the public health and environmental quality. They are usually placed in areas where land features act as natural buffers between the landfill and the environment. For example the area may be comprised of clay soil which is fairly impermeable due to its tightly packed particles, or the area may be characterised by a low water table and an absence of surface water bodies thus preventing the threat of water contamination. In addition to the strategic placement of the landfill other protective measures are incorporated into its design. The bottom and sides of landfills are lined with layers of clay or plastic to keep the liquid waste, known as leachate, from escaping into the soil. The leachate is collected and pumped to the surface for treatment. Boreholes or monitoring wells are dug in the vicinity of the landfill to monitor groundwater quality."* *"Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorised according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc). Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal."*

				"The RAL quality assurance scheme provides a systematic control system that ensures that plant performance meets the requisite minimum ecological standards. RAL – ADDED VALUE FOR ALL The introduction of the RAL scheme as a binding minimum quality standard for the fridge recycling sector offers a number of key benefits: • Transparency for everyone involved in the fridge recycling chain • Independent, neutral and transparent
	Servitization	Waste management	15	*''Van Gansewinkel has taken on full responsibility for managing the entire waste streams of customers, who in turn can focus on their core activities''/ ''integrated waste management solutions which means full service offering'' / ''waste management can be turned into profitable streams for companies'' ''waste management solution which offers customized recycling for all industries''/ ''hazardous waste services lab''*
	Digital Technology	Online platform	1	*''through Dutch online platform www.deafvalmarkt.nl consumers and business can match supply and demand for waste''*
	Renewable Energy	Renewable energy	6	*''utilize waste food to produce renewable heat and power''*
	Adv. Engineering	Conversion tech	2	*''a conversion technology that produces biodiesel from the used oils and fats'', ''clean technology to turn waste coffee into advanced bio-fuels''*
		Material Sciences	1	*"Resource efficient processes and products« is the guiding principle that drives close cooperation between the scientists from the fields of biotechnology, food chemistry and technology, energy and process technology, environmental science and technology, and materials science at the Process Sciences Faculty at TU Berlin. The aim of the UPgrade project is to improve the valorization of select metals in the processing of waste electronic and electric equipment (WEEE) throughout all stages of the recycling chain via new and optimized processes and process chains to improve their recovery within existing recycling systems, minimize losses and close circuits"*
		Auto sorting	1	*''the semi-automatic sorting of waste... eliminating the contact between waste and the operator''*
		Adv. recycling	5	*''Veolia runs an advanced recycling plant for dismantling and recovering WEEE and plastics''*
	HUB	Hub	1	*''steel factory APERAM becomes recycling hub'', ''the company recycles metal waste from scrap metal companies, which are refined into steel slabs for the construction, asphalt and concrete industry''*
	Industrial Symbiosis	By-product, feedstock	22	*''we also use by-products from other industries'' / ''recovering valuable resources and byproducts'' / '' monetizing 'by-products and waste streams''/ '' by-products trading''*
	Knowledge Management	Knowledge sharing	5	*''by offering our knowledge along with customized solutions to customers, local communities or manufacturers'' ''Van Scherpenzeel is a knowledge-based business that controls a wide range of raw material supply chains. Van Scherpenzeel analyses the waste flow and advises enterprises and municipalities on the correct approach to take"*
	Recycling		40	*'' Capannori to top the European waste prevention leagues and, through its position as the Zero Waste Network's Flagship Municipality, inspire other communities to aim higher than just fulfilling recycling targets. Through transparent engagement with the population have made this the achievement of an entire community."*
	Resell	Remarketing, resell	4	*''the back end refers to remarketing the recovered products in secondary markets'' / ''find places to recycle, resell and haul off commercial waste''*
	Reuse		22	*''the nike reuse-a-shoe program takes worn out athletic shoes back and grinds them down to create a new material.. ''reuse waste streams''*

	Take Back Systems	Collect, incentives	58	*"St Helens Recycling rewards is an incentive scheme run by St Helens council in partnership with local green points to reward residents for recycling. It is funded by the department of communities and local government. Your actions are measured and rewards given in the form of 'points' based upon your participation in the scheme".* *" LafargeHolcim wants to reduce its dependency on natural resources and fossil fuels by transforming waste into resources for all our production processes. This can bring value to environment and society by reducing the need for land filling and waste incineration. Additionally this provides employment and other income opportunities through community-based waste collection."*
		Drop-off points	2	*‘’the separation can be done at the source (e.g. different bins in households or at drop-off points’’*
	Waste separation	Sorting, separating	33	*"Cooperation with waste producers plays a key role in enabling the correct and economically viable collection of their materials, separated at source by the citizens. Both the organisation and the communication of the separate collection systems is a joint effort and those Member States that have taken this on board demonstrate high recycling rates."* *‘’Van Gansewinkel specializes in the separation of wastes’’ / ‘’..precise and cost-effective waste sorting can allow higher recovery rates’’ ‘’collected separately so that the products are homogeneous and fit for recycling’’*
	Social Currency	points	1	*'St Helens Recycling rewards is an incentive scheme run by St Helens council in partnership with local green points to reward residents for recycling. It is funded by the department of communities and local government. Your actions are measured and rewards given in the form of 'points' based upon your participation in the scheme".*
	Waste-to-energy	Anaerobic digestion, bio-refining	14	*‘’the anaerobic digestion process can be used to recover waste to produce a combination of biogas’’ / ‘’bio-refining avoids harmful greenhouse gas emissions and can generate energy’’*
	Waste-to-material	Recover	46	*‘’ econyl a 100% regenerated nylon made from recovered waste materials’’*
		up-cycle	19	*‘’by up-cycling phosphorus Ostara offers a closed-loop solution to nutrient management’*
		biochemical extraction	2	*‘’extract bio-chemicals from organic waste*
Reverse Logistics	HUB	HUB	4	*"In these various countries, integrated specialists provide high-tech logistics services. The devices are collected at the end customer's place of work, packed up and transported to a local hub. A European-wide line haul concept provides the transport to the technical logistics sites of which one site is run by LGI and another by the customer. Here, the data is wiped from the high-tech products and they are tested thoroughly in preparation for the 2nd hand market and then distributed onwards."*
	Hybrid	Track and trace	3	*“ Deutsche Post DHL already offers an ‘Electro Return’ service which enables German households to print out a shipping label from the comfort of their own home, put old electronics devices into an envelope, and drop this off at a mailbox. Unlike certain collection services, each carton is identified to the final user by a barcode label, assuring total traceability of the outcome"* *" We can track all equipment that we receive allowing you to see how choosing digital growth has directly contributed to improving lives in communities both here and around the world"*

	Quality management	Testing, monitoring	2	*‘’Once your redundant IT equipment reaches one of our depots it undergoes a series of strict safety checks to ensure all IT equipment is in working order and safe to use. All equipment that passes our visual assessment is then subject to PAT testing/ These tests are particularly useful, not only because they assess the safety of the appliance, but also the rate of deterioration can be seen and a judgment made to replace the appliance before it becomes unsafe. This is followed by safe and secure data destruction."*
	Waste Separation	Pre-sorted, separated	12	*‘’presorting products to limit the reverse logistics flow to usable materials’’* *"I:CO arranges the environmentally friendly hand sorting, re-wear, reuse, removal, and recycling of these collected textiles."*
	Take-back systems	Collection	53	*‘’optimize collection infrastructure through increased collection rates’’, ‘’shoppers deposit apparel from any brand at collection points’’*
		trade-in, take back schemes	8	*‘’the customer is offered a trade-in price for the redundant product’’*
		Incentivized returns	2	
	Servitization	Collection services	1	*‘’A personalized collection plan’’*
	Adv. engineering	Automated collection machines	2	*‘ EcoATM increasesthe reuse of such devices by establishing a network of automated e-waste recycling kiosks. Consumers can easily recycle their devices in one of the almost 1,900 kiosks, while receiving an instant cash payout. When a device is dropped off for recycling, the model type and serial number are scanned, and the condition is checked."*
		Telematics	2	*"We implement a wide range of measures to improve the carbon efficiency of our operations. These are first tested for their effectiveness before being rolled out on a larger scale. Solutions mainly focus on lightweight vehicle design and telematics".*
	Digital Tech	online	5	*‘’quotes can be obtained online, based on product type and condition’’*
		Mobile	2	*"Dhl ExpresSMS allows mobile phone users to track the progress of single shipments."*
		Peer-to-peer	2	*" Nimber is a collaborative peer-to-peer service that connects people who need to send something from one place to another with people going that way anyway. Whether they are on the road, taking the train or traveling by other means, they can use their mobile phone to pickup and deliver, make some money and maybe save the environment as well. Smart safe and sustainable.*
	Share	Share	1	*And then the more rational benefits of the sharing economy can gradually start to permeate: good, reliable service for a low price, which also has a positive impact on the environment since we - in the case of PiggyBee - make extra use of existing trips for transporting parcels. We all have room in our suitcase, so ‘share your trunk’.*
	Resell	Resell	5	*‘’ Equipment is then refurbished and made ready for its second life; our distribution teams then provide them at low cost to individuals, schools as well as charities and small community organisations in the UK and around the world"*
	Reuse	Reuse	18	*‘’Camara is a registered Irish charity that provides highly secure and efficient solutions for your IT disposal needs. Operating since 2005, we have securely erased over 100.000 hard drives for businesses, goverment agencies and private individuals. Camara reuses technology to enhance education of disadvantaged students around the world. Any IT equipment which cannot be reused is recycled at an authorized WEEE facility."*

	Eco Design	Modular, standardized	1	*‘’The modulushca project focuses on standardized, modular solutions for logistics organizations…can help achieve the scale effects of using such standardized packaging solutions for transport and warehousing. Come in several sizes, are easily configurable and can be locked onto other modules’’.*
	Social Currency	credits	2	*"Customers can drop off unwanted clothing at Oxfam outlets for £5 credit at M&S stores or bring old garments"* *"For every kilo of textiles that consumers drop off, they receive a voucher with a discount for their"*
Sharing Platform	Digital Tech	Mobile	4	*‘’ Spare to Share has developed software to build a private collaboration network within residential buildings. A web and mobile application connects residents of the building, enabling them to share items, space, skills and activities. For example, residents can share tools, rent a parking spot, find someone to walk their dog or collaborate on a home improvement project. The application allows users to keep an inventory of items they are willing to share or sell. As a security measure, users only share items with people they invite into their personal network using a unique code. Property managers also use the app to provide residents with notifications, alerts and maintenance requests. The platform promotes the circular concept by enabling reuse of one-time use items. It helps lenders make money and borrowers save money. Spare to Share also aims to strengthen community ties at a hyper-local level."*
		Online platform	10	*"Peerby is an online platform in which neighbors connect to share household items such as lawnmowers or drills that spend a lot of time sitting in storage unused. Automated reminders, whish list alerts and private messaging facilitate connection. Once enough people on a street sign up, a special site goes live in the area to create a community forum for neighbors online. Neighbors can help encourages people to take an active part in their neighborhood and makes it easier for them to ask for and offer help to each other."* *" At Swedish ICT Urban Life we are experts in the introduction and application of sustainable ICT-based infrastructure for smart homes, buildings, cities and communities. We develop concepts based on open platforms, open data and access to digital infrastructure, in which development of business and collaboration models and privacy and security are equally important elements"*
		Peer-to-peer	10	*‘’Rentez-Vouz is the first Peer-to-peer and designers fashion rental marketplace*
		Reviews	2	*’members earn badges for sharing’’ / ‘’customer reviews serves a crucial market monitoring function’’/ users with consistently sub-standard reviews are dropped out’’*
	Insurance		8	*"Van Hoogenhuyze agrees: “One of Barqo’s struggles has been insurance. Lessors do not tend to rent their boat when there is no insurance which covers damage. Tenants do not want to rent when there is a risk of a lot of costs when something happens. To cover this, we have declared that we definitely will sort out the insurance part but this is easier said than done."*
	Maintenance		1	*‘’…use the app to provide residents with notifications, alerts and maintenance requests’’*
	Servitization	Access based	20	*‘’membership to access the community marketing services’’ / ‘’shift to access of products rather than ownership’’*
		Intermediary Services	6	*‘’Through an intermediary who creates the platform (enabling exchange, shared access, and supply and demand against a fee)’’, ‘’enabling exchange, shared access against a fee’’*
	Share	share	59	*‘’residents can share tools ‘’ / ‘’we all have room in our suitcase so ‘share your trunk’’*

	Social Currency	Credits, points	4	*‘’in swishing.co.uk users get virtual money credits for the items they send to the site operators and they can be immediately used to order any item on the site’’ / ‘’members earns points when another member stays’’*
	Take-back-systems	return	1	*‘’Super Neighbors can earn even more extra cash by delivering the item themselves or let peerby arrange delivery by bike. As a Superbuur you have the guarantee that your item is returned in the same condition that you lent it.".*
Knowledge Platform	Knowledge Management	Open source	3	*‘This project is an open source project. Following the principles of the free software movement the source code and hardware designs are available at no cost to everyone under the GNU public license. This makes it possible to do more than just use the technology but learn how it works ‘’*
		Online courses	2	*‘’online courses play a key role by empowering individuals’’ / ‘’the team is currently producing more courses and oversees the distribution of the platform worldwide’’* *"Each course contains many videos and animations made exclusively for the Savory foundation'*
		Blueprints	1	*‘’Shares the blueprints of machines (which you can build yourself/ DIY)*
	Digital Tech	Online	5	*‘’translated repair guides available online’’ / ‘’compostory.org is the first online university dedicated to organic waste management’’* *"CL:AIRE publishes a wide variety of materials and to allow these to remain available to download free from our online library, we ask that people support CL:AIRE and sign up as members". Cl:AIRE encourages organizations to submit interesting material to be published".*
		Peer-to-peer	1	*‘’ encourages a collaborative peer-to-peer community to contribute to gadget repair manuals’’*
		Data	1	*‘’share the data with the world, post how much energy you are capturing and using to the internet’’*
	Hybrid	3D print, laser cutter	1	*‘’fab lab have the additive (3d printer) and reductive (laser cuter) kit to enable and open repair activities*
	Servitization	Spare parts services	2	*‘’sells spare parts’’/ ‘’could for example increase customer access to spare parts services’’*
	Recycling		4	*‘’ start a local plastic recycle center’’ / ‘’ provide a comprehensive introduction to organics recycling’’*
	Renewable Energy		1	*‘’build open source energy monitoring and analysis tools for energy efficiency and distributed renewable micro-generation’’*
	Share	Share	5	*‘’When developing and building an alternator for a wind or hydro turbine it would be useful to be able to characterize and share its performance so that areas for improvement could be found’’ / ‘’the network was our expert panel and sounding board and their collective views and findings were amplified’’* *‘’share the data with the world’’* *" Reflect on what you’ve learned and share your thoughts with others in the course on the discussion board. Participate in assignments to build your capacity to manage holistically and take objective quizzes to see how well you learned the concepts of each course."* *"3D ponics is all about innovation through collaboration. We're giving you all the resources you need to build your own system, interact with others and make 3Dponics better. All we ask is that you share, share, share with the community. After all , that's what open source is all about".*
	Quality Management	Monitoring, testing	2	*‘Makes it possible to monitor aspects of building performance and makes it easier to identify improvements in energy efficiency’’* *"Make space for testing, failing & prototyping* *space in which they could test ideas and new relationships, especially if*

				learning and insights, and to test and develop new designs"
		Peer review	3	*Peer review is a form of usability testing, or testing a document to see if it is effective- in this case, to see if users can easily and successfully follow your guide. Usability testing provides an opportunity to find any problems or issues with your guides before they are released"*
	HUB		2	*'' Fab Lab is an open access space and community hub is a big advantage as people can just walk through the door and get involved'' / ''repair cafes combine community-led repair with a café setting rather than a workshop''*
	Repair and Remanufacturing	Repair	16	*''the tangible environmental and social benefits of repair cafes has led to their spread'' / ifixit sees prevention, reuse and repair as preferable to recycling''*
Remediation	Take back systems	collect	3	*"Net-works empowers people in coastal communities in the developing world to collect and sell discarded nylon fishing nets, thereby removing these nets from the ocean where they weak havoc with marine life.* *''collection and treatment of waste water''/ ''collection of plastic debris''*
	Digital Tech	Big Data	3	*''Hemmis offers supporting environmental software for collecting, processing , forwarding and reporting environmental data. EMASever also underpins a computerized environmental care system according to regional, national, or international standards'' / '' In France commercial software packages like RBCA toolkit are usually used to quantify the risk posed by a contaminant''*
	Advanced Engineering	In-situ - ex-situ remediation technologies	8	*"* Finally, Landeshauptstad Stuttgart is performing an innovative in-situ remediation technique, including THERIS (thermally enhanced in-situ remediation), on-site in a source zone in Stuttgart-Feuerbach. *" Examples of technologies for soil remediation that PIB can deliver* ***Ex situ:*** *thermal washing landfarming immobilisation* ***In situ*** *:pump & treat Air sparging Bio sparging* *Soil vapour extraction Bioventing Multiphase extraction Heat enhanced extraction In situ chemical oxidation In situ chemical reduction Anaerobic bioremediation*
	Hybrid	3D printing	3	*''my idea is to 3D print a plastic pot insert that can be placed in the bottom of whatever pot the remediator has around so that their pot can be connected to the vacuum and air can be circulated across the root system''* *''at the larvotto marine reserve in Monaco, home to hundreds of diverse plants and water animals, six new 3D printed coral reefs have just been revealed that promise to maintain bio-diversity and allow restore ruined marine areas''*
	Insurance		3	*''the Stena group has transferred the risk to remediate contaminated soil to an insurance company'' / ''investigation and remediation covered by insurance''*
	Knowledge Management	Knowledge sharing, Open-source	5	*'''the problem :communities lack access to the tools and techniques needed to participate in decisions being made about their communities, especially when facing environmental hazards...* *" The public lab community is increasing public access to open source data collection tools and techniques, sharing best practices for advocacy and building networks. We support the work of individuals and groups focused on better indoor and outdoor air quality for their communities."*

				‘’with chlorinated solvents, the knowledge about the pollution will always have a certain uncertainty that can have an impact on the course and the costs of the remediation. An efficient managing of knowledge will try to decrease this degree of uncertainty’’
	Pure Inputs	Bioremediation	5	*‘’use bioremediation at locations of intense pollution, notably oil spills through nutrient amendment, bioaugmentation, photremediation’’ / ‘’bioremediation combined with temporary use can transform these areas into a societal asset while progressively building local biodiversity’’ / ‘’cooconut bio bed is an ecological ornamental element in the garden with which household waste water can be treated and recycled’’ / ‘’partnering with fungi can open the door to an accelerated process of soil healing’’*
	Eco-design	modular	1	*‘’Desotec developed the mobicon a modular container for activated charcoal absorption*
	Quality Management	Monitoring,	1	*"We are a open network of community organizers, educators, technologists and researchers working to create low cost solutions for monitoring air, water and land. Discover, collaborate on , and contribute to locally important matters with the support of a global community"*
	Recycling/ Reuse		6/6	*‘’whereas the conventional imperative was to remove pollutants, it has now shifted to reuse and recycle resources’’/ ‘’integrated plastic management projects are set up to lead to increased recyclability and remediation of littering’’ / ‘’..in particular fishing nets for the purpose of creating healthier seas and recycling marine litter’’/ ‘’the output water is then reused by gully lories’’/ ‘’Envirotreat’s own proprietary remediation technologies can enable material reuse on development projects’’*
	Renewable Energy		2	*‘’Its patented technology uses only solar power to purify water’’ / ‘’on board and for extended periods through the employment of renewable energy sources’’*
	Waste separation		1	*‘’install technologies or facilities for the separation and purification of water’’*
	servitization		3	*‘’the activity component environmental advice comprises different services: licensing applications, external environmental coordination, and assistance’’ / ‘’the heart of SUEZ environment is to deliver services and equipment essential to the lives of populations’’ / ‘’sanitation services’’*
	Share		1	*‘’residents were able to share all their questions and concerns about the remediation and the new use the site will be soon give… all their concerns and demands about their neighborhood: a new play area, more safe cycle paths, more green areas’’*
	HUB		2	*"A CLUSTER is considered to include a group of sites that are categorised as land affected by contamination, that include shared decontamination capacity located at one site (the hub) to produce recovered materials that are reused by itself and by the other sites in the group. This definition can be adapted to suit the needs of a group of brownfield sites that are not necessarily (but could be) contaminated, and that share processing plant (composting/soil manufacturing plant). The CLUSTER approach is being developed specifically for roll-out of the compost-to-brownfield scenario at the time of this report."*

Appendix 6: Empirical Data from document analysis indicating the configuration of building blocks per archetype

The central building in the picture represents the Hub where collected items are inspected and sorted for resell, refurbish or recycling purposes. The peripheral elements represent the spokes. At the left side, the inbound connections (e.g. drop off points) and at the right side the outbound connections (e.g. households, recycling centres).

Appendix 7: Hub and spoke systems for reverse logistics, retrieved from DHL (2015)